5 Management Plan

The management plan described in this section is a culmination of extraordinary efforts by the subbasin planners, the public and stakeholder input. Its development came as a laborious result of carrying out the assessment and inventory work and formation of the vision, goals and principles sections of the subbasin plan. Additional guidance and direction was derived from the conscientious integration of socio-economics, harvest, hydropower and artificial production information and synthesis into the final construct.

As a result, this management plan depends upon an assimilation of this information and careful review and full use of all sections of the subbasin plan and its key findings.

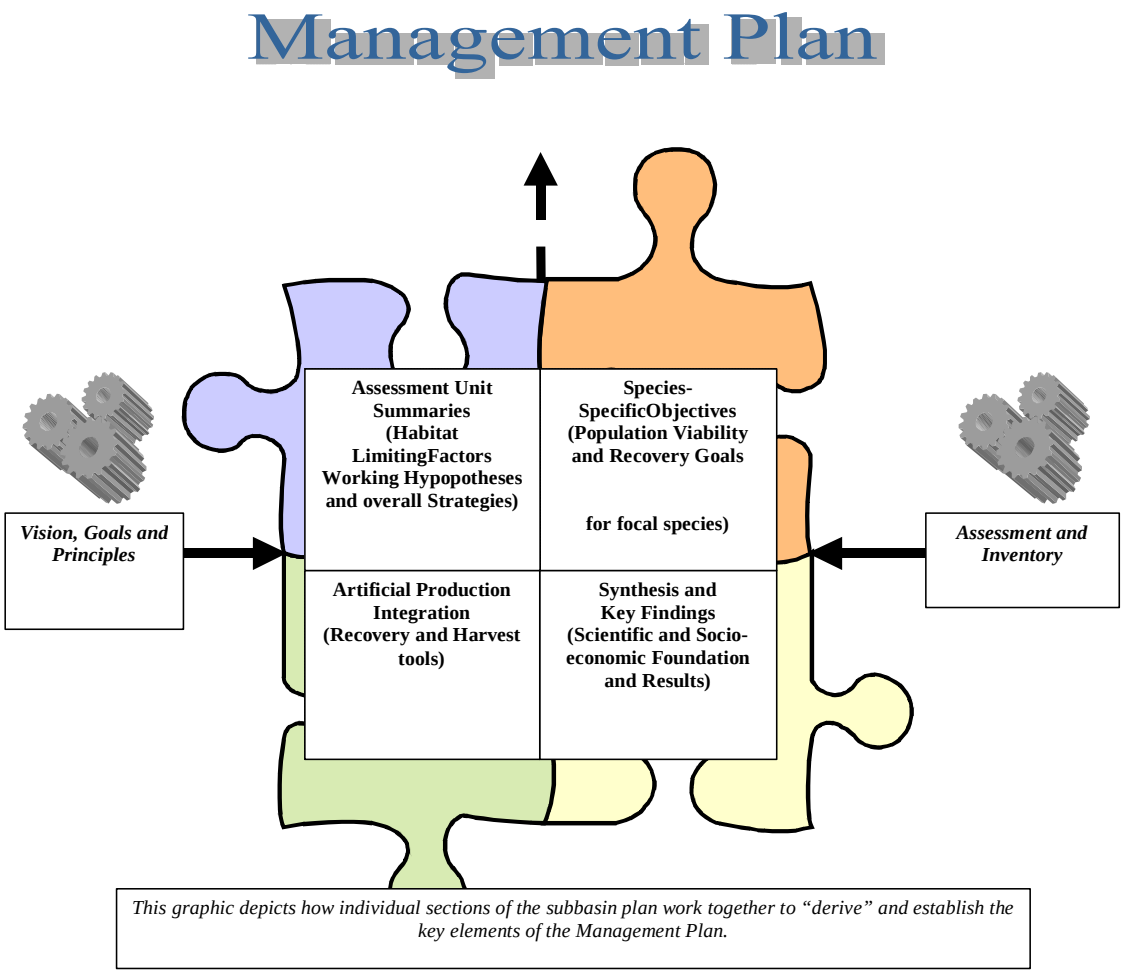


Figure 66 Logic path for translating management guidance into science

5.1 Management and Our Vision for the Methow subbasin

The management plan to follow is designed to be consistent with, and guided by, our Vision. The Vision for the Methow subbasin is consistent with the 2000 Columbia Basin Fish and Wildlife Program's Vision, yet tailored specifically to the geographic region of the Methow subbasin and its citizenry. Within 15 years, it is envisioned that:

The Methow subbasin supports self-sustaining, harvestable, and diverse populations of fish and wildlife and their habitats, and supports the economies, customs, cultures, subsistence, and recreational opportunities within the basin. Decisions to improve and protect fish and wildlife populations, their habitats, and ecological functions are made using open and cooperative processes that respect different points of view and statutory responsibilities, and that are made for the benefit of current and future generations.

Specific planning assumptions and principles are provided at the beginning of this subbasin plan.

Decisions as to which management strategies will be implemented should be a part of a public process that takes into account economics, public policy, community values and tradeoffs of several different kinds. Strategies may be rejected during the public review process because they are too expensive, conflict with policy, or are inconsistent with community values. When this occurs, it will be necessary to look for appropriate alternative strategies or re-examine the goals, and to assess the effect on the plan goals. (NPPC 1997).

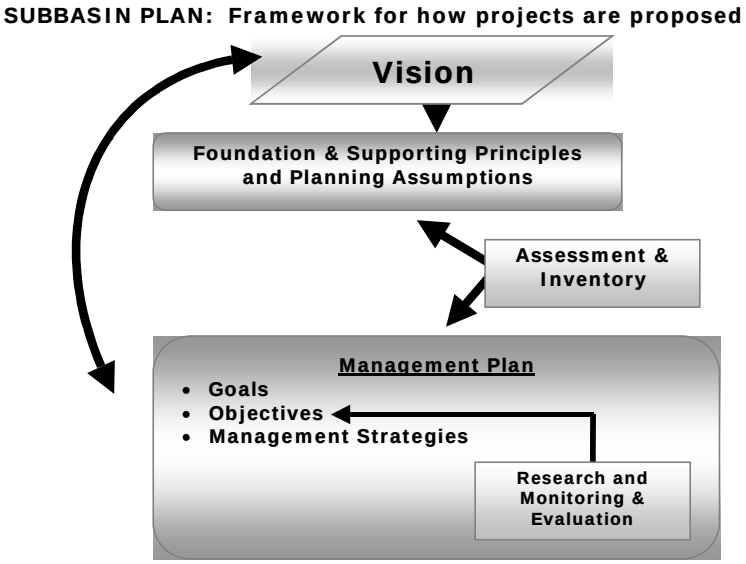


Figure 67 Framework for Project Proposal

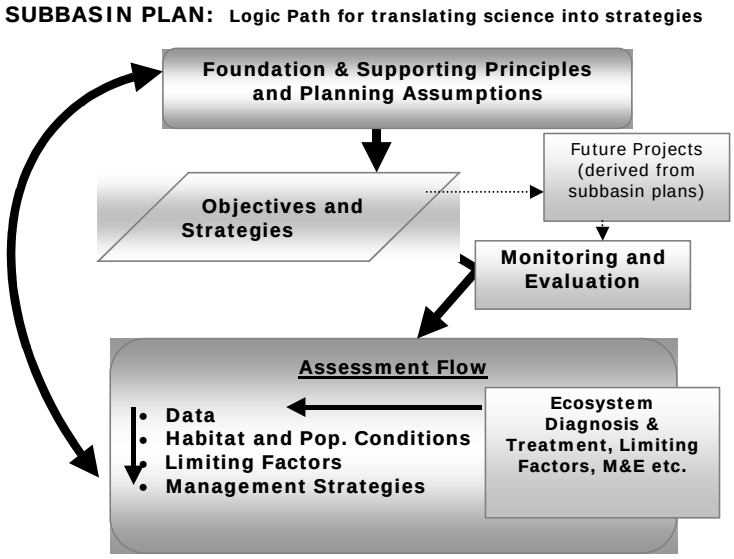


Figure 68 Logic path for translating science into strategies

5.2 Desired Future Condition

5.2.1 Fish

Major portions of the Methow watershed have relatively intact, and high quality fish and wildlife habitat because of inaccessibility and a related lack of human development. This, combined with extensive Wilderness and National Forest designations in the basin's upper reaches, point to a protection emphasis in these areas. Restoration of those habitats impacted in the middle and lower reaches of the subbasin then become the predominant strategy.

The viability of habitat types including riparian zones and floodplains, shrubbesteppe, and dry forest depends on protection of existing stands, linkages, and natural process. In addition, control of exotic species and restoration of native species diversity is critical to maintaining habitat function for fish.

5.2.2 Wildlife

Natural habitats exist with sufficient quantity, quality, and linkages to perpetuate existing native wildlife populations into the foreseeable future. Where sufficient habitat exists, through a combination of protection and restoration, extirpated wildlife species are restored within the subbasin.

5.3 Description of Values and Priorities

We developed strategies that: 1) Operate directly upon the limiting factors, including out-of-basin effects in the case of artificial production, 2) Are rationale, implementable and cost-effective, 3) Support the biological objectives, and, 4) Sustain the goals and vision of the subbasin plan. Use of testable hypotheses statements and measurable objectives, coupled with the M&E framework and current baseline efforts for the subbasin, will allow planners to more credibly and accurately assess the effects of the strategies and the overall progress towards reaching the goals of the subbasin plan over the life of the management plan.

5.3.1 Prioritization Framework for the Methow and Okanogan subbasins

The Council removed the material in this subsection because it is not consistent with the provisions in the 2000 Columbia Basin Fish and Wildlife Program and/or the Northwest Power Act that relate to program implementation. During the public comment period that runs through January 31, 2005, the Council and Washington State Subbasin Planning Coordinator will work with those involved in subbasin planning for the Methow subbasin to develop a prioritization framework for this plan.

The Council understands that much of the material that was removed here draws upon Washington state and local land use law and permitting procedures. State and local legal requirements have, and always will, apply to the implementation of the fish and wildlife program. However, those requirements cannot be relied upon exclusively given the requirements of the Northwest Power Act.

~~This framework describes the process and criteria that will be used to prioritize projects for implementation when project selection processes are initiated. It addresses the Subbasin Plan Foundation Principles, Upper Columbia Biological Strategy, Salmon Recovery Plan provisions,~~

~~and project costs by ranking projects according to 1.) technical, 2.) economic, and 3.) political criteria, while ensuring consistency with local policies. This prioritization framework is subject to adaptive management and will be improved upon as it is tested through time.~~

~~The Subbasin Plan objectives and strategies are also subject to adaptive management. As such, projects may be proposed to address objectives and strategies that have not been listed in the Subbasin Plans, provided the project proposals: a) show how the project will mitigate for fish and wildlife impacts of the FCRPS in the context of the vision and foundation principles presented in the subbasin plan, and b) provide adequate justification for employing alternatives.~~

~~To streamline the project application process, Okanogan County suggests development of a standardized funding application. All project applications submitted to Okanogan County for review will be ranked using an eight-step prioritization framework. The diagram below outlines the framework. A detailed description follows.~~

[omitted]

~~**Figure 69** Prioritization Framework.~~

Prioritization Framework

I.Criteria Definition.

Define the criteria for "complete" applications; determine scoring system and criteria; and establish application deadlines.

II.NPCC solicits project applications.

III.NPCC checks all on-time submittals for completeness.

The checklist for complete applications may include, but will not be limited to, the following items:

All projects: For all of the projects proposed for implementation in Okanogan County, the following items must also be addressed in a "Supplemental Application."

Explanatory Statement

- The situation as it presently exists. Include how the current situation creates or exacerbates limiting factors for fish and/or wildlife.
- The effect of the proposed project if it is implemented. Include how the project would minimize or eliminate limiting factors (causes, not just the symptoms) for fish and/or wildlife. Explain the individual and cumulative benefits to fish and/or wildlife related to this project.
- Provide specific information, with literature citations as appropriate, regarding methodology that will be used to implement the project.

Impact Statement

- Estimated Cost
- Estimated Benefit to fish and/or wildlife
- Summary of Impact:
  - > Actual Cost to the tribes, county, cities, or landowners
  - > Actual Benefit to the tribes, county, cities, or landowners
- Assumptions for Analysis:

- In the project application, indicate who is responsible for implementing each action or set of actions in a project. How will actions be sequenced? What is the overall timeframe for the project?
- Where appropriate, ensure that Canadian agencies and organizations are cooperating and have assisted in prioritizing projects

Restoration projects: For restoration projects proposed for implementation in Okanogan County, the following items must also be addressed in a "Supplemental Application."

- Does the application include a JARPA and an "Application for Streamlined Process for Fish Habitat Enhancement Projects Addition to the Joint Aquatic Permit Application Form (JARPA)" (projects in U.S.) or the appropriate Canadian paperwork (projects in Canada)?

- Does the application include a Monitoring Plan (including monitoring and assessment before, during, and after completion of the project), provisions for funding implementation of the monitoring plan, and a signed contract for implementation of the land management plan?

- When required, does the application contain a completed environmental checklist and related documents to fulfill NEPA/SEPA requirements?

IV. Local technical review and rating.

Local technical review should be completed by a team appointed by the Upper Columbia Salmon Recovery Board. The team may include, but is not limited to, representatives of the CCT, WDFW, USFWS, NOAA Fisheries, YN, PUDs, and U.S. Forest Service.

All projects will be rated by the technical team using criteria that assess the following factors:

- If appropriate, has the project sponsor fulfilled obligations (such as implementing the project, implementing the land use management plan, controlled noxious weeds, etc.) on previous projects?

- Does the project address limiting factors or data gaps *or* does the application include sufficient justification to include the project in the ranking process?

- How will the project impact self-sustaining populations of fish and wildlife (productivity)?

- How will the project impact fish or wildlife abundance?

- How will the project impact fish or wildlife diversity?

- How will the project impact fish or wildlife spatial structure?

Restoration projects will be rated by the technical team using criteria that assess the following factors:

- For projects that involve structural manipulation of the stream channel, is the project designed at the reach level or context?

- Is the proposed monitoring plan comprehensive, and will it be effective in a assessing the outcomes of the project relative to the NPCC's fish and wildlife mitigation responsibilities?

Research, Monitoring and Evaluation projects will be rated by the technical team using criteria that assess the following factors:

- Is the Research, Monitoring, and Evaluation Plan designed to be consistent with other monitoring efforts in the Columbia Basin?

- Does the Research, Monitoring, and Evaluation Plan analyze recovery potential and address the recovery goals of regulatory agencies?

- Does the Research, Monitoring, and Evaluation Plan provide data for management actions, project implementation, and planning within the subbasin?

~~Additional technical ranking questions may include, but are not limited to, the following:~~

~~1.All: Are the projects ranked by UCRTT Category?~~

~~2.All: Are the projects ranked to have the highest priority if they are in a UCRTT watershed with the highest number of significant subwatersheds?~~

~~3.All: Are the projects ranked to have highest priority if they are within a UCRTT significant subwatershed?~~

~~4.All: Are the projects ranked according to the UCRTT Biological Strategy for the entire subbasin?~~

~~5.All: Are the projects ranked by the UCRTT Biological Strategy for the watershed?~~

~~6.All: Does the project address limiting factors or data gaps?~~

~~7.All: Does it support self-sustaining populations of fish and wildlife (productivity)?~~

~~8.All: Does it support harvestable populations of fish and wildlife (abundance)?~~

~~9.All: Does it support diverse populations of fish and wildlife (diversity)?~~

~~10.All: Does it expand the spatial distribution (spatial structure)?~~

~~11.All: Does the project help to achieve multiple priorities (e.g., benefit both fish and wildlife, restoration of ecosystems rather than single species)?~~

~~12.All: Will implementation of the objective or strategy result in long-term biological benefits over short-term gains?~~

~~13.All: Does it promote fish habitat diversity?~~

~~14.All: Does it promote wildlife habitat diversity?~~

~~15.All: Does it benefit ecological function?~~

~~16.All: Does it benefit habitat connectivity?~~

~~17.All: Does the project help to protect, mitigate, or restore habitat while avoiding or minimizing impacts to native fish and/or wildlife species?~~

~~18.All: Does the project emphasize restoration of, or provide benefits to, native over non-native species?~~

~~19.All: Does it promote water quantity/instream flows?~~

~~20.All: Does it promote water quality?~~

~~21.All: Does the project benefit current and future generations?~~

~~22.All: Does the project support recreational opportunities?~~

~~23.All: Have the projects been reviewed and ranked based on their economic impact?~~

~~24.Restoration: For Barriers, will removal of the barrier be beneficial to the ecosystem over the long term?~~

25.Restoration: Does it restore the complexity of the stream channel?

26.Restoration: Does it restore the complexity of the floodplain?

27.Restoration: Does it place emphasis on using proper land management practices rather than promoting structural manipulation of the stream channel?

28.Educational: Is the project designed to help fish or wildlife?

29.Educational: Has a "Lesson Plan" been developed?

30.Educational: Does the project include an effective means of distributing information (TV, newspaper, radio, email, letters, signs, personal contacts)?

31.Educational: Can the project be expected to be cost effective based on the number of people who will be exposed to this information?

32.Educational: Can the project be expected to be beneficial based on the length of time over which people will be exposed to the information? Emphasis will be placed on long-term education projects (signage, etc.).

33.Educational: Will the project decrease negative impacts on fish and/or wildlife?

V. Policy review and ranking; Citizen comments.

Okanogan County will develop a policy review committee to check the consistency of proposed projects with local policies and stipulations. The County will offer a public comment forum to address the proposed projects at an open public meeting.

Policy review and ranking questions may include, but are not limited to, the following:

1.All: If appropriate, has the project sponsor fulfilled obligations (such as implementing the project, implementing the land use management plan, controlled noxious weeds, etc.) on their previous projects?

2.All: Is the proposed project consistent with local policies?

3.All: Does the project benefit current and future generations?

4.All: Does the project support recreational opportunities?

5.All: Have the projects been reviewed and ranked based on their economic impact?

6.Protection: Does the application include a statement of support for the granting of an easement or acquisition of property, signed by the owner of the subject property?

7.Protection: Is money allotted to mitigate for long-term economic impacts (i.e., PILT)?

8.Protection: Does the application include a land use management plan that is consistent with local plans and regulations?

9.Protection: Does the plan effectively address noxious weed control?

10.Protection: Does the plan effectively address fire hazards?

11.Protection: Does the project incorporate the cost to implement the land management plan?

12.Protection: Does the application include a signed contract for implementing the land management plan?

13.Protection: Does the project modify existing rights/privileges of a landowner (land use/water rights)? If yes, has a full written disclosure been provided to the landowner? Has a signed document been obtained from the landowner to infringe on his rights? Has the landowner waived compensation or been compensated appropriately for the loss of rights/privileges?

Citizen Comments

The County will offer a public comment forum to address the proposed projects at an open public meeting.

VI. Partners develop a committee to rank projects.

For the Okanogan sub basin, Okanogan County and CCT will develop a committee to rank projects that balances the technical, policy and economical views and considers them appropriately; For the Methow sub basin, Okanogan County and WDFW will develop a committee to rank projects that balances the technical, policy and economical views and considers them appropriately.

VII. Submit project applications with tiered rankings.

VIII. Adaptive Management.

Adaptive Management will be used to improve upon the Prioritization Framework as well as to update Objectives, Strategies and proposed Projects with research, monitoring, and evaluation results.

5.4 EDT Report on Habitat Limiting Factors

The EDT reports (subbasin, assessment unit, and reach level) are intended to provide an integrated and step-wise description of findings for use by subbasin planners.

provides a subbasin *summary list* of the Methow subbasin's key factors limiting fish habitat productivity—and by extension, characterizes viability concerns associated with low abundance, limited diversity and insufficient spatial structure.

A set of EDT report maps provide an overview by Assessment Unit to aid in spatial understanding.

The Assessment Unit (AU) Summary tables provide more exhaustive and detailed information about geographic location, priority factors, working hypotheses, data gaps, and objectives. Reach-level habitat attributes information and analysis can be found in Appendix G, EDT Output Tables.

Table 54 List of Key Limiting Factors for the Methow Subbasin condensed and derived from the Assessment Unit Summaries

Key Limiting Factor or Problem	Management Strategies	Applicable AU's
Barriers (including flow) to Chinook, steelhead migration/spawning/rearing	Plan and implement fish passage; inventory barriers. Assess passage conditions. Address thermal blocks and low flow barriers.	2, 4 (Early Winters), 5, 6, 7 (secondary in upper reaches), 8, 10, 13
Fish losses in unscreened irrigation canals	Prepare and implement screening plan. Complete survey where lacking information. Assess entrainment.	
Water Temperature & Dissolved Oxygen	Investigate extent of problem. Prepare plan for remedies (e.g. flushing flows, hypolimnetic aeration, etc.)	1
Predation	Investigate extent of losses. Prepare plan for control	1,2
Habitat Diversity	Increase LWD. Reconnect to floodplain areas. Increase side channel habitat. Install habitat boulders and artificial logjams. Improve riparian habitats with the potential to contribute to future LWD recruitment. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas. Many additional strategies in AU summary.	1, 2, 3, 4, 5, 6, 7, 8, 9 (mostly natural harsh conditions in Twisp), 10, 11, 12 (mostly on alluvial fan and near Vander pool), 13
Sediment and Channel Stability	Establish baseline for residual pool depths. Monitor residual pool depths annually and evaluate trends. Conduct sediment reduction strategies throughout the Okanogan subbasin, especially in the upper portions of the watershed.	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13
Salmon Carcasses (low abundance of salmon/steelhead and their nutrients contribution to stream ecology including benthic marco invertebrates and fish growth)	Increase or maintain artificial production capacity at levels necessary to meet management needs, maintain new and existing acclimation sites, and support existing and new scatter plantings. Program is intended to support conservation, reestablishment of natural broodstock and interim harvest opportunities.	3, 4, 7,
Loss of Floodplain Connectivity and Habitat Quantity	Reestablish back channels, re-slope vertical banks, and (re)establish wetland habitats that allow floodplain inundation to occur approximately every two years. Conduct a channel migration corridor study and monitor trends and identify opportunities. Protect and re-establish groundwater sources. Numerous others strategies are found in summaries.	4, 5, 6, 7, 8 (for spck), 10 (primary for steelhead and bull trout), 11, 12 (for spawning and incubation), 13
Mining and Other Water and Habitat Quality Issues besides temperature	BMP, enforcement, clean-up of existing land-fill and pesticide dumps, etc.	2

5.5 Assessment Unit Summaries

The following Assessment Unit Summary Sheets are intended to be used as a *guide* for developing future strategies, projects and direct actions as they relate to salmon habitat. They support and form the basis for the Management Plan, and are in turn supported by the subbasin plan sections: Goals and Vision, Species Objectives, Hatchery Integration and the Monitoring and Evaluation Framework. Taken together, these form our scientific and socio-economic foundation, and ultimately, the core of the Management Plan itself.

Four course-scale filters were used to guide us in developing the specific strategies found in the AU summary sheets. These were used ensure that actions are balanced and rationale. Ultimately them were used to gauge if the actions would be (will be) implementable. In taking this step, we found that trade-off analysis and multiple iterations of planning was reduced by focusing actions in areas and on habitat attributes that fell within the "realm of the doable and effectual."

1. Is the strategy supported by science?

17. Is the strategy cost effective?

18. Does the strategy have (or is it likely to win) public support?

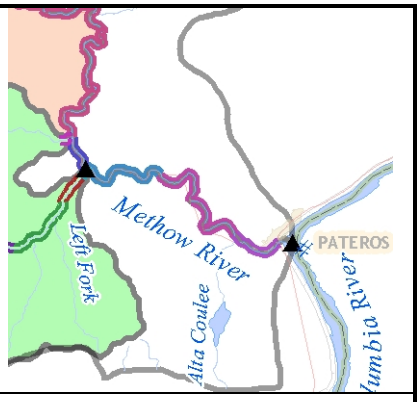
19. Are resources available to implement the strategy and monitor the outcomes—including enforcement where relevant?

The working hypotheses in these summaries are the "testable" part of the management plan equation. The strategies themselves provide the metrics for testing and form the most appropriate foundation for the monitoring and evaluation program priorities.

Assessment Unit (AU): M1—Lower Methow

Reaches: 7

1	2	3	10	14	27	39



FOCAL species: Spring, summer/fall Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 235,553 acres

SUBWATERSHEDS:

Black Canyon Creek, Squaw Creek, McFarland Creek, French Creek, Texas Creek

ASSESSMENT UNIT DESCRIPTION:

The Lower Methow River subwatershed encompasses the mainstem Methow River and its tributaries from just upstream of the town of Carlton (RM 33) downstream to the mouth of the Methow River. Running in a northwesterly to southwesterly direction, the river carves a gorge as the valley narrows; it narrows considerably in this part of the watershed in comparison to the broader floodplains and terraces from above Winthrop down to Carlton (USFS 1999a). Valley widths vary from about a mile at the upper end to less than ½ mile at the lower end (USFS 1999a). Tributaries to the Lower Methow River include Texas Creek, Libby Creek, Gold Creek, McFarland Creek, French Creek, Squaw Creek and Black Canyon Creek. The subwatershed also includes the towns of Carlton and Methow.

LEVEL OF CERTAINTY:

Use EDT level of proof Table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat diversity (Loss of connection to the floodplain via roads and riprap, loss of riparian vegetation, lack of large woody debris [LWD])

P-Predation (Exotic species and warm temperatures in the inundated zone)

S-Sediment load (high turbidity during high flows, high % fines in depositional areas)

S-Temperature (warm summer temperatures)

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer Chinook in the following life stages: a) fry colonization, and; b) pre-spawn holding. Summer steelhead survival will increase in all juvenile life stages. Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add LWD and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Predation may be a limiting factor; decreasing predation, particularly in the inundated zone, will increase survival of all juvenile salmonid life stages.

Objective 1 - Determine predation rates and quantify impacts on salmonids by exotic and native piscivores. Note: No data specific to the Methow estuary exists; the model predicted "a high predation risk" and was derived from high species richness, high numbers of exotics, and increased temperatures.

Objective 2 - Reduce unacceptable predation impact based upon results from Objective 1.

Strategy 1 - Determine predator abundance and consumption rates.

Strategy 2 - Reduce predation impact by managing aquatic predator abundance.

Strategy 3 - Monitor predator abundance annually and evaluate trends.

Hypothesis 3 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer/fall Chinook in the fry colonization life stage, and steelhead in the egg incubation life stage.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification)

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement best management practices (BMPs) for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies*:*

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2 - Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts, and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 4 - Decreasing summer maximum temperatures will increase survival of summer Chinook spawning and egg incubation life stages.

Objective 1 - No maximum daily temperatures over 64^{o} F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (<57 °F) are not realistic for the lower Methow River mainstem, and probably represent a condition that could not exist, even under pristine historical conditions.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPs.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and from roads, using detention, treatment, and infiltration measures.

Hypothesis 5 - Artificial production (supplementation) will: increase fish population numbers to partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members, and; aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits.

Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS:

Aquatic habitat surveys

Fish habitat use (species- and life stage-specific)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity)

Piscivory in the inundated zone

Benthic invertebrate productivity

Winter temperature and icing studies

Monitoring and evaluation programs

Bull Trout:

Population, distribution and abundance

Exotic interaction

Fish use activity and life stage

Genetics

Westslope cutthroat trout:

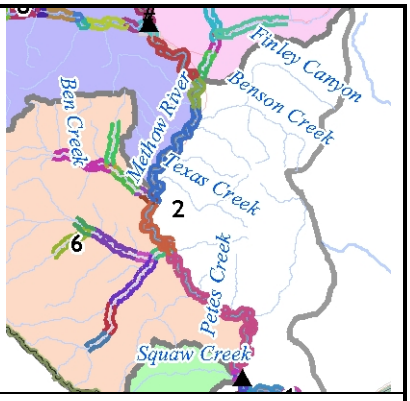
Fish use - activity and life stage

Population, distribution and abundance

Assessment Unit (AU): M2—Middle Methow

Reaches: 19

40	**52**	**53**	**98**	**99**	**100**	**104**	**105**	**143**	
144	**149**	**151**	**152**	**153**	**160**	**163**	**164**	**169**	**174**



FOCAL species: Spring, summer/fall Chinook salmon, coho, bull trout, weststlope cutthroat trout, and steelhead

Drainage area: 162,834 acres

SUBWATERSHEDS:

Alder Creek, Bear Creek, Beaver Creek and Benson Creek

ASSESSMENT UNIT DESCRIPTION:

The Middle Methow River subwatershed contains 15,600 acres, encompassing the mainstem Methow River from the Weeman Bridge (RM 59.7) downstream to RM 33. It includes Wolf Creek, Hancock Creek, Alder Creek, Bear Creek, Beaver Creek, and Benson Creek drainages, and the towns of Winthrop and Twisp. The upstream end of this AU is where natural dewatering sections start to occur, and the downstream end was selected based on changes in gradient and natural confinement.

LEVEL OF CERTAINTY:

See EDT level of proof document in Level of Proof Table, Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; loss of riparian vegetation; lack of LWD)

P-Obstructions (MVID East -Foghorn and Barkley were modeled as having no impact, but Barkley has some impacts due to channel alteration)

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows)

S-Key Habitat Quantity (only a couple of reaches for summer/fall Chinook; the largest problem was in the upstream reach (RM 50-53) where they do not spawn every year; fewer pools and pool tailouts and more large substrate riffles seemed to be the problem, but we need better habitat data to confirm)

S-Sediment Load (high turbidity during high flows; high % fines in depositional areas; high embeddedness in spawning habitat)

S-Flow (increased peak flows [from fire activity in headwaters]; reduced low flow [water use, increased peak flow, loss of riparian function]; hydroconfinement [channelization and accelerated erosion])

S-Predation (various wild and hatchery salmonid predators primarily impacting fry (model prediction), no foraging studies available to confirm.

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer Chinook in the following life stages: a) spawning, b) prespawn holding, and; c) fry colonization. Summer steelhead survival will increase in the following life stages: a) spawning; b) fry colonization, and; c) age 0-2 juvenile rearing. Spring Chinook survival will increase for: a) fry colonization; b) age-0 rearing; c) prespawn holding, and; d) spawning. Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12” diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and

estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Improving passage at diversion dams will increase survival for all juvenile life stages of all salmonids.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 3 - Increasing channel stability will increase survival of summer steelhead in the following life stages: a) egg incubation, and; b) fry colonization.

Objective 1 - See objectives 1 and 2 of Hypothesis 1.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 3).

Note: re current assumption: major survival implications in EDT when greater than 5.5 inches [EDT score =2]).

Protection and Restoration options: See strategies for Hypotheses 1, 5, and 6.

Hypothesis 4 - Increasing key habitat quantity will increase survival for summer/fall Chinook in the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-0 active rearing (particularly in reaches Met 14-15). Steelhead survival will increase for: a) prespawn holding; b) spawning, and; c) egg incubation (particularly in reach Met 14). Spring Chinook survival will increase for: a) prespawn holding; b) spawning; c) egg incubation; d) fry colonization , and; e) age-0 summer rearing (particularly in reaches Met 14-17). Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Fill data gap by conducting formal habitat surveys in the Methow River mainstem.

Note: A preliminary survey was conducted for this assessment; however, it was not complete and did not conform to standard protocols.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Objective 3 - See Objectives 1 and 2 of Hypothesis 1, Objectives 1 and 2 of Hypothesis 5, and Hypotheses 6a and 6b.

Note: The majority of benefit was estimated to occur in reaches Met 14-15 where the upper rangeof summer/fall Chinook are represented; habitat improvements may not be as beneficial elsewhere.

Protection and Restoration options: See Strategies for Hypotheses 1, 5, and 6.

Strategy 1. Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer/fall Chinook in the fry colonization life stage, and steelhead in the: a) spawning; b) egg incubation, and; c) fry colonization life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 6a - Increasing summer base flows will increase survival of spring Chinook for prespawn holding, and of summer/fall Chinook for: a) prespawn migrants; b) prespawn holding, and; c) age-0 active rearing. Summer steelhead survival will increase for all juvenile summer and winter rearing life stages. Bull trout survival will increase for holding, migration and overwintering. Westslope cutthroat trout survival will increase for migration and overwintering.

Hypothesis 6b - Decreasing spring peak flows (to natural hydrograph levels) will increase survival for steelhead and Chinook in the following life stages: a) fry colonization, and; b) juvenile active rearing.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objective 3 of Hypothesis 3 (Road Density).

Objective 3 - Minimize negative impacts of irrigation and municipal water withdrawals.

Objective 4 - See Objectives 1-5 of Hypothesis 5 (Sediment Load).

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 of Hypothesis 1.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 7 - Predation may be a limiting factor, and decreasing predation would increase survival of all juvenile salmonid life stages.

Objective 1 - Determine predation rates, and quantify impacts on salmonids by exotic and native piscivores.

Note: No data specific to the Middle Methow mainstem exists; the model predicted “a high predation risk” and was derived from high species richness, high numbers of exotics, and increased temperatures).

Objective 2 - Reduce unacceptable predation impact, based upon results from Objective 1 of Hypothesis 6.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Aquatic habitat surveys (including measurements of bed scour)

Fish habitat use (species- and life stage-specific)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity)

Benthic invertebrate productivity

Winter temperature and icing studies

Implement monitoring and evaluation programs

Bull Trout:

Population, distribution and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

Westslope cutthroat trout:

Population, distribution and abundance

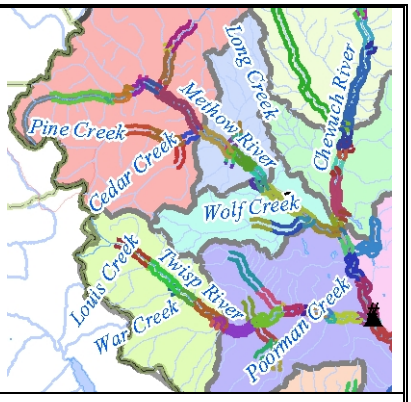
Fish use - activity and life stage

Genetics.

Assessment Unit (AU): M3—Upper-Middle Methow

Reaches: 17

81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
91	**92**	**93**	**94**	**95**	**96**	**97**			



FOCAL species: Spring Chinook, bull trout, steelhead, coho, westslope cutthroat trout, and cutthroat trout

Drainage area: 162,834 acres

SUBWATERSHEDS:

Goat Creek, Little Boulder Creek, Fawn Creek, Gate Creek, Early Winters Creek, and Lost River

ASSESSMENT UNIT DESCRIPTION:

The Upper-Middle Methow River subwatershed encompasses the mainstem of Methow River from the Weeman Bridge (RM 59.7) to Robinson Creek (RM 74.5). This stretch of the Methow River was segregated from the Upper and Middle Methow AUs because it commonly has reaches that naturally dewater during baseflow.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; loss of riparian vegetation; lack of LWD)

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows (from fire activity in headwaters); increased flashy flows (from fire activity in headwaters)

S-Flow - impacts above and beyond natural condition (increased peak flows [from fire activity in headwaters]; reduced low flow [water use, increased peak flow, loss of riparian function]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Key Habitat Quantity (reduction in quality pool, LWD; loss of riparian vegetation)

S-Sediment Load (high turbidity during high flows; high % fines in depositional areas; high embeddedness in spawning habitat

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENTS:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook, steelhead, and bull trout in the following life stages: a) spawning (spring Chinook, and steelhead), b) fry colonization (spring Chinook and steelhead) and c) rearing (spring Chinook, steelhead, and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12” diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Increasing channel stability will increase survival for spring Chinook, steelhead, and bull trout in the following life stages: a) fry colonization (spring Chinook, and steelhead); and rearing (spring Chinook, steelhead, and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - See Objective 1 and 2 of Hypothesis 1.

Objective 2 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and possess good cover (NMFS 1996). (don't understand this)

Objective 3 - Achieve less than 10% eroding slopes.

Objective 4 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Objective 5 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 6: Reduce bed scour to appropriate PFC (based on Objective 5)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See Strategies for Hypotheses 1, 3, and 6.

Hypothesis 3 - Improving flow condition within the AU will increase the survival of spring Chinook, steelhead and bull trout in the following life stages: a) fry colonization (Spring Chinook, and steelhead), and; d) rearing (spring Chinook, steelhead and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - See Objectives 1and 2 of Hypothesis 1.

Objective 2 - Restore burned areas in the headwaters to a natural condition.

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 and 2 of Hypothesis 1.

Strategy 2 - Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 4 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, and bull trout in the following life stages: a) fry colonization (spring Chinook, steelhead, and bull trout), and; b) rearing (spring Chinook, steelhead, and bull trout). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - See Objective 1and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 6 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 4. Achieve 125 salmon carcasses / mile as an interim target (based on estimates of historic run size (Mullen et al. 1992 distributed in areas of current spawning and rearing (WDFW unpublished data).

Protection and Restoration options: See strategies for Hypotheses 1and 6.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 5 - Increasing key habitat quantity (increased number of quality pools and improved riparian vegetation) will increase the survival of spring Chinook, steelhead and bull trout in the following life stages: a) spawning (spring Chinook, and steelhead); b) egg incubation (spring Chinook, and steelhead); c) rearing (spring Chinook, steelhead and bull trout), and; d) holding (spring Chinook and steelhead). Westslope cutthroat trout survival will increase for migration and overwintering.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation, large woody debris, and connectivity to the floodplain, and off-channel habitat).

Objective 2: Reach or exceed 20 pieces/mile (12" diameter and 35 inches long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjorn and Reiser 1995).

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and possess good cover (NMFS 1996).

Protection and Restoration options: See strategies for Hypotheses 1, 3, and 6.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 6 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer/fall Chinook in the fry colonization life stage, and steelhead in the a) spawning; b) egg incubation, and; c) fry colonization life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2 - Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations.

Strategy 4 - Upgrade stream crossing, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 7 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS:

Winter temperature and icing studies

Channel migration zone study

Aquatic habitat survey

Fish habitat use (species- and life stage-specific)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Others from EDT

Groundwater-surface water interactions

Bull Trout:

Population, distribution and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

Westslope Cutthroat Trout:

Population, distribution and abundance

Exotic interaction

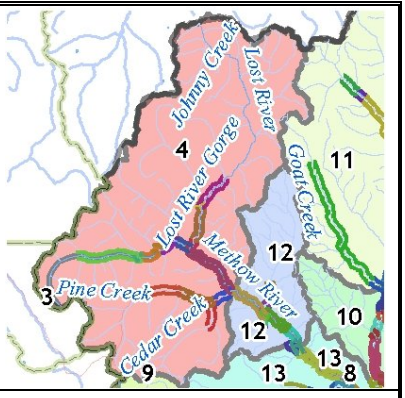
Fish use-activity and life stage

Genetics

Assessment Unit (AU): M4—Upper Methow/Early Winters/Lost River

Reaches: 17

81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
91	**92**	**93**	**94**	**95**	**96**	**97**			



FOCAL species: Steelhead, spring Chinook, coho, bull trout, and westslope cutthroat

Drainage area: 322,385 acres

SUBWATERSHEDS:

Brush Creek, Trout Creek, Rattlesnake Creek and Robinson Creek.

ASSESSMENT UNIT DESCRIPTION:

The Upper Methow River subwatershed contains approximately 322,385 acres, encompassing the upper Methow River from its headwaters (RM 86.8) downstream to the Robinson Creek confluence (RM 74). These HUC watersheds were grouped due to similarities of pristine conditions and lack of dewatering reaches.

LEVEL OF CERTAINTY:

Use EDT level of proof Table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity -1st reach of Early Winters and Lost River (loss of connection to the floodplain via roads, riprap, and dikes; loss of riparian vegetation; lack of LWD)

P-Key Habitat Quantity (reduction in quality pool, LWD; loss of riparian vegetation)

S-Flow - Early Winters Creek is particularly important for watering spawning habitat in the Methow mainstem, 500-1000' (increased peak flows [from fire activity in headwaters (excluding Early Winters Creek]; reduced low flow [water use, increased peak flow, loss of riparian function]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Channel Stability (loss of connection to the floodplain via roads and riprap [lower reaches only]; loss of riparian vegetation [unnaturally intense fire regime]; lack of LWD; increased peak flows [from fire activity in headwaters]; increased flashy flows [from fire activity in headwaters])

Sediment Load - Not identified as a limiting factor in this AU, but due to unnaturally intense fire regime, AU is a critical area for generating sediment that causes downstream problems (high turbidity during high flows; high % fines in depositional areas; high embeddedness in spawning habitat

Refer to Electronic Appendix B for reference and specific detail by reach and species

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1: Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of bull trout, westslope cutthroat trout, spring Chinook and summer steelhead in all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels, and disconnect habitat in floodplains and

estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add LWD and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Increasing "key habitat quantity" will increase the survival of bull trout, westslope cutthroat trout, and spring Chinook in the following life stages: a) fry colonization; b) 0-age active rearing; c) 0-age inactive rearing; d) 1-age active rearing; e) spawning; f) egg incubation, and; g) prespawn holding, and of steelhead during: a) spawning, and; b) egg incubation.

Objective 1 - See Objective 1, 3, and 6

Objective 2 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Protection and Restoration options: See strategies for Hypotheses 1, 3, and 6.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 3 - Increasing summer base flows and decreasing spring peak flows will increase survival of bull trout, westslope cutthroat trout, and spring Chinook in the following life stages: a) prespawn holding; b) fry colonization; c) 0-age active rearing, and; d) 0-age inactive rearing, and for steelhead during: a) fry colonization; b) 1–age inactive rearing, and; c)1-age active rearing.

Objective 1 - See Objective 1 and 2 of Hypothesis 1.

Objective 2 - Minimize negative impacts of irrigation water withdrawals.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Objective 4 - Minimize negative impacts of land use in riparian and upland areas (BMPss).

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objectives 1 and 2 of Hypothesis 1.

Strategy 2 - Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 4 - Increase in forage will increase the survival of bull trout, westslope cutthroat trout, and spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing, and; c) 0-age inactive rearing; and of steelhead during: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing, and; d) 1-age active rearing.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 6 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 4. Achieve 125 salmon carcasses / mile as an interim target (based on estimates of historic run size (Mullen et al. 1992 distributed in areas of current spawning and rearing (WDFW

unpublished data).

Protection and Restoration options: See strategies for Hypotheses 1and 6.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 5 - Increasing channel stability will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) fry colonization (spring Chinook, and steelhead), and; b) rearing (Spring Chinook, steelhead, and bull trout).

Objective 1: See Objectives 1 and 2 of Hypothesis 1.

Objective 2 - See Objectives 1-5 of Hypothesis 3.

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Objective 4 - Achieve less than 10% eroding slopes.

Objective 5 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 6 - Reduce bed scour to appropriate PFC (based on Objective 5 of Hypothesis 5)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Objective 7 - See Objectives 1-4 of Hypothesis 6.

Protection and Restoration options: See strategies for Hypotheses 1, 3, and 6.

Hypothesis 6 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for all focal species in the fry colonization life stage and for steelhead in the a) egg incubation, and; b) fry colonization life stages, particularly in downstream reaches.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 7: Artificial production (supplementation) will increase fish population numbers to partially mitigate for habitat deficiencies and provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members, and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Channel migration zone study

Aquatic habitat surveys (mainstem reaches only)

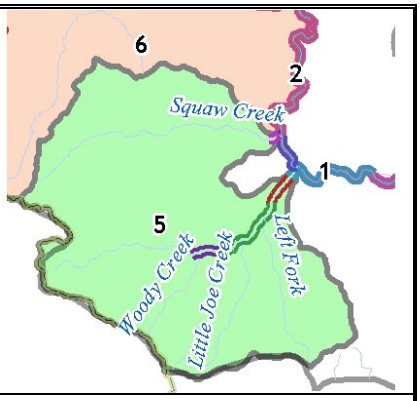
Fish habitat use (species- and life stage-specific)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)
Benthic invertebrate productivity
Others from EDT
Groundwater-surface water interactions (lower reaches only)
Winter temperature and icing studies
Implement monitoring and evaluation programs
Bull Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Presence/absence studies in tributaries
Population, distribution and abundance
Exotic interaction
Fish use-activity and life stage
Genetics

Assessment Unit (AU): M5—Black Canyon/Squaw Ck.

Reaches: 8

4	5	6	7	8	9	11	12



FOCAL species: Steelhead and coho

Drainage area:

SUBWATERSHEDS:

None

ASSESSMENT UNIT DESCRIPTION:

Little information on habitat conditions is available for these drainages. Squaw Creek joins the Methow River at RM 9.0 and has a drainage of about 16 square miles (USFS 1999a). It is considered to have very little influence on anadromous habitat in the Methow River (USFS 1999a), and no stream survey has been conducted in this drainage. Black Canyon Creek joins the Methow River at RM 8.1, has a drainage of about 25 square miles (15,940 acres; USFS 1999a), and is 7.2 miles in length. Summer steelhead spawn in the lower 0.4 miles of Black Canyon Creek (USFS 1999a), and resident rainbow trout are known to occur further upstream to about F.S. Road 100 (TAG 2000). The State Highway 153 culvert crossing at the mouth of Squaw Creek blocks anadromous fish passage into Squaw Creek (USFS 1999a). Rainbow trout were noted in Squaw Creek up to and just above the FS Road 125 crossing (about RM 3.0; November 1998 field notes, D. Hopkins, USFS fish technician).

LEVEL OF CERTAINTY:

Use EDT level of proof Table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Sediment Load - limiting across all life stages (extremely high % fines and embeddedness; high turbidity during high flows

high road density, agriculture, logging, extreme fire regime)

P-Obstructions (2 culverts in lower 3.5 miles)

P-Habitat Diversity (loss of connection to the floodplain; reduced beaver activity)

S-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals)

S-Flow - problem for summer rearing (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters]; hydroconfinement [channelization in lower 2 miles])

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer steelhead in the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-0,1 winter rearing.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies and estimate appropriate target for PFC in these subwatersheds based on naturally elevated ambient sediment budget.

Objective 3 - Reduce embeddedness to an average of 20% or less (or appropriate target based on Objective 2 of Hypothesis 1) throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less (or appropriate target based on Objective 2 of Hypothesis 1) throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 2 - Improving passage at culverts will increase survival for summer steelhead in the following life stages: a) spawning, and; b) age-0,1,2 rearing.

Objective 1 - Obtain no impact to upstream or downstream movement by all fish species at all life stages.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 3 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead in the following life stages: a) spawning; b) age-0,1, 2 rearing, and; c) age-1, 2 migrants.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12” diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning conditions for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and

streams.

Hypothesis 4 - Increasing key habitat quantity will increase survival for summer steelhead in the following life stages: a) prespawn holding; b) spawning, and; c) egg incubation.

Objective 1 - Fill data gap by conducting formal habitat surveys in Black Canyon and Squaw Creeks.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996) with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Objective 3 - See Objectives 1 and 2 of Hypothesis 3. (Habitat Diversity)

Hypothesis 5 - Increasing base flows will increase survival of summer steelhead in the age-0,1 summer/winter rearing life stage. Decreasing spring peak flows (to natural hydrograph levels) will increase survival for steelhead in the fry colonization life stage.

Objective 1 - Minimize negative impacts of water withdrawals.

Objective 2 - Obtain/maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads.

Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with "functioning at risk"(NMFS 1996); however, the properly functioning objectives (including "no valley bottom roads") are not feasible.

Objective 3: See Objectives 1 and 2 of Hypothesis 3. (Habitat Diversity)

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 and 2 of Hypothesis 3.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Aquatic habitat surveys

Fish habitat use (species- and life stage- specific, e.g. bull trout)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Others from EDT

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Determine impact of land use practices on riparian zone

Streamflow

Winter temperature and icing studies

Assessment of current versus historical beaver abundance and distribution

Implementation of monitoring and evaluation programs

Westslope Cutthroat Trout:

Population, distribution, and abundance

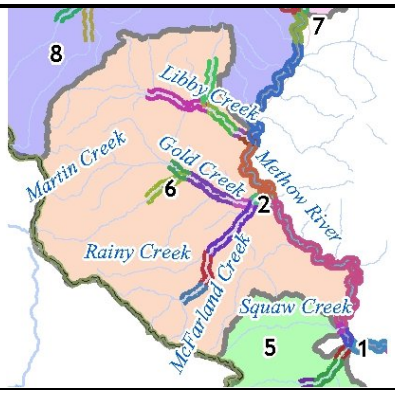
Exotic interaction

Fish use-activity and life stage

Assessment Unit (AU): M6—Gold/Libby

Reaches: 12

15	16	17	18	19	20	21	22	23	24	25	26



FOCAL species: Spring Chinook, coho, bull trout, westslope cutthroat trout, and steelhead.

Drainage area: 83,800

SUBWATERSHEDS:

Gold Creek: South Fork Gold Creek, Foggy Dew Creek, Crater Creek, North Fork Gold Creek, Libby Creek, Smith Canyon Creek, Mission Creek, North Fork Libby Creek, South Fork Libby Creek

ASSESSMENT UNIT DESCRIPTION:

The Libby Creek drainage runs east to west and contains approximately 25,000 acres. Libby Creek is approximately 14 miles in length, and drains into the Methow River at RM 26.4 about 0.5 mile downstream of the town of Carlton (RM 27.0). Tributaries include Smith Canyon, Chickamun Canyon, Ben Canyon, Mission, South Fork Libby and North Fork Libby Creeks.

The Gold Creek drainage runs east to west and encompasses approximately 58,800 acres. It drains into the Methow River from the east at RM 21.8, about 6 miles downstream of the town of Carlton (RM 27.0). Gold Creek is 10.2 miles in length. Its tributaries include South Fork Gold Creek, North Fork Gold Creek, Foggy Dew Creek, and Crater Creek.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Obstructions (flow diversions; culverts)

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes, reduced beaver activity; loss of riparian vegetation; lack of LWD

P-Sediment Load (high % fines and embeddedness; high turbidity during high flows; high road density, agriculture, and logging)

P-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals

P/S-Flow - may be a bigger problem than EDT indicated; there are low natural flows, so in certain years, spring Chinook and bull trout may be impacted significantly (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters])

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows)

Temperature -for spawning and incubation of spring Chinook (high summer temperatures in lowest reach [do not know if they extend past the South Fork])

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Improving passage at diversion dams and culverts will increase survival for summer steelhead, spring Chinook, bull trout, and westslope cutthroat trout at all life stages.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring, and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook, westslope cutthroat trout, and bull trout in the following life stages: a) fry colonization; b) age-0 winter rearing, and; c) prespawn holding. Summer steelhead and westslope cutthroat trout survival will increase in the following life stages: a) spawning; b) fry colonization, and; c) age 0-2 juvenile rearing.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for summer steelhead and westslope cutthroat trout in the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-1 migrants (steelhead).

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices

Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 4 - Increasing key habitat quantity will increase survival for bull trout, westslope cutthroat trout, summer steelhead (lower Gold South Fork, Lower Libby Creek) in the following life stages: a) spawning, and; b) egg incubation. Spring Chinook survival will increase for the following life stages: a) spawning; b) egg incubation; c) fry colonization, and; d) age-0 summer rearing, particularly in reach Gold 4.

Objective 1 - Fill data gap by conducting formal habitat surveys in the lower reaches on private land that have not been surveyed.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options: See strategies for Hypotheses 2, 3, and 5.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5a - Increasing base flows will increase survival of spring Chinook and bull trout for the following life stages: a) prespawn holding, and; b) age-0 winter rearing. Summer steelhead survival will increase for all juvenile summer and winter rearing life stages.

Hypothesis 5b - Decreasing spring peak flows (to natural hydrograph levels) will increase survival for steelhead, spring Chinook, bull trout, and westslope cutthroat trout in the following life stages: a) fry colonization, and; b) juvenile active rearing.

Objective 1 - See objectives 1 and 2 of Hypothesis 2.

Objective 2 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 3 - Minimize negative impacts of irrigation water withdrawals.

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objective 1 of Hypothesis 1.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Increasing channel stability will increase survival of westslope cutthroat trout and summer steelhead in the following life stages: a) egg incubation, and; b) fry colonization.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options*:* See strategies for Hypotheses 2, 3, and 5.

Hypothesis 7 - Decreasing summer high temperatures will increase survival for spring Chinook and bull trout in the following life stages: a) spawning, and; b) egg incubation, particularly in lower Gold Creek.

Objective 1 - Reduce summer temperatures so that there are no days over 61^{o} F.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and roads using detention, treatment, and infiltration measures.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Winter temperature and icing studies

Survey diversions and culverts

Benthic invertebrate productivity

Fish habitat use (species- and life stage-specific, e.g. bull trout)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Impact of land use practices on riparian zone

Others from EDT

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Spatial and temporal thermal regime

Aquatic habitat surveys (including measurements of bed scour)

Assessment of current versus historical beaver abundance and distribution

Ongoing water quality monitoring

Implementation of monitoring and evaluation programs

Bull Trout:

Presence/absence studies in tributaries

Population, distribution, and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

Westslope Cutthroat Trout:

Population, distribution, and abundance

Exotic interaction

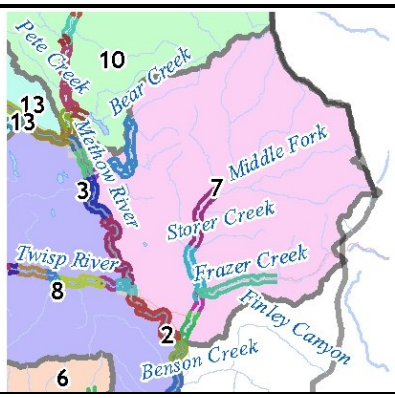
Fish use-activity and life stage

Genetics

Assessment Unit: M7—Beaver/Bear Creek

Reaches: 11

41	42	43	44	45	46	47	48	49	50	51



FOCAL species: Spring Chinook, coho, bull trout, and steelhead.

Drainage area: 71,400 acres (Beaver Creek)

SUBWATERSHEDS:

Frazer Creek, South Fork Beaver Creek, Middle Fork Beaver Creek, Lightning Creek, and Blue Buck Creek.

ASSESSMENT UNIT DESCRIPTION:

The Beaver Creek drainage runs northeast to southwest, encompassing about 71,400 acres. It drains into the Methow River east at RM 35.2 about 5 miles downstream of the town of Twisp (RM 40.0). Beaver Creek is 22.3 miles in length and includes the following tributaries: Frazer Creek, South Fork Beaver Creek, Middle Fork Beaver Creek Lightning Creek, and Blue Buck Creek. Water uses in the Beaver Creek drainage have been adjudicated, with water use exceeding water availability most years during late irrigation season (USFS 1997). In a 1998 fish passage barrier and screen safety inventory (Gower and Espie 1999), a total of 78 partial and full fish passage barriers, including both culverts and dams, were identified in the Beaver Creek drainage (Map Appendix C - inventory included Beaver Creek and all its tributaries). Of the 36 water diversions located, 20 gravity diversions and 6 pump diversions were unscreened.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Obstructions (flow diversions; culverts)

P-Sediment Load (high % fines and embeddedness on public lands [need to incorporate information from private property]; high turbidity during high flows; high road density, agriculture, and logging)

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD)

P-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals

P/S- Flow - secondary in upper reaches (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters (excluding Early Winters Creek)]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Survival for all life stages of Chinook, steelhead, and bull trout will increase by restoring proper passage conditions at human-made barriers.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for steelhead in the: a) spawning; b) egg incubation, and; c) fry colonization life stages.

Objective 1 - Minimize and/or avoid land use activities in areas susceptible to surface erosion and in riparian zones, to prevent accelerating the naturally occurring rate and delivery of sediment.

Objective 2 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 3 - Determine % fines and embeddedness through empirical studies.

Objective 4 - Reduce embeddedness to an average of 20% or less throughout the AU (or appropriate target based on Objective 3 of Hypothesis 2 throughout the AU).

Objective 5 - Reduce % fines to an average of 12% or less throughout the AU (or appropriate target based on Objective 3 of Hypothesis 2 throughout the AU).

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 3 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead and bull trout at all juvenile life stages.

Objective 1 - Protect key habitat and channel conditions by restoring and maintaining habitat processes directly affecting channels in the watershed.

Objective 2 - Protect healthy areas and restore degraded riparian zones to a more natural condition. Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat). Riparian

corridor provides adequate shade, LWD recruitment, habitat protection and connectivity.

Objective 3 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 4 - Increasing key habitat quantity will increase survival for steelhead and bull trout during the following life stages: a) prespawn holding; b) spawning, and; c) egg incubation.

Objective 1 - Fill data gap by conducting formal habitat surveys on private lands in lower Beaver Creek/Bear Creek drainages.

Objective 2 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options: See Strategies for Hypotheses 2, 3, and 5.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5 - Increasing summer base flows will increase the survival of summer steelhead and bull trout at all juvenile summer and winter rearing life stages.

Objective 1 - Ensure that base flows sufficiently support resident and anadromous fishes similar to an undisturbed watershed of similar size, geology and geography. Use common and professionally accepted methodologies and/or analytical tools to determine appropriate flow needs (timing, order and magnitude) and implementation strategies.

Objective 2 - See Objectives 1 and 2 of Hypothesis 3 (Habitat Diversity).

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies*:*

Strategy 1. See strategies for Objectives 1 and 2 of Hypothesis 3.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater, and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, and bull trout in the following life stages: a) fry colonization (spring Chinook, steelhead, and bull trout), and; b) rearing (spring Chinook, steelhead, and bull trout).

Objective 1 - See Objectives 1 and 2 of Hypothesis 3 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 2 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 6.

Protection and Restoration options: See strategies for Hypotheses 2 and 3.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 7 - Increasing channel stability will increase survival of summer steelhead and bull trout in the following life stages: a) egg incubation, and; b) fry colonization.

Objective 1 - See Objectives 1-5 of Hypothesis 2, Objectives 1-2 of Hypothesis 3, and Objective 1 of Hypothesis 5.

Objective 2 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 3 - Reduce bed scour to appropriate PFC (based on Objective 2 of Hypothesis 7)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 2, 3, and 5.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Aquatic habitat surveys (including bed scour)

Fish habitat use (species- and life stage-specific, e.g. bull trout)

Benthic invertebrate productivity

Others from EDT

Groundwater-surface water interactions

Include sediment information from OCD, implement in other areas

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Impact of land use practices on riparian zone

Survey diversions and culverts (some unknowns in Bear Creek; effectiveness monitoring for previous projects)

Winter temperature and icing studies

Assessment of current versus historical beaver abundance and distribution

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Implementation of monitoring and evaluation programs

Bull Trout:

Presence/absence studies in tributaries

Population, distribution and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

Westslope Cutthroat Trout:

Presence/absence studies in tributaries

Population, distribution and abundance

Exotic interaction

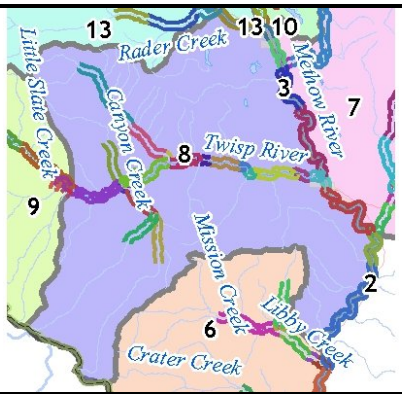
Fish use-activity and life stage

Genetics

Assessment Unit (AU): M8—Lower Twisp

Reaches: 27

54	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**
69	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**			



FOCAL species: Spring Chinook salmon, coho, bull trout, steelhead, westslope cutthroat trout, and cutthroat trout.

Drainage area: 157,114 acres (entire Twisp)

SUBWATERSHEDS:

Poorman, Newby, Little Bridge, Canyon, and Buttermilk

ASSESSMENT UNIT DESCRIPTION:

The capability of the lower 15 miles of the Twisp River to provide productive salmonid habitat has been substantially reduced (TAG 2000). This is the result of reduced LWD levels, road placement, dike placement, bank hardening, and conversion of riparian areas to agriculture and residential uses. In addition, from RM 4.0 to the mouth, the reduction of instream flows resulting from water diversions further reduces the quantity of rearing habitat and access to rearing habitat.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD

P-Temperature (warm temperatures limiting spawning and incubation [spring Chinook] in 3 lowest reaches (RM 0-4)

P-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD

P-Obstructions (MVID West canal diversion; culverts)

P-Sediment - below Buttermilk Ck., primarily for steelhead (high road densities in Little Bridge Creek, Poorman Creek, and Buttermilk Creek; fire regime

P-Key Habitat Quantity - primarily for spring Chinook (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals

S-Flow - impacts above and beyond natural condition (reduced low flow [water use, loss of riparian function]; hydroconfinement [channelization])

S-Food (reduced salmon carcasses)

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead at all juvenile life stages and spring Chinook at the following life stages: a) spawning; b)fry colonization; c) age-1 summer rearing, and; d) prespawn holding. Bull trout and westlope cutthroat trout survival will increase in all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Decreasing summer maximum temperatures will increase survival of spring Chinook during the following life stages: a) pre-spawn holding; b) spawning, and; c) egg incubation, and increase survival of summer steelhead during the following life stages: a) age-0,1, and; b) 2 active rearing. Bull trout survival will increase for rearing, spawning and migration. Westslope cutthroat trout survival will increase for rearing.

Objective 1 - No maximum daily temperatures over 64^{o}F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (< 57oF) are not realistic for the lower Twisp River mainstem and probably represent a condition that could not exist, even under pristine historical conditions.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Reserve Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and from roads, using detention, treatment, and infiltration measures.

Hypothesis 3 - Increasing channel stability will increase survival of summer steelhead and westslope cutthroat trout in the following life stages: a) egg incubation, and; b) fry colonization.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^{2} with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with "functioning at risk" (NMFS 1996); however, the properly functioning objectives (including "no valley bottom roads") are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 3)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 1, 2, and 5.

Hypothesis 4 - Survival for all life stages of Chinook, steelhead, westslope cutthroat trout, and bull trout will increase by restoring proper

DATA GAPS AND M&E NEEDS:

Winter temperature and icing studies

Fish habitat use (species- and life stage-specific, e.g. bull trout)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Others from EDT

Groundwater-surface water interactions

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Impact of land use practices on riparian zone

Survey diversions and culverts (some unknowns in Bear Creek; effectiveness monitoring for previous projects)

Long term temperature and flow monitoring throughout (including tributaries)

Channel migration zone study

Aquatic habitat surveys (periodic and ongoing)

Implementation of monitoring and evaluation programs

Bull Trout:

Presence/absence studies in tributaries

Population, distribution, and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

Westslope Cutthroat Trout:

Population, distribution, and abundance

Exotic interaction

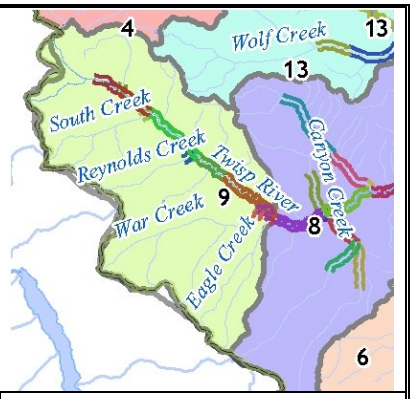
Fish use-activity and life stage

Genetics

Assessment Unit (AU): M9—Upper Twisp

Reaches: 27

54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
69	70	71	72	73	74	75	76	77	78	79	80			



FOCAL species: Spring, summer/fall Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 157,114 acres (entire Twisp)

SUBWATERSHEDS:

Poorman, Newby, Little Bridge, Canyon, Buttermilk, Eagle, War, Reynolds, South, and North Creeks.

ASSESSMENT UNIT DESCRIPTION:

This is a relatively pristine area that extends from the headwaters down to the Eagle Creek confluence. There is a stretch between Reynolds Creek and South Creek that naturally goes dry during below-average water years.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Obstructions (culverts in tributaries [generally only block small stretches before a natural barrier])

P-Habitat Diversity - mostly limited by naturally harsh conditions (reduced LWD [from historic logging]; reconnection of off-channel habitat [1 spot on War Creek only])

P-Key Habitat Quantity (reduction in quality pools; LWD)

Flow (natural low flow conditions)

Food (reduced salmon carcasses)

P-Sediment (steelhead)

Refer to Electronic Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1: Survival for all life stages of steelhead, westslope cutthroat trout, and bull trout will increase by restoring proper passage conditions at culverts.

Objective 1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Increasing (maintaining) habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer steelhead at all juvenile life stages. Bull trout and westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Protect key habitat and channel conditions by restoring and maintaining habitat processes directly affecting channels in the watershed.

Objective 1 - Protect healthy areas and restore degraded riparian zones to a more natural condition (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat). Riparian corridor provides adequate shade, LWD recruitment, habitat protection and connectivity.

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3: Increasing key habitat quantity will increase survival for steelhead during the following life stages: a) prespawn holding; b) spawning, and; c) egg incubation. Spring Chinook and bull trout survival will increase during the following life stages: a) prespawn holding; b) spawning; c) egg incubation; d) fry colonization, and; e) age-0 summer rearing. Westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options**:** See strategies for Hypotheses 2, 4, and 5.

Hypothesis 4: Increasing summer base flows will increase the survival of summer steelhead, bull trout, and spring Chinook at all juvenile summer and winter rearing life stages. Westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Ensure that base flows sufficiently support resident and anadromous fishes similar to an undisturbed watershed of similar size, geology and geography. Use common and professionally accepted methodologies and/or analytical tools to determine appropriate flow needs (timing, order and magnitude) and implementation strategies.

Objective 2 - See Objectives 1 and 2 of Hypothesis 1.

Protection strategies:

Strategy 1 - Maintain natural fire regime in this AU and upstream.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Restoration strategies:

Strategy 1 - Restore natural fire regime in this AU and upstream and actively recover intensely burned areas.

Strategy 2 - See strategies for Objective 1 of Hypothesis 1.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6. -Conserve and reuse water.

Hypothesis 5: Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for steelhead in the following life stages: a) spawning; b) egg incubation, and; c) fry colonization life stages. Westslope cutthroat trout survival will increase for all life stages.

Objective 1 - Minimize and/or avoid land use activities in areas susceptible to surface erosion and in riparian zones, to prevent accelerating the naturally occurring rate and delivery of sediment.

Objective 2 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 3 - Determine % fines and embeddedness through empirical studies.

Objective 4 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 5 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Strategy 2 - Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 7 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Hypothesis 6 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) fry colonization, and; b) rearing.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 5 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 6.

Protection and Restoration options: See strategies for Hypotheses 2 and 5.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 7 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Winter temperature and icing studies

Benthic invertebrate productivity

Others from EDT

Aquatic habitat surveys (periodic and ongoing, include bed scour)

Fish habitat use (species- and life-stage specific, e.g. long term monitoring of species assemblage)

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Long term monitoring of temperatures and flow

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Bull Trout:

Presence/absence studies in tributaries

Population, distribution, and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

Westslope Cutthroat Trout:

Population, distribution, and abundance

Exotic interaction

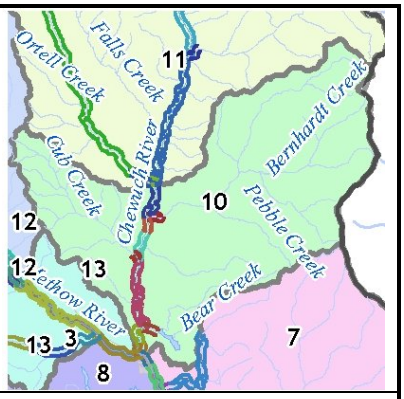
Fish use-activity and life stage

Genetics

Assessment Unit (AU): M10—Lower Chewuch

Reaches: 11

106	**107**	**108**	**109**	**110**	**111**	**112**
113	**114**	**115**	**116**			



FOCAL species: Spring Chinook salmon, coho, bull trout, steelhead, westslope cutthroat trout, and cutthroat.

Drainage area: 340,000 acres (entire Chewuch)

SUBWATERSHEDS:

Pearrygin Lake Creek, Cub Creek, Boulder Creek

ASSESSMENT UNIT DESCRIPTION:

The Chewuch River subwatershed contains approximately 340,000 acres (USFS 2000c), is oriented north-to-south, and drains into the Methow River at the town of Winthrop (RM 50.0). The Chewuch River is 44.8 miles in length from its headwaters to the mouth.

Tributaries include Cub Creek, Boulder Creek, Eightmile Creek, Falls Creek, Lake Creek, Andrews Creek, Twentymile Creek, Thirtymile Creek, and Dog Creek. Upper natural falls barriers have been mapped on all these tributaries. All other tributaries to the Chewuch River also have natural upstream migration barriers (either falls or steep gradients) reflecting the geological formation of the mainstem Chewuch valley, a U-shaped trough with side slopes often in excess of 60-70%.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD

P-Sediment Load - limiting across all life stages (high % fines and embeddedness; high turbidity during high flows)

P-Temperature - spring Chinook spawning (high summer temperatures)

P-Obstructions (flow diversions [Chewuch]; culverts [in bull trout reaches of Cub and Little Boulder])

S/P-Key Habitat Quantity - for steelhead and bull trout in Cub Creek (reduction in quality pools, LWD; loss of riparian vegetation

reduced stream width because of water withdrawals)

S-Flow (reduced low flow [water use, increased peak flow, loss of riparian function]; increased peak flows [from fire activity in headwaters, road density]; hydroconfinement [channelization and accelerated erosion])

S-Food (reduced benthic productivity; reduced salmon carcasses)

S-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook and summer steelhead in almost all life stages. Bull trout and westslope cutthroat trout survival will be increased in all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for spring Chinook during the following life stages: a) prespawn migration; b) adult holding; c) spawning; d) incubation, and; e) 0-age active rearing, and for summer steelhead, bull trout, and westslope cutthroat trout in almost all life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 3a - Decreasing summer maximum temperatures will increase survival of summer steelhead, bull trout, and westslope cutthroat trout during the following life stages: a) age-0 active rearing, and; b) age-1 active rearing, and for spring Chinook during the following life stages: a) pre-spawn holding; b) spawning; c) incubation, and d) age-0 active rearing.

Objective 1 - No maximum daily temperatures over 61^{o} F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (< 57oF) are not realistic for the lower Chewuch River and may represent a condition that could not exist, even under pristine historical conditions.

Hypothesis 3b - Restoring hyporheic function will decrease negative effects of winter low temperatures for steelhead, bull trout, and westslope cutthroat trout spawning and rearing, and for spring Chinook rearing.

Objective 1 - No anchor ice and less than 15 days per month under 34°F.

Objective 2 - See Objective 1 of Hypothesis 1.

Protection Strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 4 - Survival for all life stages of Chinook, steelhead, westslope cutthroat trout, and bull trout will increase by restoring proper passage conditions at human-made barriers.

Objective 1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 5 - Increasing “key habitat quantity” will increase the survival of spring Chinook during the following life stages: a) prespawn holding; b) spawning; c) egg incubation; d) fry colonization; e) 0-age active rearing; f) 0-age inactive rearing; and; g) 1-age active rearing, and during the following life stages for steelhead: a) prespawn holding; b) spawning, and c) egg incubation. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - Achieve a pool frequency of 18/mile (NMFS 1996), with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options: See strategies for Hypotheses 1, 2, and 7.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 6 - Improved channel stability will increase survival of spring chinook egg incubation, fry colonization, and 0-age active rearing, and 0-age inactive rearing; and summer steelhead egg incubation, fry colonization, 0-age active rearing, 0,1-age inactive rearing and 1-age active rearing. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 2 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with “functioning at risk” (NMFS 1996); however, the properly functioning objectives (including “no valley bottom roads”) are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 1, 5, and 7.

Hypothesis 7: Increasing summer base flows and decrease in spring peak flows will increase survival of summer steelhead during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing; d) 1-age active rearing, and; e) 2+ age active rearing, and for spring Chinook during the following life stages: a) prespawn holding; b) fry colonization; c) 0-age active

rearing, and; d) 0-age inactive rearing. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objective 3 of Hypothesis 6 (Minimum Road Density).

Objective 3 - Minimize negative impact of water withdrawals.

Protection Strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objectives 1 and 2 of Hypothesis 1, and Objective 3 of Hypothesis 6.

Strategy 2 - Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Manage stormwater and reduce the extent of impervious surfaces.

Strategy 5 - Implement BMPs for water use.

Strategy 6 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 8 - Increasing forage will increase the survival of spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing, and c) 0-age inactive rearing, and for steelhead during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing, and; d) age-1 active rearing. Bull trout and westslope cutthroat trout survival will increase in all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 1 (Habitat Diversity).

Objective 2 - See Objectives 1-5 of Hypothesis 2 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 8.

Protection and Restoration options: See strategies for Hypotheses 1 and 2.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 9 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Winter temperature and icing studies

Channel migration zone study

Aquatic habitat surveys (Including bed scour)

Fish habitat use (species- and life-stage specific, e.g. bull trout)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Others from EDT

Groundwater-surface water interactions

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Continue summer and implement winter temperature/icing monitoring

Impact of land use practices on riparian zone

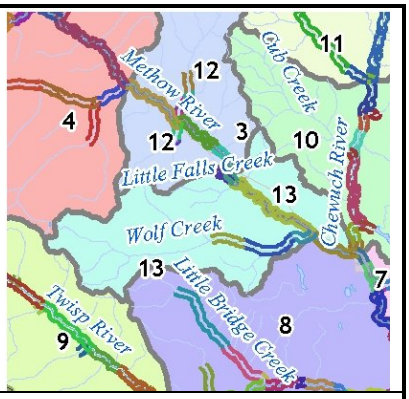
Survey culverts (in Cub and Little Boulder)

Assessment of current versus historical beaver abundance and distribution
Implementation of monitoring and evaluation programs
Bull Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Presence/absence studies in tributaries
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics

Assessment Unit (AU): M13—Wolf/Hancock Cr.

Reaches: 5

145	146	147	148	150



FOCAL species: Spring Chinook salmon, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 25,800 acres -Wolf Creek

SUBWATERSHEDS:

Little Wolf Creek, North Fork Wolf Creek, South Fork Wolf Creek, and Hubbard Creek

ASSESSMENT UNIT DESCRIPTION:

The Wolf Creek drainage runs east to west, encompasses about 25,800 acres, and ranges in elevation from 8,897 feet (Gardner Mountain is the highest point in Okanogan County) in its headwaters to near 2,000 feet at its mouth. It drains into the Methow River from the south at RM 52.8, about 3 miles upstream of the Town of Winthrop (RM 50.0). Wolf Creek is 14 miles in length. Its named tributaries are Little Wolf Creek, North Fork Wolf Creek, South Fork Wolf Creek, and Hubbard Creek. The upper portion of the drainage is confined in a steep valley until it opens up on to an alluvial fan 1.5 miles upstream from the confluence with the Methow river. The portion of Wolf Creek that runs through the alluvial fan has been channelized.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (IN PRIORITY FROM EDT ANALYSIS):

P-Obstructions (WCRD diversion dam)

P-Habitat Diversity (loss of riparian vegetation; lack of LWD)

P-Sediment (mostly natural in Wolf Creek, very low road density; land use practices [Hancock Creek[)

P-Key Habitat Quantity - lower 4 miles Wolf Creek and Hancock Creek (reduction in quality pools, LWD; loss of riparian vegetation [lower mile])

S-Flow - only an issue on Wolf Creek from the mouth to the diversion at RM 0-4.3 (low flow problem made worse by natural losing reach on the alluvial fan; loss of riparian function; hydroconfinement [channelization])

S-Channel Stability (loss of connection to the floodplain via roads and riprap [lower 800 feet]; loss of riparian vegetation; lack of LWD)

S-Food (reduced salmon carcasses)

S-Temperature (EDT identified moderate impacts to spring Chinook in lower reach but it did not exceed 61° F in 1999.

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Improving adult and juvenile passage over Wolf Creek Irrigation Diversion at RM 4.0 will increase survival of steelhead, westslope cutthroat trout, and bull trout for the following life stages: a) spawning (steelhead and bull trout); b) rearing (steelhead and bull trout); c) holding (steelhead and bull trout), and d) migration (westslope cutthroat trout).

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring, and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide

adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 2 - Increasing habitat diversity (riparian function, LWD, man-made confinement will increase survival of spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) spawning (spring Chinook); b) egg incubation (spring Chinook); c) fry colonization (spring Chinook), and; d) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3: Decreasing sediment load (turbidity, % fines, and embeddedness) will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout during the following life stages: a) spawning (spring Chinook, westslope cutthroat trout, steelhead and bull trout); b) egg incubation (Spring Chinook, westslope cutthroat trout, steelhead and bull trout); c) fry colonization (spring Chinook, westslope cutthroat trout, steelhead, and bull trout); d) rearing (spring Chinook, westslope cutthroat trout, steelhead, and bull trout), and; e) migration (spring Chinook, westslope cutthroat trout, steelhead, and bull trout).

Objective 1 - Reduce turbidity to a SEV index <7.5, (sub-lethal impacts, minimal behavior modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 15% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 11% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 4 - Increasing key habitat quantity (number of quality pools and improved riparian vegetation) will increase the survival of steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) spawning (spring Chinook, westslope cutthroat trout, steelhead and bull trout); b) egg incubation (spring Chinook, westslope cutthroat trout, steelhead and bull trout), and; c) rearing (spring Chinook, westslope cutthroat trout, steelhead and bull trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Protection and Restoration options: See Strategies for Hypotheses 2, 3, and 5.

Strategy 1. Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 5 - Improving flow conditions in the lower 4 miles of Wolf Creek will increase the survival of spring Chinook, steelhead and bull trout in the following life stages: a) spawning (bull trout); b) egg incubation (bull trout); c) fry colonization (Spring Chinook, steelhead and bull trout),; d) rearing (spring Chinook, steelhead and bull trout); and e) migration.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reduce hydroconfinement in the lower 800 feet of Wolf Creek by 50%, and provide connectivity to the floodplain.

Objective 3 - Decrease negative impacts of water withdrawals.

Protection strategies:

Strategy 1 - Establish flows in priority rivers and streams through a comprehensive instream flow study.

Strategy 2 - Protect and maintain established instream flows by monitoring water use and enforcing laws and regulations.

Strategy 3 - Administer groundwater and surface water right permits and changes consistent with the established instream flow.

Strategy 4 - Protect groundwater recharge areas from impacts of land development by designating and protecting critical areas.

Strategy 5 - Maintain natural fire regime in this AU and upstream.

Restoration strategies:

Strategy 1 - See strategies for Objectives 1 and 2 of Hypothesis 2.

Strategy 2 – Conserve and reuse water.

Strategy 3 - Promote water storage and innovative ways to recharge groundwater.

Strategy 4 - Implement BMPs for water use.

Strategy 5 - Restore natural fire regime in this AU and upstream, and actively recover intensely burned areas.

Hypothesis 6 - Increasing channel stability will increase survival for spring Chinook, steelhead, westslope cutthroat trout, and bull trout in the following life stages: a) egg incubation (spring Chinook, westslope cutthroat trout, steelhead, and bull trout); b) fry colonization (spring Chinook, westslope cutthroat trout, steelhead, and bull trout), and c) rearing (Spring Chinook, westslope cutthroat trout, steelhead, and bull trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Objective 3 - Achieve properly functioning pool frequency of 18 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and posses good cover (NMFS 1996).

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival

implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 2, 3, and 5.

Hypothesis 7: Increasing food availability within the AU will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) fry colonization (steelhead, bull trout and westslope cutthroat trout), and; b) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - See Objectives 1 and 2 of Hypothesis 2 (Habitat Diversity).

Objective 2 - See Objectives 1-4 of Hypothesis 3 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 7.

Protection and Restoration options: See strategies for Hypotheses 1 and 3.

Strategy 1. Restore nutrients through salmon carcass or analog distribution.

Hypothesis 8 - Decreasing instream summer temperature in the lower 1 mile of Wolf Creek will increase survival for spring Chinook in the following life stages: a) spawning; b) egg incubation, and; c) rearing. This will increase survival for bull trout in the following life stages: a) migration, and b) holding.

Objective 1 - Reduce summer temperatures so that there are no days over 61^{o} F.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and roads using detention, treatment, and infiltration measures.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. Note: For measurable objectives and strategies, see sections of this report regarding artificial supplementation and species-specific biological objectives.

DATA GAPS AND M&E NEEDS

Aquatic habitat surveys (Including bed scour)

Fish habitat use (species- and life stage-specific)

Channel migration zone study

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Winter temperature and icing studies

Others from EDT

Assessment of current versus historical beaver abundance and distribution

Implementation of monitoring and evaluation programs

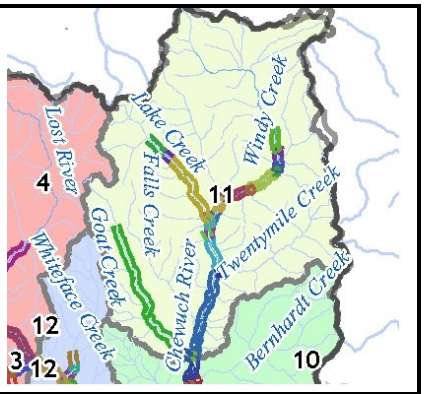
Bull Trout:

Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage
Genetics
Westslope Cutthroat Trout:
Population, distribution, and abundance
Exotic interaction
Fish use-activity and life stage

Assessment Unit (AU): M 11—Upper Chewuch

Reaches: 26

117	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**
130	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**	**142**



FOCAL species: Spring Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead.

Drainage area: 340,000acres (entire Chewuch)

SUBWATERSHEDS:

Eightmile Creek, Falls Creek, Lake Creek, Andrews Creek, Twentymile Creek, Thirtymile Creek, Dog Creek, and Dodd Creek

ASSESSMENT UNIT DESCRIPTION:

The Upper Chewuch AU begins at the headwaters and ends at Eightmile Creek (RM12). The Chewuch River subwatershed contains approximately 340,000 acres (USFS 2000c), is oriented north to south, and drains into the Methow River at the town of Winthrop (RM 50.0). The Chewuch River is 44.8 miles in length from its headwaters to the mouth. All other tributaries to the Chewuch River have natural upstream migration barriers (either falls or steep gradients) reflecting the geological formation of the mainstem Chewuch valley, a U-shaped trough with side slopes often in excess of 60-70%.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (IN PRIORITY FROM EDT ANALYSIS):

P-Sediment Load - limiting across all life stages (high % fines and embeddedness on public lands; high turbidity during high flows)

P-Habitat Diversity (loss of connection to the floodplain via roads, riprap, and dikes; reduced beaver activity; loss of riparian vegetation; lack of LWD)

P-Key Habitat Quantity (reduction in quality pools, LWD; loss of riparian vegetation; reduced stream width because of water withdrawals)

S-Obstructions (flow diversions; road confinement velocity barrier in Eightmile Creek; culverts [in bull trout reaches of tributaries])

S-Temperature - only from Eightmile to Twentymile Creek; spring Chinook spawning and incubation

S-Channel Stability (loss of connection to the floodplain via roads and riprap; loss of riparian vegetation; lack of LWD; increased peak flows; increased flashy flows)

S-Food (reduced benthic productivity; reduced salmon carcasses)

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Decreasing sediment load (turbidity, % fines, embeddedness) will increase survival for spring Chinook during the following life stages: a) prespawn holding; b) prespawn migration; c) spawning; d) fry colonization, and; 0-age active rearing, and for summer steelhead during the following life stages: a) prespawn migrant; b) spawning; c) fry colonization; d) 0-age active rearing; e) 1-age migrant, and; f) 1-age active rearing. Bull trout and westslope cutthroat trout survival will increase at all life stages.

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 20% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 12% or less throughout the AU.

Protection strategies:

Strategy 1 - Implement BMPs for development, road construction, logging, and intensive farming in riparian and upland areas that have a high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2 - Minimize total road density within the watershed, and provide adequate drainage control for new roads.

Strategy 3 - Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4 - Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5 - Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 7 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Hypothesis 2 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook during the following life stages: a) prespawn holding; b) prespawn migrant; c) spawning; d) fry colonization; e) 0-age active rearing; f) 0-age migrant; g) 0-age inactive; h) 1-age active rearing, and; i) 1-age migrant, and for summer steelhead during the following life stages: a) spawning; b) fry colonization; c) 0-age active rearing; d) 0,1-age inactive rearing; e) 1-age migrant; f) 1-age active rearing; g) 2+-age active rearing, and h)2+-age migrant. Bull trout and westslope cutthroat trout survival will increase at all life stages.

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential (applicable in area from Eightmile Creek to Andrews Creek). This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 3 - Increasing "key habitat quantity" will increase the survival of spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0-age inactive rearing; d) 1-age active rearing; e) spawning; f) egg incubation, and; prespawn holding. Bull trout and westslope cutthroat trout survival will increase at all life stages.

Objective 1 - Achieve a pool frequency of 18/mile. (NMFS 1996) with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Protection and Restoration options**:** See strategies for Hypotheses 1 and 2.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 4: Survival for all life stages of Chinook, westslope cutthroat trout, steelhead, and bull trout will increase by restoring proper passage conditions at human-made barriers.

Objective 1 - Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring, and evaluation) are permissible.

Protection strategies:

Strategy 1 - Prevent new passage problems by restricting the placement of new roads or other possible fish barriers, and provide adequate mitigation for unavoidable impacts.

Strategy 2 - Design and construct road culverts consistent with standards and guidelines.

Strategy 3 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4 - Education, outreach, and enforcement of current and future regulations.

Restoration strategies:

Strategy 1 - Remove, replace, or modify diversion dams, culverts, or other structures affecting fish passage and habitat connectivity.

Hypothesis 5 - Decreasing summer maximum temperatures will increase survival of summer steelhead during the following life stages: a) spawning; b) egg incubation; c) fry colonization; d) age-0 active rearing, and; e) age-1active rearing, and for spring Chinook during the following life stages: a) pre-spawn holding; b) spawning; c) incubation, and; d) age-0 active rearing. Bull trout survival will increase for migration and rearing.

Objective 5-1: No maximum daily temperatures over 61^{o}F. Note: This objective does not meet the criteria for PFC (NMFS 1996); however, the guidelines for PFC (< 57^{o}F) are not realistic for the lower Chewuch River, and may represent a condition that could not exist, even under pristine historical conditions.

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Implement Forest Practices Regulations.

Strategy 3 - Implement Total Maximum Daily Loads (TMDLs) that address temperature.

Strategy 4 - Use incentives and technical assistance, such as the Conservation Enhancement Program (CREP), to implement BMPss.

Strategy 5 - Implement education and enforcement programs.

Restoration strategies:

Strategy 1 - Restore geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels; all create hydraulic gradients and, therefore, facilitate hyporheic flow.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 4 - Manage stormwater runoff from existing and new development and roads using detention, treatment, and infiltration measures.

Hypothesis 6 - Improved channel stability will increase survival of spring Chinook during the following life stages: a) egg incubation; b) fry colonization; c) age-0,1; d) age-0; e) 1 inactive rearing, and for summer steelhead during the following life stages: a) egg incubation; b) fry colonization; c) 0-age active rearing; d) 0,1-age inactive rearing, and; e) 1-age active rearing. Bull trout survival will increase at all life stages.

Objective 1 - See Objectives 1-4 of Hypothesis 1, and Objectives 1 and 2 of Hypothesis 2.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 3 - Maintain road densities less than 3 miles/mile^{2} with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with "functioning at risk" (NMFS 1996); however, the properly functioning objectives (including "no valley bottom roads") are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 1 and 2.

Hypothesis 7: Increasing forage will increase the survival of spring Chinook during the following life stages: a) fry colonization; b) 0-age active rearing, and; c) 0-age inactive rearing, and for steelhead during the following life stages: a) fry colonization; b) 0-age active rearing; c) 0,1-age inactive rearing, and; d) age-1 active rearing. Bull trout will increase at all life stages.

Objective 1 - See Objectives 1 and 2 of Hypothesis 2 (Habitat Diversity).

Objective 2 - See Objectives 1-5 of Hypothesis 1 (Sediment Load).

Objective 3 - Conduct productivity analysis (invertebrate sampling and organic/inorganic constituent sampling/analysis), and determine appropriate nutrient supplementation program.

Objective 4 - Supplement nutrients as needed and determined from Objective 3 of Hypothesis 7.

Protection and Restoration options*:* See strategies for Hypotheses 1 and 2.

Strategy 1 - Restore nutrients through salmon carcass or analog distribution.

Hypothesis 8 - Artificial production (supplementation) will increase fish population numbers to: partially mitigate for habitat deficiencies; provide harvestable surplus for recreation, ceremonial and subsistence fisheries for tribal members; and aid in salmon and steelhead recovery efforts.

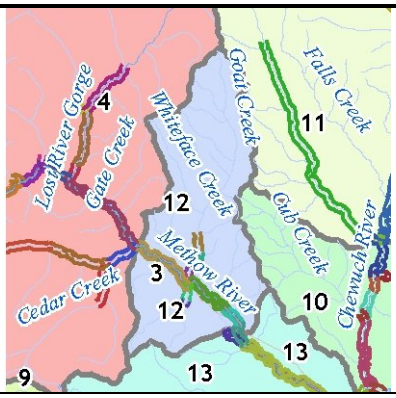
Objective 1 - Implement artificial production/supplementation consistent with approved and future Hatchery Genetic Management Plans, Habitat Conservation Plans, and Section 10 permits. For measurable objectives and strategies, see sections of this report regarding artificial supplementation

and species-specific biological objectives.
DATA GAPS AND M&E NEEDS: Winter temperature and icing studies Aquatic habitat surveys (including bed scour) Fish habitat use (species- and life-stage specific, e.g. bull trout) Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics) Benthic invertebrate productivity Others from EDT Sediment budget and delivery study (understand background levels and impacts of past and current land use practices) Continue summer and implement winter temperature/icing monitoring Impact of land use practices on riparian zone Survey culverts (tributaries) Evaluation of past habitat improvement projects (PWI engineered log jams) Assessment of current versus historical beaver abundance and distribution Implementation of monitoring and evaluation programs Bull Trout: Presence/absence studies in tributaries Population, distribution, and abundance Exotic interaction Fish use-activity and life stage Genetics Westslope Cutthroat Trout: Presence/absence studies in tributaries Population, distribution, and abundance Exotic interaction Fish use-activity and life stage

Assessment Unit: M 12—Goat Creek/Little Boulder

Reaches: 8

154	155	156	157	158	159	161	162



FOCAL species: Spring Chinook salmon, coho, bull trout, westslope cutthroat trout, and steelhead

Drainage area: 22,200 acres -Goat Creek

SUBWATERSHEDS:

Montana Creek, Whiteface Creek, Long Creek, Short Creek, Roundup Creek and Cougar Creek

ASSESSMENT UNIT DESCRIPTION:

The Goat Creek drainage runs north to south, contains about 22,200 acres, and ranges in elevation from 8,000 feet in its headwaters to 2,100 feet at its mouth. Goat Creek drains into the Methow River from the north at RM 64, about one mile downstream of the Town of Mazama. Goat Creek is 12.5 miles in length with nine named tributaries that include Montana Creek, Whiteface Creek, Long Creek, Short Creek, Roundup Creek and Cougar Creek. The upper third of the stream course has a moderate gradient and flows through a U-shaped valley that begins in alpine meadows and avalanche paths. The middle six miles flow through a high gradient inner gorge before the valley opens up into an alluvial fan in which the stream drops large amounts of bedload. In the 1970s, the lower 1.5 miles of Goat Creek were channelized. The maximum average annual precipitation is 35-40 inches in the northern part of the watershed, and lessens to a low of 15-20 inches at the mouth of Goat Creek.

LEVEL OF CERTAINTY:

Use EDT level of proof table in Appendix F

FACTORS LIMITING PRODUCTION (IN PRIORITY FROM EDT ANALYSIS):

P-Habitat Diversity - mostly on the alluvial fan and near Vander pool (loss of riparian vegetation; lack of LWD; loss of connection to the floodplain)

P-Sediment (road density, grazing, historic mining [near Montana Creek], bank erosion)

P-Key Habitat Quantity - for spawning and incubation of steelhead in Little Boulder and in the gorge in Goat Creek (reduction in quality pools, LWD; loss of riparian vegetation [lower mile])

S-Channel Stability (loss of connection to the floodplain; loss of riparian vegetation; lack of LWD)

S-Food - consistent low to moderate impact to age-0 and age-1 steelhead (reduced salmon carcasses)

Refer to Appendix G for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) spawning (steelhead, bull trout and westslope cutthroat trout); b) egg incubation (bull trout); c) fry colonization (steelhead, and bull trout), and; d) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Reach or exceed 20 pieces/mile (12” diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Protection strategies:

Strategy 1 - Conserve and protect riparian areas and buffer zones.

Strategy 2 - Prevent the placement of structures that may confine or restrict side channels and disconnect habitat in floodplains and

estuaries.

Strategy 3 - Establish salmon-friendly land use patterns and design standards.

Strategy 4 - Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Restoration strategies:

Strategy 1 - Restore and reconnect wetlands, floodplains, side-channels, and other off-channel habitat.

Strategy 2 - Replant degraded riparian zones by reestablishing native vegetation and natural wood recruitment processes.

Strategy 3 - Add large woody debris and place in-channel engineered log jams.

Strategy 4 - Install and maintain fencing or fish-friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Hypothesis 2 - Decreasing sediment load (turbidity, % fines, and embeddedness) will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) spawning (steelhead, bull trout and westslope cutthroat trout); b) egg incubation (bull trout); c) fry colonization (steelhead, and bull trout); d) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout), and; e) migration (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - Reduce turbidity to a SEV index < 7.5. (sublethal impacts, minimal behavioral modification).

Objective 2 - Determine % fines and embeddedness through empirical studies.

Objective 3 - Reduce embeddedness to an average of 15% or less throughout the AU.

Objective 4 - Reduce % fines to an average of 11% or less throughout the AU.

Objective 5 - Decrease road density levels to less than 2 miles/mile^2, and eliminate roads within the valley bottom.

Protection strategies:

Strategy 1. Implement BMPs for development, road construction, logging and intensive farming in riparian areas and upland areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 2. Minimize total road density within the watershed and provide adequate drainage control for new roads.

Strategy 3. Protect sensitive areas, such as unstable slopes and riparian zones.

Strategy 4. Maintain and upgrade culverts and other drainage structures to prevent failure events.

Strategy 5. Establish and maintain natural fire regime.

Restoration strategies:

Strategy 1 - Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 2. -Remove, reconstruct, or upgrade roads that are non-essential or vulnerable to failure due to design or location.

Strategy 3 - Implement road maintenance and abandonment or decommissioning plans approved under Forest Practices Regulations.

Strategy 4 - Upgrade stream crossings, culverts and road drainage systems.

Strategy 5 - Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 6 - Construct detention and infiltration ponds to capture runoff from roads, development, farms, and irrigation return flows.

Strategy 7 - Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 8 - Restore natural fire regime and restore vegetative cover following forest fires to minimize erosion and slope failure.

Hypothesis 3 - Increasing key habitat quantity (increase number of quality pools and improve riparian vegetation) will increase the survival of steelhead and bull trout in the following life stages: a) spawning (steelhead and bull trout); b) egg incubation (steelhead and bull trout), and; c) rearing (spring Chinook and bull trout).

Objective 1 - Achieve a pool frequency of 18/mile (NMFS 1996, with high quality pools containing good cover and non-embedded pool tailouts for spawning.

Objective 2 - See Objectives 1 and 2 of Hypothesis 1.

Objective 3 - See Objectives 1-5 of Hypothesis 2.

Protection and Restoration options: See Strategies for Hypotheses 1 and 2.

Strategy 1 - Create or redesign pools, spawning habitat, and other limiting key habitat types for temporary mitigation until long-term channel formation processes can take effect.

Hypothesis 4 - Increasing channel stability will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat

trout in the following life stages: a) egg incubation (steelhead, bull trout and westslope cutthroat trout); b) fry colonization (steelhead, bull trout and westslope cutthroat trout), and; c) rearing (Spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - See Objectives 1 and 2 of Hypothesis 1.

Objective 2 - Achieve less than 10% eroding slopes.

Objective 2 - Maintain road densities less than 3 miles/mile^2 with minimal impact of valley bottom roads. Note: The goal of this objective is to reduce flashy flows and increased peak flows that contribute to decreased channel stability; objective applies to areas upstream of this AU. This objective is consistent with "functioning at risk" (NMFS 1996); however, the properly functioning objectives (including "no valley bottom roads") are not feasible.

Objective 4 - Determine current levels of bed scour and appropriate PFC value for reaches in this AU.

Objective 5 - Reduce bed scour to appropriate PFC (based on Objective 4 of Hypothesis 6)[current assumption: major survival implications in EDT when greater than 5.5 inches (EDT score =2)].

Protection and Restoration options: See strategies for Hypotheses 1 and 2.

Hypothesis 5 - Increasing food availability within the AU will increase survival for spring Chinook, steelhead, bull trout and westslope cutthroat trout in the following life stages: a) fry colonization (steelhead, bull trout and westslope cutthroat trout), and; b) rearing (spring Chinook, steelhead, bull trout and westslope cutthroat trout).

Objective 1 - Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation and connectivity to the floodplain/off-channel habitat).

Objective 2 - Achieve properly functioning pool frequency of 70 pools/mile. Additionally, increase pool quality to 75% of pool exceed 1 meter in depth and possess good cover (NMFS 1996).

Objective 3 - Reach or exceed 20 pieces/mile (12" diameter and 35 feet long) LWD with adequate recruitment potential. This represents properly functioning condition for LWD in Eastern Washington (Bjornn and Reiser 1995).

Objective 4 - Reduce embeddedness to an average of 15% or less throughout the AU.

Objective 5 - Reduce % fines to an average of 11% or less throughout the AU.

DATA GAPS AND M&E NEEDS (not necessarily in priority order):

Aquatic habitat surveys (Little Boulder)

Determine bed scour

Fish habitat use (species- and life stage-specific; e.g. abundance and distribution of bull trout, temporal use by juvenile spring Chinook)

Hatchery-Wild fish interactions (predation, competition, pathogens, productivity, introgression, exotics)

Benthic invertebrate productivity

Sediment budget and delivery study (understand background levels and impacts of past and current land use practices)

Winter temperature and icing studies

Others from EDT

Implementation of monitoring and evaluation programs

Assessment of current versus historical beaver abundance and distribution

Bull Trout:

Presence/absence studies

Population, distribution, and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

Westslope Cutthroat Trout

Presence/absence studies

Population, distribution, and abundance

Exotic interaction

Fish use-activity and life stage

Genetics

5.6 Biological Objectives

The following summary of biological objectives, by species of fish and wildlife, is provided to guide development of recovery and management plans that will involve listed species, as well as other species and habitats of management importance.

5.7 Fish Species Objectives and Strategies

5.7.1 Spring Chinook

Goal: Run size and spawning escapement level that provides for the recovery of ESA-listed upper Columbia spring Chinook salmon in the Methow subbasin, effectively mitigates for hydrosystem losses and supports a harvestable surplus.

Objective 1: Determine natural smolt production capabilities within the Methow subbasin by 2013.

Strategy 1. Determine adult-to-adult and smolt-to-adult return rates, and quantify spawner success rates for naturally produced and hatchery-produced fish.

Strategy 2. Operate a smolt trap in the lower Methow River, and at least one tributary to the Methow River, to monitor migration pattern, timing, as well as to determine smolt production.

Strategy 3. Design and implement an overwinter ecology study to examine use and survival of stream-type fish through the winter.

Strategy 4. Locate or create a genetic mark on fish within the hatchery that can be located in progeny after adult return and spawning in order to quantify productivity.

Strategy 5. Design and implement shared monitoring and evaluation goals and objectives specific to upper Columbia River spring Chinook natural and artificial production elements.

Strategy 6. Determine egg-smolt survival for naturally spawning fish.

Objective 2: Determine and quantify natural and artificial limitations to natural production by 2013.

Strategy 1. Design and implement a study to quantify use and survival of stream-type fish through the summer and winter months of their first year.

Strategy 2. Conduct annual spawning ground surveys.

Strategy 3. Determine fry production, parr production, and spring smolt production, and correlate to spawner abundance and human and natural changes over time.

Strategy 4. Characterize the habitat utilization through a series of years and abundance trends.

Strategy 5. Develop and implement shared monitoring and evaluation goals and objectives specific to upper Columbia River spring Chinook natural and artificial production elements.

Objective 3: Achieve a natural cohort replacement rate of one or greater and a minimum of 2,000 naturally produced spawners for at least eight consecutive years (NOAA Fisheries interim recovery abundance and productivity targets).

Strategy 1. Maintain artificial production programs identified in ESA Section 10 Permits #1196 and 1300.

Strategy 2. Use locally adapted stocks in supplementation programs.

Strategy 3. Eliminate exogenous stocks from the artificial production programs.

Strategy 4. Manage consumptive fisheries consistent with adult escapement objectives.

Strategy 5. Increase and require spring flow augmentation.

Strategy 6. Reduce predatory consumption of smolts during seaward migration.

Strategy 7. Enlarge existing hatchery facilities, and construct additional facilities to increase effectiveness, not through quantity, but through quality of the hatchery programs to supplement the natural production.

Strategy 8. Improve smolt bypass systems at mainstem hydropower facilities.

Strategy 9. Design and implement shared monitoring and evaluation goals and objectives specific to upper Columbia River spring Chinook natural and artificial production elements.

Strategy 10. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 11. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 4: Maintain artificial production programs to supplement naturally spawning populations using locally adapted brood fish to meet recovery, conservation and harvest needs, while mitigating for fish losses from the Columbia River hydropower system.

Strategy 1. Use locally adapted stocks only.

Strategy 2. Implement supplementation programs identified in the mid-Columbia River HCPs and ESA Section 10 Permits #1196 and #1300.

Strategy 3. Use natural rear to determine if a better smolt (smolt-to-adult survival) can be produced from competition, predator avoidance, temperature, flow, and cover than from a traditional production facility.

Strategy 4. Quantify naturally produced spawners with CWT marked spawners.

Strategy 5. Maintain distinct population attributes of the Methow subbasin.

Strategy 6. Develop or improve tributary adult collection facilities so all brood stock requirements are met from these locations.

Strategy 7. Eliminate exogenous stocks from Methow subbasin.

Strategy 8. Increase and require spring flow augmentation.

Strategy 9. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 10. Develop, implement, manage and monitor consumptive fisheries consistent with adult escapement objectives (i.e, limit proportion of hatchery fish on the spawning grounds in years of excess spawn escapement).

Strategy 11. Perform annual spawning ground surveys.

Strategy 12. Collect DNA or genetic tissue from adult spawners within the hatchery and on the spawning ground to ensure artificial production is not altering the genetic composition of the populations.

Strategy 13. Design and implement shared monitoring and evaluation goals objectives and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

Strategy 14. Develop new and modify existing acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (Upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost rivers).

Strategy 15. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 5: Maintain the genetic diversity/ integrity and population structure of the locally adapted stocks (natural and artificially propagated stocks), consistent with VSP criteria developed through the TRT for recovery planning.

Strategy 1. Eliminate exogenous stocks.

Strategy 2. Improve existing, or create, adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 3. Collect DNA or genetic tissue to monitor and evaluate artificial production program effects upon genetic divergence from founding stocks.

Strategy 4. Quantify naturally produced and hatchery spawners on the spawning grounds to assess the relative BY production relative to proportion hatchery fish on the spawning grounds.

Strategy 5. Design and implement shared monitoring and evaluation goals objectives, and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

Strategy 6. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 7. Achieve habitat objectives identified in the AU summaries in the Methow subbasin Plan.

Strategy 8. Conduct smolt monitoring to assess BY production of tributary-specific populations.

Objective 6: Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through genetic and fish health monitoring, juvenile rearing and release strategies, and brood collection.

Strategy 1. Modify current acclimation ponds on the Chewuch and Twisp Rivers to allow overwintering of juveniles on natal water.

Strategy 2. Improve existing, or create additional, adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 3. Eliminate exogenous spring Chinook stocks.

Strategy 4. Collect DNA or genetic tissue to monitor and evaluate artificial production programs impacts relating to genetic divergence from founding stocks.

Strategy 5. Monitor smolt migration development using external visual observation within the hatchery, and coincide release with peak smoltification.

Strategy 6. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

Strategy 7. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 8. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 7: Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 1. Increase and require spring flow augmentation.

Strategy 2. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 3. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 4. Improve juvenile bypass systems within the Columbia River hydrosystem.

Objective 8: Provide species status report every five years.

Strategy 1. Collect life history information data; produce spawner-recruit analysis, monitor trends in abundance, correlate them with external influences, and assess how well artificial production is meeting goals and objectives.

Strategy 2. Develop and implement shared monitoring and evaluation goals and objectives and strategies specific to upper Columbia River spring Chinook natural and artificial production components.

5.7.2 Summer Chinook

Goal: Run size and spawning escapement levels that provide for viable self-sustaining, naturalized population of upper Columbia summer Chinook salmon in the Methow subbasin; management effectively mitigates for hydrosystem losses and supports a harvestable surplus.

Objective 1: Increase the natural spawning escapement to pre-1980 numbers in the Methow subbasin by 2013, consistent with at least 3,500 adults past Wells Dam.

Strategy 1. Identify and evaluate most successful rearing strategy for artificial production to ensure demographic success.

Strategy 2. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Strategy 3. Increase and require spring/summer flow augmentation.

Strategy 4. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 5. Manage consumptive fisheries consistent with adult escapement objectives (i.e., limit proportion of hatchery fish on the spawning grounds in years of excess spawn escapement).

Strategy 6. Achieve habitat objectives identified in the AU Summaries in the Methow subbasin Plan.

Objective 2: Annually, provide a sport and tribal fisheries, consistent with the protection of endemic naturally produced stocks.

Strategy 1. Improve juvenile bypass facilities at Columbia River hydropower facilities.

Strategy 2. Identify and evaluate most successful rearing strategy for artificial production to ensure demographic success.

Strategy 3. Increase and require spring/summer flow augmentation.

Strategy 4. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 5. Identify, conserve and monitor natural production demographics.

Strategy 6. Develop, implement, manage, and monitor consumptive fisheries consistent with adult escapement objectives (i.e., limit proportion of hatchery fish on the spawning grounds in years of excess spawn escapement).

Strategy 7. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Strategy 8. Implement supplementation programs associated with the Mid-Columbia River HCPs, ESA Section 10 Permit # 1347, and those identified in pending HGMPs.

Objective 3:Maintain/implement artificial production programs that supplement natural production using locally adapted stocks.

Strategy 1. Identify and evaluate most successful rearing strategy for artificial production to ensure demographic success.

Strategy 2. Quantify naturally produced spawners with CWT marked spawners.

Strategy 3. Implement supplementation programs consistent with Mid Columbia HCPs, ESA Section 10 Permit 1347, and pending HGMPs.

Strategy 4. Provide adult collection facilities on Columbia River tributaries for management of locally adapted stock(s).

Strategy 5. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Objective 4: Determine natural production smolt capabilities within the Methow subbasin by 2013.

Strategy 1. Determine egg-to-smolt survival of natural spawning fish.

Strategy 2. Operate a smolt trap in the lower Methow River to monitor migration pattern and timing, as well as to determine natural production capabilities.

Strategy 3. Identify, conserve, and monitor natural production demographics.

Strategy 4. Conduct annual spawning ground surveys.

Strategy 5. Design and implement shared monitoring and evaluation, and goals and objectives specific to upper Columbia River summer Chinook natural and artificial production elements.

Strategy 6. Characterize the habitat utilization through a series of years and abundance trends.

Strategy 7. Determine adult-to-adult and smolt-to-adult return rates, and quantify spawner success rates for naturally produced and hatchery-produced fish.

Objective 5: Determine and quantify natural and artificial limitations to natural production.

Strategy 1. Design and implement microhabitat study.

Strategy 2. Evaluate long-term production trends with human and natural events.

Strategy 3. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

Strategy 4. Characterize the habitat utilization through a series of years and abundance trends.

Objective 6: Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through juvenile rearing and release strategies, brood collection and genetic monitoring.

Strategy 1. Rear and release high quality smolts determined through size, fish health, smoltification, and imprinting.

Strategy 2. Create tributary traps to collect only locally adapted fish for supplementation programs.

Strategy 3. Collect DNA or genetic tissue from natural spawners and hatchery spawners every three years to ensure consistency between the two, and with the baseline.

Strategy 4. Determine early life history strategy most successful to adult return for natural production and hatchery production. Ensure artificial production does not change demographics.

Strategy 5. Monitor fish health monthly, and ensure disease occurrence mirrors natural production.

Strategy 6. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

Strategy 7. Expand the number of acclimation facilities to better distribute releases of artificial production, and facilitate better spawning distribution within the available habitat.

Objective 7: Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 1. Increase and require spring/summer flow augmentation.

Strategy 2. Improve juvenile bypass facilities at Columbia River hydropower facilities.

Strategy 3. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 4. Identify, conserve and monitor natural production demographics.

Objective 8: Provide species status report every five years to evaluate effectiveness of attaining/direction toward the goal, with adoption of changes as necessary.

Strategy 1. Collect life history information data, producing spawner-recruit analysis, monitoring trends in abundance and correlating them with external influences, and assessing how well artificial production is meeting goals and objectives.

Strategy 2. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

Objective 9: Identify, conserve, and monitor life history characteristics of summer Chinook salmon, as they relate to juvenile migration pattern and timing.

Strategy 1. Operate smolt trap in the lower Methow River.

Strategy 2. PIT tag naturally produced and artificially-produced smolts to determine if migration patterns are similar.

Objective 10: Maintain and expand evaluation of the artificial production program.

Strategy 1. Operate a smolt trap in the lower Methow River to assess natural production and smolt migration timing and pattern.

Strategy 2. Design complete life history study to monitor survival through Columbia River hydropower system, estuary and marine environment.

Strategy 3. Provide query of PSMFC database for CWT recoveries to determine escapement, fishery contributions, and general marine survival.

Strategy 4. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer Chinook natural and artificial production components.

5.7.3 Steelhead

Goal: Run size and spawning escapement levels that provide for the recovery of ESA-listed upper Columbia River steelhead in the Methow subbasin; management effectively mitigates for hydrosystem losses and supports a harvestable surplus.

Objective 1: Determine natural smolt production capabilities within the Methow subbasin by 2013.

Strategy 1. Determine adult-to-adult and smolt-to-adult return rates, and quantify spawner success rates for naturally produced and hatchery-produced fish (including implementation of a reproductive success study).

Strategy 2. Operate a smolt trap in the lower Methow River, and at least one tributary to the Methow River, to monitor migration pattern, timing, as well as to determine smolt production.

Strategy 3. Design and implement an overwinter ecology study to examine use and survival of stream-type fish through the winter.

Strategy 4. Locate or create a genetic mark on fish within the hatchery that can be located in progeny after adult return and spawning, in order to quantify productivity.

Strategy 5. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 6. Determine egg-smolt survival for naturally spawning fish.

Objective 2: Determine and quantify natural and artificial limitations to natural production.

Strategy 1. Design and implement a study to quantify use and survival through the summer and winter months of the first and second year.

Strategy 2. Conduct annual spawning ground surveys.

Strategy 3. Determine fry production, parr production, and spring smolt production, and correlate to spawner abundance and human and natural changes over time.

Strategy 4. Characterize the habitat utilization through a series of years and abundance trends.

Strategy 5. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Objective 3: Achieve a natural cohort replacement rate of one or greater and a minimum of 2,500 naturally produced spawners for at least eight consecutive years (NOAA Fisheries interim recovery abundance and productivity targets).

Strategy 1. Maintain artificial production programs identified in ESA Section 10 Permit 1395, 1396 and 1412.

Strategy 2. Use locally adapted stocks in supplementation programs.

Strategy 3. Manage consumptive fisheries consistent with adult escapement objectives (i.e., implement recreational fishery strategy detailed in ESA Section 10 Permit 1395 when warranted).

Strategy 4. Increase and require spring flow augmentation.

Strategy 5. Reduce predatory consumption of smolts during seaward migration.

Strategy 6. Enlarge existing hatchery facilities, and construct additional facilities, to increase effectiveness, not through quantity but through quality, of the hatchery programs to supplement the natural production (i.e., feasibility of "natures rearing" strategies).

Strategy 7. Reduce predatory consumption in mainstem migration corridor.

Strategy 8. Increase and require spring flow augmentation on the Columbia mainstem.

Strategy 9. Improve smolt bypass systems at mainstem hydropower facilities.

Strategy 10. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 11. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 12. Achieve habitat objectives identified in the AU summaries in the Methow subbasin Plan.

Objective 4: Maintain/implement artificial production programs using locally adapted brood fish to meet recovery, conservation and harvest needs, while mitigating for fish losses from the Columbia River hydropower system.

Strategy 1. Use locally adapted stocks only.

Strategy 2. Implement supplementation programs identified in ESA Section 10 Permit 1395, 1396 and 1412.

Strategy 3. Use "natures rearing" to determine if a better smolt (smolt-to-adult survival) can be produced from competition, predator avoidance, temperature, flow, and cover than from a traditional production facility.

Strategy 4. Radio-tag adult steelhead migrants in upper Columbia River to monitor location of winter holding, spawning, kelting, and wild origin apportioning to subbasins above Wells Dam.

Strategy 5. Maintain/develop distinct population attributes of the Methow subbasin.

Strategy 6. Develop tributary adult collection facilities so all brood stock requirements are met from these locations.

Strategy 7. Increase and require spring flow augmentation.

Strategy 8. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 9. Manage and monitor consumptive fisheries consistent with adult escapement objectives (i.e. implement Permit #1395 recreational fishery plan when warranted).

Strategy 10. Perform annual spawning ground surveys.

Strategy 11. Collect DNA or genetic tissue from adult spawners within the hatchery and on the spawning ground to ensure artificial production is not altering the genetic composition of the populations.

Strategy 12. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 13. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 14. Achieve habitat objectives identified in the AU summaries in the Methow subbasin Plan.

Objective 5: Maintain the genetic diversity/ integrity and population structure of the locally adapted stocks (natural and artificially propagated stocks), consistent with VSP criteria developed through the TRT for recovery planning.

Strategy 1. Improve existing, or create, adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 2. Collect DNA or genetic tissue to monitor and evaluate artificial production programs effects on genetic divergence from founding stocks.

Strategy 3. Quantify naturally produced and hatchery spawners on the spawning grounds to assess the relative BY productivity related to proportion of hatchery fish on the spawning ground.

Strategy 4. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 5. Develop new and modify existing acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 6. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Strategy 7. Conduct smolt monitoring to assess BY production of tributary specific populations.

Objective 6: Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through genetic and fish health monitoring, juvenile rearing and release strategies, and brood collection.

Strategy 1. Modify current acclimation ponds on the Chewuch and Twisp rivers to allow overwintering of juveniles on natal water.

Strategy 2. Create adult collection facilities on the tributary streams to promote local stock production through supplementation programs.

Strategy 3. Collect DNA or genetic tissue to monitor and evaluate artificial production programs effects upon genetic divergence from founding stocks.

Strategy 4. Monitor smolt migration development using external visual observation within the hatchery, and coincide release with peak smoltification.

Strategy 5. Design and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River steelhead natural and artificial production components.

Strategy 6. Develop new, and modify existing, acclimation facilities to improve distribution of spawners at return, facilitate volitional migration, and reduce point source impact of direct plants (upper Methow, Early Winters, upper Chewuch, upper Twisp and Lost Rivers).

Strategy 7. Achieve habitat objectives identified in the AU summaries of the Methow subbasin Plan.

Objective 7: Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 1. Increase and require spring flow augmentation.

Strategy 2. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 3. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 4. Improve juvenile bypass systems within the Columbia River hydrosystem.

Objective 8: Provide species status report every five years to evaluate effectiveness of objective attaining/direction toward goal, with adoption of changes as necessary.

Strategy 1. Collect life history information data, producing spawner-recruit analysis, monitoring trends in abundance and correlating them with external influences, and assessing how well artificial production is meeting goals and objectives.

Strategy 2. Develop and implement shared monitoring and evaluation goals, and objectives and strategies specific to upper Columbia River summer steelhead natural and artificial production components.

5.7.4 Bull trout

Objective 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of bull trout distribution across the species' native range, so that the species can eventually be delisted.

Strategy 1. Maintain current distribution of bull trout, and restore distribution in previously occupied areas within the Methow Core Area.

Strategy 2. Maintain stable or increasing trends in abundance of bull trout.

Strategy 3. Restore and maintain suitable habitat conditions for all bull trout life stages and strategies.

Strategy 4. Conserve genetic diversity and provide opportunity for genetic exchange.

Objective 2: Reduce threats to the long-term persistence of bull trout populations and their habitat, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms.

Strategy 1. Restore passage of specific man-made migrational barriers within the Methow Watershed, providing the barriers are not providing protection from invasive species such as brook trout.

Strategy 2. Reduce impacts on stream corridor through improved road management throughout the Methow Watershed.

Strategy 3. Reduce impacts on the stream corridor through improved land use practices, such as increased riparian buffer widths, decreased livestock grazing and improved irrigation efficiencies.

Strategy 4. Reduce or eliminate impacts from past, present, and future mining activities.

Strategy 5. Reduce impacts from residential and recreational development.

Strategy 6. Reduce or eliminate effect from non-native species. This includes brook trout eradication and discontinuation of stocking non-native species.

Strategy 7. Maintain and expand fishing prohibitions on bull trout throughout the Methow watershed.

Strategy 8. Maintain and restore floodplain connectivity throughout the watershed.

Objective 3: Improve current knowledge base on bull trout throughout the Methow watershed.

Strategy 1. Complete genetic study on fluvial and resident bull trout.

Strategy 2. Investigate the resident/fluvial interaction.

Strategy 3. Complete a population distribution and abundance study throughout the watershed.

Strategy 4. Complete a life history study throughout the watershed.

Strategy 5. Investigate the effects of natural dewatering areas on bull trout habitat and life histories.

5.7.5 Westslope cutthroat trout

Goal: Manage native stocks for viability, sustainability, and opportunity.

Objective 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of westslope cutthroat trout distribution across the species' native range.

Strategy 1. Maintain current distribution of westslope cutthroat trout, and restore distribution in previously occupied areas within the Methow Core Area.

Strategy 2. Maintain stable or increasing trends in abundance of westslope cutthroat trout.

Strategy 3. Restore and maintain suitable habitat conditions for all westslope cutthroat trout life stages and strategies.

Strategy 4. Conserve genetic diversity and provide opportunity for genetic exchange.

Objective 2: Reduce threats to the long-term persistence of westslope cutthroat trout populations and their habitat, ensuring the security of multiple interacting groups of westslope cutthroat trout, and providing habitat and access to conditions that allow for the expression of various life history forms.

Strategy 1. Restore passage of specific man-made migrational barriers within the Methow Watershed, providing the barriers are not providing protection from invasive non-native species.

Strategy 2. Reduce impacts on stream corridor through improved road management throughout the Methow watershed.

Strategy 3. Reduce impacts on the stream corridor through improved land use practices, such as increased riparian buffer widths, decreased livestock grazing, and improved irrigation efficiencies.

Strategy 4. Reduce or eliminate impacts from past, present, and future mining activities.

Strategy 5. Reduce impacts from residential and recreational development.

Strategy 6. Reduce or eliminate effect from non-native species.

Strategy 7. Maintain and restore floodplain connectivity throughout the watershed.

Objective 3: Improve current knowledge base on westslope cutthroat trout throughout the Methow Watershed.

Strategy 1. Complete genetic study on migratory and resident westslope cutthroat trout.

Strategy 2. Complete a population distribution and abundance study throughout the watershed.

Strategy 3. Complete a life history study throughout the watershed.

Strategy 4. Investigate the effects of natural dewatering areas on westslope cutthroat trout habitat and life histories.

5.8 Wildlife Habitat Biological Objectives and Strategies

The following summary of biological objectives for wildlife and fish is provided to guide development of BPA-funded recovery and management plans that will involve listed species, as well as other species and habitats of management importance.

Emphasis in this subbasin plan is placed on the selected focal habitats and wildlife species described in the Assessment (“Synthesis and Interpretation for Wildlife/Terrestrial Ecosystems,” Section 2.6).

It is clear from the Assessment that reliable quantification of most subbasin-level impacts is lacking; however, many anthropogenic changes have occurred and clearly impact the focal habitats: riparian wetlands, shrubsteppe, and Ponderosa pine forest habitats. While all habitats are important, focal habitats were selected, in part, because they are disproportionately vulnerable to anthropogenic impacts, and likely have received the highest level of impacts within the subbasin.

In particular, the majority of shrubsteppe and Ponderosa pine habitats fall within the "low" or "no" protection status categories defined above. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (e.g., USFS adjustments to grazing management).

It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. The context within which this plan was drafted recognizes that human uses do occur, and will continue into the future. Recommendations are made within this presumptive framework. The Okanogan Subbasin Management Plan directs conservation efforts towards three focal habitats: Ponderosa pine, Shrubsteppe, and Eastside (Interior) Riparian Wetlands.

Focal species selected to represent the three Focal Habitats include: a) Ponderosa pine: white-headed woodpecker, Pygmy nuthatch, gray flycatcher, and flammulated owl; b) Shrubsteppe: sharp-tailed grouse, mule deer, Brewer's Sparrow, and grasshopper sparrow; and c) Eastside Riparian Wetlands: red-eyed Vireo, yellow-breasted chat, and beaver.

The table below lists the working hypotheses, goals, objectives, and management strategies for the three focal habitat types in the Okanogan subbasin.

A working hypothesis is a statement that summarizes the subbasin planners' understanding of the subbasin at the time of development of this plan based on assessment data and analysis. Working hypotheses provide the rationale for the objectives and management strategies.

Subbasin planners have developed a goal for each of the three focal habitat types. Achieving the goal for each focal habitat type should result in functional habitats for the focal species assemblage selected to represent that habitat type, and hence, for other species dependent on the habitat type.

The planners have identified both habitat and biological objectives that will advance the goals for each habitat type. Objectives describe the types of changes within the subbasin needed to achieve the goals and, ultimately, the vision for the subbasin. When insufficient data are available, objectives describe the research that will need to be done to identify physical and biological changes needed to achieve goals.

Strategies are sets of actions to accomplish objectives. The strategies in the table below are intended to serve as guidance for development of projects to accomplish the objectives listed above. Each of the strategies is intended to further one of the objectives; the number in the left-hand column shows which one.

Table 55 Summary of Wildlife Biological Goals, Objectives and Strategies

Working Hypotheses and Goals	Objectives	Strategies
Ponderosa Pine		
Working Hypothesis: The near-term or major factors affecting Ponderosa Pine stands are direct loss of habitat due primarily to timber harvesting, fire reduction/wildfires, mixed forest encroachment, development, recreational activities, reduction of habitat diversity and function resulting from invasion by exotic species and vegetation and overgrazing. The principal habitat diversity stressors are the spread and proliferation of mixed forest conifer species within Ponderosa pine communities due primarily to fire reduction, intense, stand-replacing wildfires, and invasive exotic weeds. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation), coupled with poor habitat quality of existing vegetation (i.e., lack of old growth forest and associated large-diameter trees and snags) have resulted in significant reductions in Ponderosa pine habitat obligate wildlife species. **Goal**: Provide sufficient quantity and quality Ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing Ponderosa pine toward conditions 1a, 1b, 2 and 3 identified in 3.1.7.1.3	**Habitat Objective 1**: Determine the necessary amount, quality, and juxtaposition of Ponderosa pine habitat to sustain focal species populations.	Identify and distinguish ecologically functioning and non-functioning Ponderosa pine habitats, corridors, and linkages.
		Identify sites that are currently not in Ponderosa pine habitat that have the potential to be of high ecological value, if restored.
	Habitat Objective 2: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.	Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
		Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).
		Emphasize conservation of large blocks and connectivity of functional, high quality Ponderosa pine habitat.
		Uphold existing land use and environmental regulations that protect habitats.
		Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.
	Habitat objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture practices, fire management, weed control, livestock grazing practices, and road management on existing and restored Ponderosa pine habitats.	Provide information, outreach, and coordination with public and private land managers to improve the use of prescribed fire, fire protection, and silviculture practices to restore and conserve habitat functionality.
		Implement habitat stewardship projects with private landowners.

Working Hypotheses and Goals	Objectives	Strategies
		Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
		Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
		Develop and implement a coordinated, cross-jurisdictional road management plan.
	Biological Objective 1: Show an increase in distribution and population status of white-headed woodpecker, flammulated owl, gray flycatcher, and Pygmy nuthatch.	Select survey protocol and determine current distribution and population status of each Ponderosa pine focal species
		Identify current and potential areas of high quality habitat for each of the Ponderosa pine focal species
		Work with state, federal, tribal, county, and private entities to maintain and improve structural stand conditions of Ponderosa pine habitat
	Biological Objective 2: Within the framework of the focal species' population status determinations, inventory other Ponderosa pine obligate populations to test assumption of the "umbrella species concept" for conservation of other Ponderosa pine obligates.	Implement federal, state, tribal management and recovery plans
Shrubsteppe		
Working Hypothesis: The near-term or major factors affecting shrubsteppe areas are direct loss of habitat due primarily to conversion to agriculture, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and livestock grazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and knapweeds that either supplant and/or radically	**Habitat Objective 1**: Determine the necessary amount, quality, and juxtaposition of shrubsteppe habitat to sustain focal species populations.	Identify and distinguish ecologically functioning and non-functioning Shrubsteppe habitats, corridors, and linkages.
		Identify sites that are currently not in Shrubsteppe habitat that have the potential to be of high ecological value, if restored.

Working Hypotheses and Goals	Objectives	Strategies
alter entire native bunchgrass communities significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation), coupled with poor habitat quality of extant vegetation have resulted in extirpation and/or significant reductions in shrubsteppe obligate wildlife species. **Goal**: Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing sagebrush-dominated shrubsteppe toward conditions 1, 2 and 3 identified in 3.1.7.2.3	**Habitat Objective 2**: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.	Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
		Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short-term)
		Emphasize conservation of large blocks and connectivity of functional, high-quality shrubsteppe habitat.
		Uphold existing land use and environmental regulations that protect habitats.
		Identify inadequate land use regulations. Work to strengthen existing regulations, or pass new regulations to improve protection of habitats.
	Habitat objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing and restored shrubsteppe.	Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to restore and conserve habitat functionality.
		Implement habitat stewardship projects with private landowners.
		Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
		Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
		Develop and implement a coordinated, cross-jurisdictional road management plan.

Working Hypotheses and Goals	Objectives	Strategies
	Biological Objective 1: Determine population status of the grasshopper sparrow, Brewer's sparrow, sharp-tailed grouse, and mule deer by 2008.	Select survey protocol and measure populations status of focal species.
		Complete a more detailed assessment of focal species, focal species assemblages, and obligate species needs to determine their habitat requirements (quantity and quality).
	Biological Objective 2: Re-introduce sharp-tailed grouse to at least desired minimum viable population levels by 2024.	Implement state and tribal management recovery plans for sharp-tailed grouse.
		Re-introduce sharp-tailed grouse into the subbasin.
		Ensure sharp-tailed grouse habitat needs are met on federal, state, and tribal managed lands during land use planning.
	Biological Objective 3: Maintain and enhance mule deer populations consistent with state/tribal herd management objectives.	Implement state and tribal management plans for mule deer.
		Ensure mule deer habitat needs are met on federal, state, and tribal managed lands during land use planning.
		Maintain mule deer populations within landowner tolerances..
		Protect and enhance important winter range and areas of sensitive habitat.
		Work with state, federal, tribal, and private entities to improve habitat quality within Ponderosa pine habitat (road closures, weed management, improved forage, etc.).
Riparian wetlands		
Working Hypothesis: The proximate or major factors affecting riparian wetlands are direct loss of habitat due primarily to urban/agricultural development, reduction of habitat diversity and function resulting from exotic vegetation, livestock overgrazing, fragmentation, and recreational activities. The principal habitat diversity stressor is the spread and proliferation of invasive exotics. That stressor, coupled with poor habitat quality of existing vegetation, has resulted in extirpation and/or significant	**Habitat Objective 1**: Determine the necessary amount, quality, and juxtaposition of riparian wetland habitat to sustain focal species' populations.	Identify and distinguish ecologically functioning and non-functioning riparian wetland habitats, corridors, and linkages.
		Identify sites that are currently not in riparian wetland habitat that have the potential to be of high ecological value, if restored.

Working Hypotheses and Goals	Objectives	Strategies
reductions in riparian habitat obligate wildlife species. **Goal**: Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing riparian wetland habitats toward conditions 1a, 1b, and 2 identified in 3.1.7.3.3	**Habitat Objective 2**: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species' populations and habitats by 2010.	Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
		Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short-term).
		Emphasize conservation of large blocks and connectivity of functional, high quality riparian wetland habitat.
		Uphold existing land use and environmental regulations that protect habitats.
		Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.
	Habitat objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands.	Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to produce desired riparian wetland habitat conditions.
		Implement habitat stewardship projects with private landowners.
		Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
		Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
		Develop and implement a coordinated, cross-jurisdictional road management plan.

Working Hypotheses and Goals	Objectives	Strategies
	Biological Objective 1: Determine population status of beaver, red-eyed vireo, and yellow-breasted chat by 2008.	Select survey protocol and measure populations status of focal species.
		Complete a more detailed assessment of focal species, focal species assemblages, and obligate species' needs to determine their habitat requirements (quantity and quality).
	Biological Objective 2: Within the framework of the focal species' population status determinations, inventory other riparian wetlands obligate populations to test assumption of the "umbrella species concept" for conservation of other riparian wetlands obligates.	Implement federal, state, tribal management and recovery plans.
	Biological Objective 3: Based on findings of Biological Objective 1, maintain and enhance beaver populations where appropriate and consistent with state/tribal management objectives.	Protect, and where necessary, restore habitat to support beaver.
		Reintroduce beaver into suitable habitat where natural re-colonization may not occur.
		Through state harvest restrictions, protect beaver populations at a level sufficient to allow natural and reintroduced beaver populations to perpetuate at levels that will meet Habitat Objective 2.

5.9 Consistency with ESA/CWA Requirements

The Technical Guide for subbasin planners says that "the management plan should describe how the objectives and strategies are reflective of, and integrated with, the recovery goals for listed species within the subbasin and the water quality management plan within that particular state. Coordination with NMFS's Technical Review Teams, the federal and state agency charged with implementing the CWA, will be an important step in ensuring consistency with ESA and CWA requirements."

In the Methow subbasin, there are potentially three federally-listed fish species. Spring Chinook and summer steelhead are considered Endangered, and bull trout are considered part of the Threatened Columbia River population. Objectives and strategies outlined in this plan are likely to benefit these species through improved habitat involving local irrigation districts, land owners and agency partners, as well as through hatchery augmentation and adult minipulation (harvest and direct removal) where appropriate. The objectives outlined in this plan will be addressed in concert with the Regional Technical Teams and state agencies, ensuring that ESA and CWA priorities are applied in concert with the detailed objectives outlined in this subbasin plan.

NMFS and FWS Biological Opinions include actions related to basic habitat needs of listed species. In tributary habitat, two objectives are relevant to this project: a) Increase tributary water flow to improve fish spawning, rearing, and migration, and; b) comply with water quality standards, first in spawning and rearing areas, then in migratory corridors. Biological Opinion Section 9.6.2.1. Action 151 states that "BPA shall, in coordination with NMFS, experiment with innovative ways to increase tributary flows."

The discussion of this action notes that, while tributary flow problems are widespread, it is unclear whether and how solutions can be implemented through existing laws and processes. New approaches must be tested, especially where there are significant non-federal diversions and ancillary water quality benefits. This action will also develop a competitive process to increase flows and water quality at the lowest cost.

When developing the Methow Subbasin Plan, planners took into consideration the FWS Draft Bull Trout Recovery Plan (BTRP). The planners developed management plans, including biological goals, objectives, actions, and research needs, that were consistent with the BTRP. In addition, federally-listed wildlife species are recognized in the management plans with objectives that call for protection of these species and their habitats; therefore, the management plan is consistent with ESA requirements. Additional species-specific detail considered throughout the development of this plan is included for each ESA-listed species.

Columbia River bull trout DPS

The Columbia Distinct Population Segment (DPS) for bull trout, which includes the entire Columbia River and its tributaries, was listed as Threatened on June 10, 1999. Bull trout once filled almost every cold-water niche in the Methow subbasin; however, within the Methow subbasin, the presence of natural barriers such as waterfalls or small stream size blocked their access to many headwater streams. Today, changes in stream morphology because of the development of irrigation diversions, alterations to the natural hydrograph, and changes to temperature regimes has affected the population distribution and abundance of these bull trout population.

Factors for decline of the bull trout populations in the Methow include: hydroelectric dams, forest management practices, livestock grazing, agricultural practices, mining, residential development and urbanization, recreational development , harvest, loss of forage base, introduction of non-native species, and habitat fragmentation (FWS, 2002)

Upper Columbia River Recovery Unit

Major tributaries entering the mid-Columbia River include the Wenatchee, Entiat, Methow, and Okanogan Rivers. The Upper Columbia River Recovery Unit includes the Methow, Entiat, and Wenatchee Rivers to their confluences with the Columbia River. There are 16 identified migratory local populations currently distributed within the Wenatchee (six), Entiat (two) and Methow (eight) Rivers. Radiotelemetry study results to date have shown that bull trout are migrating between the Columbia River and core area streams inhabited by local populations. These include the Chiwawa River (Chiwawa River and Rock Creek), Nason River (Nason River and Mill Creek), Icicle Creek, Entiat River (Entiat and Mad Rivers), and Twisp River (Twisp River and Buttermilk Creek) local populations.

There is considerable evidence that bull trout use the Columbia River in this reach for foraging, overwintering, and migration (BioAnalysts 2002, 2003). During the past five years, a large number of migratory adults have been observed moving through the fish ladders at Rock Island, Rocky Reach, and Wells dams. Current radiotelemetry studies show patterns of long distance migrations (> 100 miles one way; 140 miles round trip), and extended overwintering use (>6 months) in the mainstem Columbia River by bull trout (FWS 2001, 2002; BioAnalysts 2002, 2003). Migration of bull trout between the Columbia River and the Wenatchee, Entiat, and Methow Rivers has been documented.(FWS 2004).

The Upper Columbia Recovery Team believes that it is essential to continue to monitor bull trout use in the mainstem Columbia River as well as to determine the migration patterns within its tributaries. This Team recommended that a comprehensive study on the migratory behavior of bull trout within the Upper Columbia Recovery Unit be conducted. Increased knowledge of the use of the mainstem Columbia River may revise core area descriptions and could have management implications.

Biological Opinions, Bull Trout and Hydro-power

On December 20, 2000, the FWS issued a biological opinion to the Army Corps of Engineers, Bonneville Power Administration, and Bureau of Reclamation (Action Agencies) on the effects of the Federal Columbia River Power System (FCRPS) on Threatened and Endangered species and their critical habitat.

The four federal lower Columbia River dams are presently operating under this opinion. The FWS' biological opinion includes four reasonable and prudent measures (RPM) to reduce the take of bull trout associated with operation of these projects. The RPMs are directed at determining the presence, and extent, of bull trout use of the lower Columbia River within the FCRPS area, ensuring that bull trout passage is not impeded at FCPRS dams, preventing adverse impacts caused by FCPRS operations such as fish stranding, and reducing total dissolved gas caused by spilling at FCRPS dams to state standards. Terms and conditions to implement the reasonable and prudent measures required the Action Agencies to do the following:

1. Count and record bull trout observed at the FCRPS lower Columbia River dams.

20. Record bull trout captured in field studies funded by the Action Agencies.

21. Cooperate in studies to determine the movements of bull trout from the Hood River and other tributaries into Bonneville Reservoir.

22. Cooperate in studies to evaluate potential habitat use in the White Salmon River following removal of Condit Dam.

23. Cooperate in studies to evaluate fluvial bull trout in the Klickitat River.

24. Begin studies of the effect of flow fluctuations caused by FCRPS operations on bull trout or their prey.

25. Initiate studies to determine the use and suitability of bull trout habitat in the lower Columbia River.

26. Investigate and implement, if appropriate, ways to reduce total dissolved gas production at FCRPS dams.

These terms and conditions are directed to impacts on bull trout at the lower Columbia River dams, and do not specifically address habitat needs of bull trout in the mainstem Columbia River.

The National Marine Fisheries Service issued a December 20, 2000 biological opinion on the effects of operation of the FCRPS on listed salmon and steelhead. That opinion addresses listed anadromous salmon and steelhead, and includes reasonable and prudent alternatives to reduce the take of those fish, but does not specifically list measures to protect bull trout.

Habitat Conservation Plans

Mid-Columbia HCP

Three of the mid-Columbia River hydroelectric projects (Wells, Rocky Reach, and Rock Island), have requested FERC to include in their licenses Habitat Conservation Plans under Section 10 of the ESA. Parties to these HCPs include the Public Utility Districts of Chelan and Douglas Counties, the National Marine Fisheries Service, FWS, Washington Department of Fish and Wildlife, and the Colville Tribes.

This HCP includes operations and measures to address all anadromous fish that occur upstream of Rock Island Dam (not just ESA-listed species). Bull trout will likely benefit from these HCPs, even though dam protection measures and habitat improvements are directed toward anadromous fish.

HCPs within the Methow

Currently, there are two HCPs under development in the Methow Subasin. Both are associated with effects of irrigation withdrawals on listed spring Chinook, steelhead, and bull trout. These HCPs are being designed to minimize and mitigate for the "take" of these species.

Upper Columbia River spring-run ESU

Myers et al. (1998) defined the Upper Columbia River spring-run ESU as stream-type Chinook that spawn in the Wenatchee, Entiat, and Methow Rivers. They explain that the biological review team (BRT) felt that, in spite of the tremendous amount of hatchery influence on these fish, they still represented an important genetic resource, partially because it was presumed it still contained the last remnants of the gene pools for populations from the headwaters of the Columbia River.

Ford et al. (2001) concluded that there were currently three independent populations of spring Chinook within the Upper Columbia spring Chinook ESU: Wenatchee, Entiat, and Methow basins. The Okanogan spring Chinook are believed to be extinct, possibly since the 1930s (see below).

Brannon et al. (2002) separated the Methow spring Chinook first-order metapopulation from the Wenatchee and Entiat populations, which were linked together.

Within these populations there are other sub-populations that Ford et al. (2001) suggested should be considered when reviewing management actions within these geographic areas to maintain potential adaptive advantages of these sub-populations.

The Interior Columbia Basin Technical Recovery Team (TRT), in its draft report (TRT 2003) agree with the initial designation of independent populations by Ford et al. (2001).

In conclusion, for the purposes of sub-basin planning, we assume that there are three independent populations (Wenatchee, Entiat, and Methow) within the large groups of populations that spawn naturally upstream from Rock Island Dam. Within these independent populations, there are sub-populations that should be considered during management processes, but overall, the spring Chinook from one of the three drainages is considered as a whole.

Upper Columbia summer steelhead ESU

Buby et al. (1996) determined that the ESU for Upper Columbia summer steelhead comprised the populations that currently spawn in the Wenatchee, Entiat, Methow, and possibly Okanogan Rivers. The BRT felt that because of past hatchery practices (see below) there have been substantial homogenization of the gene pool; however, there is likely remnant genetic material from ancestral populations that could have been "stored" in resident populations (Mullan et al. 1992CPa). Ford et al. (2001) agreed with the delineation described by Busby et al. (1996), but described each subbasin, with the possible exception of the Okanogan, as an independent population (see definition above).

Brannon et al. (2002) combined all of the first-order metapopulations of summer steelhead upstream of the Yakima River into one metapopulation.

In conclusion, for the purposes of sub-basin planning, we assume that there are four independent populations (Wenatchee, Entiat, Methow, and Okanogan) within the large groups of populations that spawn naturally upstream from Rock Island Dam. Implementation of strategies and attainment of habitat through hatchery objectives identified in this plan will aid in the recovery of listed upper Columbia River spring Chinook and summer steelhead ESUs, and is, therefore, consistent with ESA.

The Methow subbasin Core Team developed objectives and strategies that will lead to improvements in water quality. This is particularly emphasized where water quality does not currently meet water quality standards. In some cases, the subbasin plan specifically acknowledges the work being done by other entities to improve water quality, and recommends consistency with other management plans, such as total maximum daily load (TMDL). Therefore, the subbasin management plan is consistent with CWA requirements.

Relationship to Other Planning Efforts

In the Methow, an open dialogue existed throughout this process to included state, federal, tribal, and other stakeholder interest, and to coordinate with other planning efforts through the Habitat Working Group, and subbasin Core Group. Both groups included members who were working on watershed planning, State Salmon Recovery Planning, the Federal BIOP, Bull Trout Recovery Planning, Mid-Columbia Habitat Conservation Planning, TMDL, water quality planning, Growth Management Planning, Land Use Planning and FERC hydropower re-licensing. Participation of these members assures that the subbasin plan is compatible with other planning efforts.

A primary strategy was to coordinate with, and have the plan reviewed, by the Technical Recovery Teams developed by the Upper Columbia Salmon Recovery Board. The Upper

Columbia Salmon Recovery Board has established technical, policy and stakeholder groups that meet regularly to coordinate, evaluate, and implement mitigation measures within this subbasin.

Many documents were utilized to develop the subbasin plan including but not limited to:

- Habitat Conservation Plans
- Hatchery Genetic Management Plans
- ESA Section 10 permits 1196, 1347, 1395, 1396 and 1412
- The Clean Water Act
- The Powers Act
- The Northwest Power and Conservation Council's 2000 Fish and Wildlife Program (and the Technical Guide to subbasin planning)
- Assorted Watershed Management Plans
- The 2001 Federal BIOP
- Pacific Salmon Treaty
- Colville Tribes' Integrated Resource Management Plan
- Washington State Wild Salmonid Policy
- The Columbia River DPS Draft Bull Trout Recovery Plan
- The Endangered Species Act
- USFWS Draft Bull Trout Recovery Plan
- Critical Habitat Designation for Bull Trout

5.10 Monitoring Plan for the Methow subbasin

5.10.1 Monitoring and Evaluation Program for the Methow subbasin

Note: The first sections of this plan address fish exclusively and are derived from a variety of sources including the PNAMP guidance. Following fish, we provide a general framework for terrestrial (wildlife) monitoring. The wildlife section is adapted from Paquet, Marcot, and Powell 2004.

Introduction

To allow the subbasin plan authors to track the progress of specific objectives and goals over time, a disciplined and well-coordinated monitoring and evaluation (M&E) program is proposed. This program is designed to help confirm our scientific assumptions, resolve key scientific uncertainties, and provide the basis for performance tracking and adaptive management. The goals for this coordinated program are to maximize efficiencies, avoid duplication, and improve experiments to minimize confounding factors or actions.

This effort will begin to provide essential information on habitat conditions and fish populations beginning in 2004. This will also allow state, federal and tribal programs to operate in a manner

consistent with efforts to detect the trends and effectiveness between and among other subbasins, ESUs, programs and planning efforts.

The monitoring plan described in this document is not another regional monitoring strategy. Rather, this plan draws from the existing strategies and outlines an approach specific to the Methow subbasin and the Upper Columbia region.

The plan described here addresses the following five basic questions:

1. What are the current habitat conditions and abundance, distribution, life-stage survival, and age composition of anadromous fish in the Methow subbasin (status monitoring)?

27. How do these factors change over time (trend monitoring)?

28. What effects do tributary habitat actions have on fish populations and habitat conditions (effectiveness monitoring)?

29. What effects do fishery management actions have on fish populations (effectiveness monitoring)?

30. Are the goals, vision and objectives of the subbasin plan being met?

Assumptions

Monitoring and evaluation coordination and implementation will be an ongoing activity at the reach, subbasin, and regional levels. The subbasin planners assume these iterative, concurrent processes at different scales will be coordinated to optimize when and where implementation occurs to increase learning from broader-scale monitoring both within and across subbasins.

Monitoring that is proposed will be more effective if it fits within a broader programmatic network of status monitoring programs and intensively monitored watersheds. The subbasin planners assume that M&E efforts will be able to rely on broader monitoring frameworks and programmatic activities (where they exist) to meet some of their needs.

The subbasin planners assume that local, bottom-up approaches developed within subbasins will have a higher likelihood for successful funding and meaningful results if they reflect the approaches being developed within the comprehensive state, tribal initiatives, and federal pilot projects (Wenatchee, John Day, and Upper Salmon), and the top-down framework and considerations being developed by PNAMP.

Approach

A coordinated and comprehensive approach to the monitoring and evaluation of status and trends in anadromous and resident salmonid populations and their habitats is needed to support restoration efforts in the Columbia Cascade Province, and in the Methow subbasin in particular. Currently, independent research projects, and some monitoring activities, are conducted by various state and federal agencies, tribes, and, to some extent, by watershed councils or landowners; however, to date there has been no overall framework for coordination of efforts, or for interpretation and synthesis of results.

Guidance for this M&E Program

Three primary documents make up this framework plan for the Methow. They are:

31. The Upper Columbia Monitoring Strategy (Hillman, et al. 2004)

32. Considerations for Monitoring in Subbasin Plan (PNAMP 2004)

33. Considerations for Monitoring Wildlife in Subbasin Plan (NPCC 2004)

The authors also used a variety of programs and plans to help construct the Methow Monitoring Framework. Examples used include:

- The Pacific Northwest Aquatic Monitoring Partnership (PNAMP)—Draft Guidance to the State, Federal Governments, and Tribes for Monitoring (2004)
- The Coordinated System Wide Monitoring and Evaluation Project (CSMEP) Work Plan
- 2001 ISRP (review of the Methow Baseline Program, 2001)
- 2003 ISAB Review of Supplementation
- Federal Research Evaluation and Monitoring (RME) Plan
- The Pacific Coastal Salmon Recovery Fund (PCSRF) Performance Standards
- The Pacific Coastal Salmon Recovery Fund Data Definitions
- A Data Management Protocol (Wolf, Jordan, Toshach et al.—in press)
- BPA Pilot Studies in Wenatchee and John Day (data dictionary and geospatial database structure)
- The Washington Coordinated Monitoring Strategy
- The Oregon Monitoring Plan
- The subbasin authors/planners also suggest use of the following resources in implementing the M&E plan:
- The Yakima Klickitat Fisheries Project: http://www.ykfp.org
- The Northeast Oregon Hatchery: http://www.cbfwa.org/2001/projects/198805301.htm.
- The Columbia Basin Fish and Wildlife Authority (M&E): http://www.cbfwa.org/rme.htm
- The State of Washington: Outline for Salmon Regional Recovery Plans. http://www.wdfw.wa.gov/recovery/recovery_model.htm
- Coordinated Management Strategy. http://www.iac.wa.gov/srfb/monitoring.htm

Principles, Goals and Objectives

The following principles will guide M&E in the Methow subbasin:

- Resource Policy and Management: The purpose of monitoring efforts is to provide the most important scientific information needed to inform public policy and resource management decisions.

- Acknowledge each party's mandates, objectives, and management milestones.
- Construct a monitoring program that meets each party's milestones and objectives through coordinating and sharing monitoring resources.
- Develop a monitoring program that is sufficiently robust to meet public policy needs; demonstrate the links between public policy needs and monitoring efforts.
- Develop a monitoring program that demonstrates compliance.
- Commit to resolving, scientifically, the most important policy and management questions using an adaptive management approach.
- Efficiency and Effectiveness: Cooperative monitoring will enhance efficiencies and effectiveness of our respective and collective efforts.
- Participate fully in the PNAMP, including the identification of contact(s) for monitoring issues.
- Identify and coordinate goals, objectives, and budgets, and demonstrate resource savings over short and longer time frames.
- Cooperatively adapt programs and budgets to address monitoring gaps.
- State and federal agencies and the tribes commit to long term inter- and intra-agency monitoring programs.
- Encourage staff exchanges and shared training to learn what each other are doing (e.g., new innovations), and ensure consistency across programs.
- Develop common monitoring approaches, including: quality control/quality assurance programs; shared evaluation tools; integrated status and trend monitoring efforts; land use, land cover, and riparian vegetation categorization, and; core data for representative subset of watersheds in all represented states.
- Perform all monitoring activities in a timely manner.
- Scientifically Based: Environmental monitoring must be scientifically sound.
- Develop an integrated monitoring program (e.g., issues, disciplines, and values).
- Monitoring program is based on shared goals and objectives (e.g., census level, regional status and trends, cause-and-effect questions, effectiveness of regional efforts, identification of trouble spots).
- Address multiple spatial and temporal scales.
- Develop and use compatible data collection and analysis protocols.
- Recognize inherent diversity and variability, and dynamic inter-relationships or resource conditions, in monitoring design, analysis and interpretation.
- All environmental data should have a known level of precision.

- All baseline data on ecosystems are known and compiled between agencies.
- Shared Information: Monitoring data should be accessible to all on a timely basis.
- Make strategic investments in information systems needed to make data useful.
- Monitoring databases would integrate a number of issues, disciplines and values.
- Data management systems and protocols provide a linkage for sharing data between agencies.
- Adopt and use common data sharing protocols.
- Adopt and use common database/s of core metadata, data, and electronically connected distribution systems.

The primary goal of this M&E framework is:

To combine, coordinate, and standardize the activities of multiple agencies working on fisheries-related issues in the Methow basin, and establish a measure of success or failure of habitat and hatchery practices directed towards rehabilitation of fish and wildlife populations.

Specific goals of the Methow subbasin M&E plan include:

- Assess status and trends of watershed conditions and salmon populations, regionally.
- Monitor habitat, water quality, biotic health, and salmon in select watersheds.
- Analyze habitat, water quality and population trends at the landscape scale.
- Document conservation and restoration projects, activities, and programs.
- Evaluate effectiveness of restoration and management efforts locally.
- Evaluate the combined effectiveness of restoration and conservation efforts in select watersheds.
- Standardize monitoring, collection, management, and analysis efforts.
- Coordinate and support public-private monitoring partnerships.
- Integrate information and product data products and reports.

Specific Questions (Long List of possible questions):

1. How are the annual abundance and productivity of salmon by species, ESU, and life stage changing over time?

34. What improvements are occurring regarding the restoration of the geographic distribution of salmon by ESU, species, and life stage in their historic range?

35. Are the unique life history characteristics of salmon within a Salmon Recovery Region changing over time because of human activities?

36. What are the trends in the climate of the Pacific Northwest that will allow the state to anticipate and account for such conditions when initiating and monitoring management actions for watershed health and salmon recovery? What trends in climate may mask or expose the status of freshwater habitat and its role in salmon recovery?

37. What are the trends in effects of hatchery production on the survival and productivity of wild salmon populations within each ESU?

38. How are surface water quality conditions changing over time?

39. How effective are clean water programs at meeting water quality criteria?

40. What are the trends in water quantity and flow characteristics?

41. What are the status and trends in habitat-forming landscape processes in riverine ecosystems as they relate to watershed health and salmon recovery?

42. Are habitat improvement projects effective?

43. What is the condition of salmon populations at the ESU, subbasin, and watershed scale?

44. What is the status, and what are the trends, in aquatic habitats, water quality, and stream flow?

45. What are the critical factors that limit watershed function and salmon productivity?

46. What constitutes detectable and meaningful change in habitat condition and populations?

47. What changes are occurring in watersheds that improve stream habitat quality?

48. What are the management practices and programs that enhance or restore watershed functions and salmon populations?

49. What habitat changes and biotic responses result from these projects, practices, and programs?

50. What are the abundances, productivity, and distributions of Columbia River basin (CRB) fish populations relative to performance standards or objectives?

51. What is the biological, chemical, and physical status of CRB fish habitat relative to performance standards or objectives?

52. What are the relationships between fish populations and freshwater and estuary/ocean habitat conditions that determine population-limiting factors?

53. What is the effect of a specific mitigation or management action on the habitat and/or population performance of CRB fish?

54. What is the combined effect of multiple watershed-level mitigation on management actions on the habitat and/or population performance of CRB fish?

55. Are federal and state mitigation actions achieving the necessary survival changes identified in the All Federal Caucus Programs and the FCRPS BO for each ESU?

1. Measurable Objectives [10] (Short List of Questions that the Methow Basin M&E plan will address:

56. Determine if there is a statistically significant difference in the abundance, survival, and timing and life history characteristics of summer/fall, spring Chinook, sockeye, and steelhead (7-20+ year time frame).

57. Determine if there is a statistically significant difference in selected physical habitat parameters and characteristics for summer/fall, spring Chinook, sockeye, and steelhead in the Methow basin resulting from the cumulative benefits of habitat actions (7-20+ year time frame).

58. Estimate in-basin and out-of-basin harvest and stock-specific harvest of hatchery and wild anadromous salmonids within the Methow subbasin (ongoing).

59. Conduct a baseline Methow Basin inventory & analysis: a) Collect data, to raise physical habitat data to an empirical level for use in EDT and other analytical models or methods; b) Collect data on historical and current fish population distributions, and; c) Collect passage conditions throughout the basin for use in EDT modeling runs to assist in future enhancement planning processes (1-20+ year time frame).

For artificial production objectives, the following performance standards will be monitored:

- Legal Standards
- Conservation Standards
- Life History Characteristics
- Genetic Characteristics
- Research Activities
- Operation of Artificial Production facilities
- Socio-economic effectiveness
- Harvest Standards
- Non-target population impacts
- Target population production
- Target population long-term fitness

The plan is designed to address these questions, and at the same time, eliminate duplication of work, reduce costs, and increase monitoring efficiency. The implementation of valid statistical

10 Please also refer to the individual Assessment Unit summaries for a long list of detailed habitat objectives by geographic area. The M&E plan is developed to capture the variables and indicators necessary to determine whether progress is being made to achieve this list of habitat and artificial production objectives.

designs, probabilistic sampling designs, standardized data collection protocols, consistent data reporting methods, and selection of sensitive indicators will increase monitoring efficiency?[11]

For this plan to be successful, all organizations involved must be willing to cooperate and freely share information. Cooperation includes sharing monitoring responsibilities, adjusting or changing sampling methods to comport with standardized protocols, and adhering to statistical design criteria. In those cases where the standardized method for measuring an indicator is different from what was used in the past, it may be necessary to measure the indicator with both methods for a few years so that a relationship can be developed between the two methods. Scores generated with a former method could then be adjusted to correct for any bias.

Specific Elements of the Plan

Program Setup

In order to set up a monitoring program, it will be important to follow a logical sequence of steps. By proceeding through each step, the planner will better understand the goals of monitoring and its strengths and limitations. These steps will aid the implementation of a valid monitoring program that reduces duplication of sampling efforts, and thus, overall costs, but still meets the needs of the different entities. The plan assumes that all entities involved with implementing the plan will cooperate and freely share information. The setup steps are:

1. Identify the populations and/or subpopulations of interest (e.g., spring Chinook steelhead, summer/fall Chinook).

60. Identify the geographic boundaries (areas) of the populations or subpopulations of interest.

61. Describe the purpose for selecting these populations or subpopulations (i.e., What are the concerns?).

62. Identify the objectives for monitoring.

63. Select the appropriate monitoring approach (status/trend or effectiveness monitoring or both) for addressing the objectives.

64. Identify and review existing monitoring and research programs in the area of interest.

65. Determine if those programs satisfy the objectives of the proposed program.

66. If monitoring and evaluation data gaps exist, implement the appropriate monitoring approach by following the criteria outlined in 9-13.

67. Classify the landscape and streams in the area of interest.

68. Complete a data management needs assessment. Describe how data collection and management needs will be met and shared among the different entities.

69. Identify an existing database for storing biological and physical/environmental data.

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11 An efficient monitoring plan reduces “error” to the maximum extent possible. One can think of error as unexplained variability, which can reduce monitoring efficiency through the use of invalid statistical designs, biased sampling designs, poorly selected indicators, biased measurement protocols, and non-standardized reporting methods.

70. Estimate costs of implementing the program.

71. Identify cost-sharing opportunities.

The Methow Baseline Program currently employs these setup steps.

Suggested Table of Contents (for any entity implementing an M&E element)

1. Statement of Need and Program Outline

72. Summary of Indicators and Program Elements

73. Summary of Monitoring and Evaluation Priorities

74. Program Setup Statistical Design

75. Sampling Design

76. Sample Size

77. Measurement Error

78. Fish Population Monitoring Overview

79. Habitat Monitoring Overview

80. Biological Variables

81. Physical/Environmental Variables

82. Spatial Scales

83. Performance Standards

84. Classification

85. Indicators to be used

86. Measuring Protocols to be used

87. Status Trend Monitoring

88. Effectiveness Monitoring

89. Data Management Needs Assessment and Data Management Plan

90. Peer Review and Annual Reporting

91. Adaptive Management

92. References

93. Appendices as needed

Basic Statistical Considerations

This document defines “statistical design” as the logical structure of a monitoring study. It does not necessarily mean that all studies require rigorous statistical analysis. Rather, it implies that all

studies, regardless of the objectives, be designed with a logical structure that reduces bias and the likelihood that rival hypotheses are correct. The purpose of this section is two-fold. First, it identifies the minimum requirements of valid statistical designs, and second, it identifies the appropriate designs for status/trend and effectiveness monitoring. The following discussions draw heavily on the work of Hairston (1989), Hicks et al. (1999), Krebs (1999), Manly (1992, 2001), and Hillman and Giorgi (2002). (See: Hillman et al. 2004, section 3, pages 9-13.)

Sampling Design Considerations

Once the investigator has selected a valid statistical design, the next step is to select sampling sites. Sampling is a process of selecting a number of units for a study in such a way that the units represent the larger group from which they were selected. The units selected comprise a sample, and the larger group is referred to as a population.[12] All the possible sampling units available within the area (population) constitute the sampling frame.[13] The purpose of sampling is to gain information about a population. If the sample is well selected, results based on the sample can be generalized to the population. Statistical theory assists in the process of drawing conclusions about the population using information from a sample of units.

Defining the population and the sample units may not always be straightforward because the extent of the population may be unknown, and natural sample units may not exist. For example, a researcher may exclude livestock grazing from sensitive riparian areas in a watershed where grazing impacts are widespread. In this case, the management action may affect aquatic habitat conditions well downstream from the area of grazing. Therefore, the extent of the area (population) that might be affected by the management action may be unclear, and it may not be obvious which sections of streams to use as sampling units.

When the population and/or sample units cannot be clearly defined, the investigator should subjectively choose the potentially affected area and impose some type of sampling structure. For example, sampling units could be stream habitat types (e.g., pools, riffles, or glides), fixed lengths of stream (e.g., 150 metre [~500 feet] long stream reaches), or reach lengths that vary according to stream widths (e.g., see Simonson et al. 1994). Before selecting a sampling method, the investigator should define the population, size, and number of sample units, as well as the sampling frame. (See: Hillman et al. 2004, section 4, pages 9-13).

Spatial Scale

Because monitoring will occur at a range of spatial scales, there may be some confusion between the roles of status/trend monitoring and effectiveness monitoring. Generally, one thinks of status/trend monitoring as monitoring that occurs at coarser scales, and effectiveness monitoring occurring at finer scales. In reality, both occur across different spatial scales, and the integration of both is needed to develop a valid monitoring program (ISAB 2003; AA/NOAA Fisheries 2003; WSRFB 2003).

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12 This definition makes it clear that a "*population*" is not limited to a group of organisms. In statistics, it is the total set of elements or units that are the target of our curiosity. For example, habitat parameters will be monitored at sites selected from the *population* of all possible stream sites in the watershed.

13 The *sampling frame* is a "list" of all the available units or elements from which the sample can be selected. The sampling frame should have the property that every unit or element in the list has some chance of being selected in the sample. A sampling frame does not have to list all units or elements in the population.

The scale at which status/trend and effectiveness monitoring occurs depends on the objectives of the study, the size or distribution of the target population, and the indicators that will be measured. In status/trend monitoring, for example, the objective may be to measure egg-parr survival of spring Chinook salmon in the Methow Basin, but because the Methow subbasin likely consisted of multiple sub-populations of Chinook (spring and summer/fall), status/trend monitoring can occur at various scales depending on the distribution of the population of interest.

In the same way, effectiveness monitoring can occur at different spatial scales. That is, one can assess the effect of a tributary action on a specific Recovery Unit or ESU (which may encompass several populations), a specific population (may include several sub-populations), at the sub-population level (may encompass a watershed within a basin), or at the reach scale. Clearly, the objectives, and hence the indicators measured, dictate the spatial scale at which effectiveness monitoring is conducted. For example, if the objective is to assess the effects of nutrient enhancement on egg-smolt survival of spring Chinook in the Chiwawa Basin (a sub-population of the Wenatchee spring Chinook population), then the spatial scale covered by the study should include the entire area inhabited by the eggs, fry, parr, and smolts. If, on the other hand, the objective is to assess the effects of a sediment reduction project on egg-fry survival of a local group of spring Chinook (i.e., Chinook within a specific reach of stream), then the study area would only encompass the reach of stream used by spawners of that local group.

In theory, there might be no limit to the scale at which effectiveness monitoring can be applied, but in practice there is a limit. This is because, as the spatial scale increases, the tendency for multiple treatments (several habitat actions) affecting the same population increases. That is, at the spatial scale representing a Recovery Unit, ESU, or population, there may be many habitat actions within that area. Multiple treatment effects make it very difficult to assess the effects of specific actions on an ESU. Even though it may be impossible to assess specific treatment effects at larger spatial scales, it does not preclude one from conducting effectiveness monitoring at this scale. Indeed, one can assess the combined or cumulative effects of tributary actions on the Recovery Unit, ESU, or population. However, additional effectiveness monitoring may be needed at finer scales to assess the effects of individual actions on the ESU or population. (See: Hillman et al. 2004, section 5, pages 31-33.)

Classification

Both status/trend and effectiveness monitoring require landscape classification. The purpose of classification is to describe the “setting” in which monitoring occurs. This is necessary because biological and physical/environmental indicators may respond differently to tributary actions depending on landscape characteristics. A hierarchical classification system, that captures a range of landscape characteristics, should adequately describe the setting in which monitoring occurs. The idea advanced by hierarchical theory is that ecosystem processes and functions, operating at different scales, form a nested, interdependent system where one level influences other levels. Thus, an understanding of one level in a system is greatly informed by those levels above and below it.

A defensible classification system should include both ultimate and proximate control factors (Naiman et al. 1992). Ultimate controls include factors such as climate, geology, and vegetation that operate over large areas, are stable over long time periods, and act to shape the overall character and attainable conditions within a watershed or basin. Proximate controls are a function of ultimate factors and refer to local conditions of geology, landform, and biotic processes that

operate over smaller areas and over shorter time periods. These factors include processes such as discharge, temperature, sediment input, and channel migration. Ultimate and proximate control characteristics help define flow (water and sediment) characteristics, which in turn help shape channel characteristics within broadly predictable ranges (Rosgen 1996).

The UCMS plan proposes a classification system that incorporates the entire spectrum of processes influencing stream features, and recognizes the tiered/nested nature of landscape and aquatic features. This system captures physical/environmental differences spanning from the largest scale (regional setting) down to the channel segment. The Action Agencies/NOAA Fisheries RME plan proposes a similar classification system. By recording these descriptive characteristics, the investigator will be able to assess differential responses of indicator variables to proposed actions within different classes of streams and watersheds. Importantly, the classification work described here fits well with Level 1 monitoring under the ISAB (2003) recommended strategies for restoring tributary habitat. Classification variables and recommended methods for measuring each variable are defined below. (See: Hillman et al. 2004) section 6, pages 33-45.).

The Upper Columbia Recovery Plan process is currently collecting information (GIS-based) to include this element.

Indicators

The Methow subbasin planners have identified the following as a subset of key indicators: bankfull width, reach length, bankfull depth, sediment, wood, gradient, pools, residual pool depth, bank stability, temperature, invertebrates, shade, and riparian characteristics.

Additional indicators that provide information for use in assessing fish population structure, distribution, and habitat conditions as described generally in the EDT analytical model and method, are also targeted in the Methow Baseline Program.

These indicators represent a subset of variables that should be measured. Investigators can measure additional variables depending on their objectives and past activities. For example, reclamation of mining-impact areas may require the monitoring of pollutants, toxicants, or metals. Some management actions may require the measurement of thalweg[14] profile, placement of artificial instream structures, or livestock presence. Adding other needed indicators will supplement the core list.

Indicator variables identified in the UCMS template are consistent with those identified in the Action Agencies/NOAA Fisheries RME Plan and with most of the indicators identified in the WSRFB (2003) monitoring strategy. The Action Agencies/NOAA Fisheries selected indicators based on their review of the literature (e.g., Bjornn and Reiser 1991; Spence et al. 1996; and Gregory and Bisson 1997) and several regional monitoring programs (e.g., PIBO, AREMP, EMAP, WSRFB, and the Oregon Plan). They selected variables that met various purposes, including assessment of fish production and survival, identifying limiting factors, assessing effects of various land uses, and evaluating habitat actions. Their criteria for selecting variables were based on the following characteristics:

14 “Thalweg” is defined as the path of a stream that follows the deepest part of the channel (Armantrout 1998).

- Indicators should be sensitive to land use activities or stresses.
- They should be consistent with other regional monitoring programs.
- They should lend themselves to reliable measurement.
- Physical/environmental indicators would relate quantitatively with fish production.

Table 56 Biological indicator variables (with conceptual protocols) to be monitored in the Methow Baseline M&E Program

General characteristics	Specific indicators	Recommended protocol	Sampling frequency	HGMP Performance Indicator
Adults	Escapement/ Number	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	--Total number of fish harvested in Colville Tribes summer/fall fisheries. --Annual number of summer/fall Chinook spawners in each spawning area, by age (Similkameen River, Methow River, Columbia River above Wells Dam). Etc.
	Age structure	Borgerson (1992)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Sex ratio	Strange (1996)	Annual	To be completed as above
	Origin (hatchery or wild)	Borgerson (1992)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above
	Fecundity	Cailliet et al. (1986)	Annual	To be completed as above
Redds	Number	Mosey and Murphy (2002)	Annual	To be completed as above
	Distribution	Mosey and Murphy (2002)	Annual	To be completed as above
Parr/Juveniles	Abundance/ Distribution	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
Smolts	Number	Murdoch et al. (2000)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above

General characteristics	Specific indicators	Recommended protocol	Sampling frequency	HGMP Performance Indicator
Macroinvertebrates	Transport	Wipfli and Gregovich (2002)	Annual/Monthly	To be completed as above
	Composition	Peck et al. (2001)1	Annual	To be completed as above

Measuring Protocols

An important component of all regional monitoring strategies (ISAB, Action Agencies/NOAA Fisheries, and WSRFB) is that the same measurement method be used to measure a given indicator. The reason for this is to allow comparisons of biological and physical/environmental conditions within and among watersheds and basins.[15] This section identifies methods to be used to measure biological and physical/environmental indicators. The methods identified in this plan are consistent with those described in the Action Agencies/NOAA Fisheries RME Plan and, for the most part, are consistent with EMAP and WSRFB protocols.

PNAMP is supporting an initiative to coordinate a side-by-side comparison of protocols, and will communicate to subbasin planners which protocols will be included in the test. This comparison, which is proposed to take place in 2005, will be done to identify which protocols are best for determining watershed condition status and trend. It is possible a pilot study in the John Day basin will take place in 2004 if funding and logistical constraints are resolved.

The Action Agencies/NOAA Fisheries monitoring group reviewed several publications, including the work of Johnson et al. (2001) that describe methods for measuring indicators. Not surprisingly, there can be several different methods for measuring the same variable. For example, channel substrate can be described using surface visual analysis, pebble counts, or substrate core samples (either McNeil core samples or freeze-core samples). These techniques range from the easiest and fastest to the most involved and informative. As a result, one can define two levels of sampling methods. Level 1 (extensive methods) involves fast and easy methods that can be completed at multiple sites, while Level 2 (intensive methods) includes methods that increase accuracy and precision, but require more sampling time. The Action Agencies/NOAA Fisheries monitoring group selected primarily Level 2 methods, which minimize sampling error, but maximize cost.

Before identifying measuring protocols, it is important to define a few terms. These terms are consistent with the Action Agencies/NOAA Fisheries RME Plan.

Reach (effectiveness monitoring) – for effectiveness monitoring, a stream reach is defined as a relatively homogeneous stretch of a stream having similar regional, drainage basin, valley segment, and channel segment characteristics, and a repetitious sequence of habitat types. Reaches are identified by using a list of classification (stratification) variables. Reaches may contain one or more sites. The starting point and ending point of reaches will be measured with Global Positioning System (GPS) and recorded as Universal Transverse Mercator (UTM).

15 Bonar and Hubert (2002) and Hayes et al. (2003) review the benefits, challenges, and the need for standardized sampling.

Although the level of accuracy expected from GPS reporting of stream locations may not be sufficient for all subbasin monitoring and evaluation purposes, the researchers for the John Day and Upper Columbia projects are planning to use it for the subbasin pilot efforts.

Reach (status/trend monitoring) – For status/trend monitoring, this section refers only to a "sampling reach" as defined by the EMAP design and referenced in the UC Strategy document. This is one method to consider using to initially locate a reach, with the "X" point being the place where bankfull width is determined. From this location, the extent of the upstream and downstream boundaries (total reach length) are determined according to the protocol used. Data collected in the sampling reach should be linked to the best available hydrograpghy layers to facilitate mapping and use in a GIS. Typically the 1:100,000 scale has been used, but a routed 1:24,000 scale hydrography may soon become available.

Note: Standardized GIS and post processing of spatial data will require a standardized protocol that does not currently exist. In the interim PNAMP recommends the following: 1. all GIS data should be provided with Federal Geographic Data Committee compliant metadata, including information on projection used; 2. data should be linked to a standardized stream each identification system to facilitate mapping and use in GIS; and, 3. use existing 1:100,000 and 1:24,000 hydrography layers where they have been cleaned and routed, and if not, use the best available information.

Site (effectiveness monitoring) – a site is an area of the effectiveness monitoring stream reach that forms the smallest sampling unit with a defined boundary. Site length depends on the width of the stream channel. Sites will be 20 times the average bankfull width with a minimum length of 150 metres (492 feet) and a maximum length of 500 metres (1640 feet). Site lengths are measured along the thalweg. The upstream and downstream boundaries of the site will be measured with GPS and recorded as UTM. For purposes of re-measurements, these points will also be photographed, marked with permanent markers (e.g., orange plastic survey stakes), and carefully identified on maps and site diagrams. Site lengths and boundaries will be "fixed" the first time they are surveyed and they will not change over time even if future conditions change.

Transect – a transect is a straight line across a stream channel, perpendicular to the flow, along which habitat features such as width, depth, and substrate are measured at predetermined intervals. Effectiveness monitoring sites and status/trend monitoring reaches will be divided into 11 evenly-spaced transects by dividing the site into 10 equidistant intervals with "transect 1" at the downstream end of the site or reach, and "transect 11" at the upstream end of the site or reach. The number of transects varies for different attributes.

Habitat Type – Habitat types, or channel geomorphic units, are discrete, relatively homogenous areas of a channel that differ in depth, velocity, and substrate characteristics from adjoining areas. This plan recommends that the investigator identify the habitat type under each transect within a site or reach following the Level II classification system in Hawkins et al. (1993). That is, habitat will be classified as turbulent fast water, non-turbulent fast water, scour pool, or dammed pool (see definitions in Hawkins et al. 1993). By definition, for a habitat unit to be classified, it should be longer than it is wide. Plunge pools, a type of scour pool, are the exception, because they can be shorter than they are wide (See: Hillman et al. 2004, section 8, pages 59-76).

Status/Trend Monitoring

If the objective of the monitoring program is to assess the current status of populations and/or environmental conditions, or to assess long-term trends in these parameters, then the following steps will help the investigator design a valid status/trend monitoring program.

Problem Statement and Overarching Issues:

1. Identify and describe the problem to be addressed.

94. Identify boundaries of the study area.

95. Describe the goal or purpose of the study.

96. List hypotheses to be tested.

- Statistical Design (see Section 3 of UCMS Strategy):

1. Describe the statistical design to be used (e.g., EMAP design).

97. List and describe potential threats to external validity and how these threats will be addressed.

98. If this is a pilot test, explain why it is needed.

99. Describe descriptive and inferential statistics to be used and how precision of statistical estimates will be calculated.

Sampling Design (see Sections 4 & 5 of UCMS Strategy):

1. Describe the statistical population(s) to be sampled.

100. Define and describe sampling units.

101. Identify the number of sampling units that make up the sampling frame.

102. Describe how sampling units will be selected (e.g., random, stratified-random, systematic, etc.).

103. Describe variability or estimated variability of the statistical population(s).

104. Define Type I and II errors to be used in statistical tests (the plan recommends no less than 0.80 power).

Measurements (see Sections 7 & 8 of UCMS Strategy):

1. Identify indicator variables to be measured.

105. Describe methods and instruments to be used to measure indicators.

106. Describe precision of measuring instruments.

107. Describe possible effects of measuring instruments on sampling units (e.g., core sampling for sediment may affect local sediment conditions). If such effects are expected, describe how the study will deal with them.

108. Describe steps to be taken to minimize systematic errors.

109. Describe QA/QC plan, if any.

110. Describe sampling frequency for field measurements.

Results:

1. Explain how the results of this study will yield information relevant to management decisions.

Subbasin planners should include a section to explain how the data from the study (with metadata) will be stored, managed and made available to others. A starting point, for some subbasin data collection efforts, could be the data definitions document for the Upper Columbia and John Day pilot projects once it has been reviewed. Proponents for the Upper Columbia and John Day projects are reviewing the final data dictionary on which their data system will be developed. The mechanics of data management in the Upper Columbia and John Day systems are being developed by the respective project teams and need significant additional work.

Data Management

Several forms of analysis will be required as data are gathered. Statistical tests, design components, database management architecture, and various reporting format requirements are things the sponsor will take into consideration. A data management protocol will be established following the general outline:

- Develop Data Dictionary
- Other Documentation
- Develop Data Flow Diagram
- Process Flow Diagram
- Prepare Data Management Plan (who, what, when, how)
- Develop Forms
- Develop Field Forms
- Create List of Useful Existing Forms
- Create Rough Drafts of Needed Forms
- Edit Forms to Coincide with Finalized Data Dictionary (when complete)
- Finalize Field Forms
- Develop PDA Forms
- Develop Data Loggers
- Establish Data Collection and Reporting Standards
- Establish appropriate level of granularity

- Create/Adopt Chain of Custody Protocols
- Create/Adopt QA/QC Protocols
- Create/Adopt All Methods, Indicators, Metrics and Protocols (sampling and statistical design)
- Create/Adopt Field Manuals
- Field Forms
- PDAs
- Data Loggers
- Test Field Manuals and Equipment
- Training of all field crews and outside contractors
- Collect Data
- Field Forms
- PDAs
- Data Loggers
- Data Reporting Timelines, Protocols and Formats
- QA/QC
- Data Transition
- Develop data transition methods (including 10.0 Below)
- Field Forms to Electronic Entry Form
- Data Loggers to Individual PCs
- Individual PCs to Central Server
- PDAs to Individual PCs
- Individual PCs to Central Server
- Test data transitions
- All data to single repository
- Develop Repository capability
- Test Repository capability
- Final Testing Check off
- Documentation

From steps above, derive a program Data Management Protocol.

Some additional considerations include:

All M&E data will be held within the data archive system developed for the Baseline M&E Plan. This system will consist of standardized Access/Excel database formats (Geospatial database structure and data dictionary being developed for the John Day will be used in the Upper Columbia), and will be compatible with other industry and BPA structures. Data will be unrestricted and available to all resource management agencies and subbasin planners. It will remain in this data archive system until delivered to BPA, the Upper Columbia RTT, CBFWA, and other basin database systems such as StreamNet, IBIS, and SSHIAP etc.

Finally, data should follow a common form for definitions. The Pacific Costal Salmon Recovery Fund project has a set of draft definitions that are currently under review by PNAMP and others, and could be used.

Wildlife

Methow Subbasin Wildlife Management Plan

The Research, Monitoring, and Evaluation (RME) plan for the subbasin is intended as a tool that will allow managers to evaluate the efficacy of employed strategies in achieving corresponding focal habitat objectives for the subbasin. If implemented, elements of the plan will also facilitate coordination and tracking of management activities within the subbasin, periodic review of progress, and a basis for recommended adjustments to management direction over time (adaptive management).

The RME plan, as presented, consists of a variety of quantitative elements, ranging from scientific wildlife and vegetation surveys, spatial analyses of project location and acreage, to simple enumeration of land use projects/regulations commented upon by cooperating agencies.

Implementation of the Subbasin Plans is ultimately the responsibility of all managers and stakeholders who participated in its development. It is recommended that this group form an "Implementation Oversight Committee," to track and guide research, monitoring and reporting activities included in the plan.

Organization of the RME plan is as follows:

Research

- Research needs, with justification, are also listed. Detailed research project design is not presented, however, being beyond the scope of the current planning effort
- Existing Data Gaps, as identified through the subbasin planning process, are listed in this section, because many will require effort above routine monitoring and evaluation to address

Monitoring and Evaluation

- Focal habitat monitoring methodology, and Management Plan strategies addressed
- Focal species monitoring methodology, and Management Plan strategies addressed

EXISTING DATA GAPS AND RESEARCH NEEDS

In the course of subbasin plan development, a number of data gaps were identified. Some of these gaps will be filled as data is collected via the monitoring and evaluation process as the plan is implemented. Others will require formal research efforts to address. Data gaps and research needs identified during development of the subbasin plan are listed in **Table 57**.

As part of the adaptive management philosophy of subbasin planning, managers believe that additional research needs not yet identified will become apparent over time. These needs will be addressed in future subbasin plan iterations.

Table 57 Data Gaps and Research Needs, Okanogan subbasin, as identified during subbasin planning

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
GENERAL		
Testing of assumption that focal habitats are functional if a focal species assemblage's recommended management conditions are achieved		Coordinated government & NGO effort
Testing of assumption that selected species assemblages adequately represent focal habitats		Coordinated government & NGO effort
Current, broad-scale habitat data	Spatial data collection and GIS analysis	Coordinated government & NGO effort
RIPARIAN WETLANDS		
Research Needs, recommended priority order		
Refinement of recommended management conditions for Riparian Wetlands	Research need; use for update to future subbasin plan iterations	Coordinated government & NGO effort.
Data are needed on all aspects of red-eyed vireo, yellow-breasted chat and beaver ecology in the subbasin.		Coordinated government & NGO effort
Data Gaps		
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current riparian wetland data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Riparian habitat quality data. Assessment data do not address habitat quality.	Monitoring activities	Subbasin managers
Refined habitat type maps	Spatial data collection and GIS analysis	Subbasin managers
GIS soils products including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution data for red-eyed vireo, yellow-breasted chat, and beaver	Species Monitoring, Spatial data collection,	WDFW, Subbasin managers

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
	and GIS analysis	
PONDEROSA PINE		
Research Needs, recommended priority order		
Data are needed on all aspects of white-headed woodpecker nesting ecology and habitat use within the Okanogan subbasin		Coordinated government & NGO effort
Data are needed on all aspects of pygmy nuthatch and gray flycatcher nesting ecology and habitat use within the Okanogan subbasin		Coordinated government & NGO effort
Data are needed on all aspects of flammulated owl nesting ecology and habitat use, specifically related to the size, configuration, and abundance of grassy openings for foraging and clumped thickets of sapling/pole trees for roosting		Coordinated government & NGO effort
Research to determine if restored sites attract white-headed woodpeckers and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine if restored sites attract pygmy nuthatches and gray flycatchers and provide viable habitat, to include recommendations on effective treatment conditions		Coordinated government & NGO effort
Research to determine whether an intensively harvested landscape that meets snag and large tree objectives support viable white-headed woodpecker populations		Coordinated government & NGO effort
Research to determine whether a managed site attracts flammulated owls and provides viable habitat. Identification of the most effective treatment processes and conditions most effective.		Coordinated government & NGO effort
Data Gaps		
Refinement of recommended management conditions for Ponderosa pine: collect current ponderosa pine structural condition/habitat variable data	Management Objective for Ponderosa pine	Subbasin managers
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current ponderosa pine data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data do not address habitat quality.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers
Finer resolution GIS habitat type maps that include structural component and KEC data.	Coordinated, standardized monitoring efforts); Spatial data collection and GIS analysis	Subbasin managers

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
GIS soils products	Spatial data collection and GIS analysis	Subbasin managers
Identify current distribution and population levels of white-headed woodpeckers, pygmy nuthatches, gray flycatchers, and flammulated owls	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Identify current and potential areas of high quality flammulated owl habitat (short-term strategy i.e., <2 years).	Habitat Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor white-headed woodpecker, pygmy nuthatch, gray flycatcher, and flammulated owl distributions within the Okanogan subbasin, to determine current distributions, population levels and population trends	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
SHRUBSTEPPE		
Research Needs, recommended priority order		
Data are needed on all aspects of Brewer's sparrow nesting ecology, especially area requirements to maintain populations		WDFW, Subbasin managers
Data are needed on all aspects of Brewer's sparrow nesting ecology, particularly relationship to livestock grazing and pesticide use		WDFW, Subbasin managers
An assessment of the viability of small populations of Brewer's sparrow in fragments of habitat versus those in large contiguous blocks		WDFW, Subbasin managers
Data Gaps		
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current shrubsteppe data and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Habitat quality data. Assessment data bases do not address habitat quality	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Refined habitat type maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
GIS soils products, including wetland delineations	Spatial data collection and GIS analysis	Subbasin managers
Local population/distribution distribution for Brewer's sparrow and Sharp-tailed grouse.	Species Monitoring, Spatial data collection, and GIS analysis	WDFW, Subbasin managers
Monitor Brewer's sparrow and Sharp-tailed grouse distribution within the	Species Monitoring,	WDFW, Subbasin

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNEL
Okanogan subbasin, to determine current distribution, population level and population trends	Spatial data collection, and GIS analysis	managers
Evaluate the role of fire, mowing, and other management treatments to maintain/improve shrupsteppe habitat quality	Coordinated, standardized monitoring efforts	Subbasin managers

5.10.2 Monitoring And Evaluation: Focal Habitat And Species Monitoring Methodology

Recommended monitoring and evaluation strategies contained below for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established by Partners in Flight for avian species (Ralph et al, 1993, 1995) and habitat monitoring (Nott et al, 2003). Deer sampling methodology follow standard protocols established by the Washington Department of Fish and Wildlife. In addition, protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure standards (USFWS 1980a and 1980b). A common thread in the monitoring strategies, which follow, is the establishment of permanent census stations to monitor bird population and habitat changes.

Wildlife managers will include statically rigorous sampling methods to establish links between habitat enhancement prescriptions, changes in habitat conditions and target wildlife population responses.

Specific methodology for selection of Monitoring and Evaluation sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest. The following protocols describe how M&E sites will be selected (from WDFW response to ISRP http://www.cbfwa.org/files/province/cascade/projects/199609400resp.pdf):

- Vegetation/HEP monitoring and evaluation sites are selected by combining stratified random sampling elements with systematic sampling. Project sites are stratified by cover types (strata) to provide homogeneity within strata, which tends to reduce the standard error, allows for use of different sampling techniques between strata, improves precision, and allows for optimal allocation of sampling effort resulting in possible cost savings (Block et al. 2001). Macro cover types such as shrub-steppe and forest are further sub-cover typed based on dominant vegetation features i.e., percent shrub cover, percent tree cover, and/or deciduous versus evergreen shrubs and conifer versus deciduous forest. Cover type designations and maps are validated prior to conducting surveys in order to reduce sampling inaccuracies.

- Pilot studies are conducted to estimate the sample size needed for a 95% confidence level with a 10% tolerable error level (Avery 1975) and to determine the most appropriate sampling unit for the habitat variable of interest (BLM 1998). In addition, a power analysis is conducted on pilot study data (and periodically throughout data collection) to ensure that sample sizes are sufficient to identify a minimal detectable change of 20% in the variable of interest with a Type I error rate # 0.10 and P = 0.9 (BLM 1998, Hintze 1999, Block et al. 2001). M&E includes habitat trend condition monitoring on the landscape scale (Tier 1-HEP)

and plant community monitoring (Tier 2) i.e., measuring changes in vegetative communities on specific sites.

- For HEP surveys, specific transect locations within strata are determined by placing a Universal Transverse Mercator (UTM) grid over the study area (strata) and randomly selecting "X" and "Y" coordinates to designate transect start points. Random transect azimuths are chosen from a computer generated random number program, or from a standard random number table. Data points and micro plots are systematically placed along the line intercept transect at assigned intervals as described in Part 2 – monitoring section of the proposal. Sample sizes for statistical inferences are determined by replication and systematic placement of lines of intercept within the strata with sufficient distance between the lines to assume independence and to provide uniform coverage over the study site.

- Permanent vegetation monitoring transect locations are determined by placing a UTM grid over the strata and randomly selecting "X" and "Y" coordinates to designate plot locations as described for HEP surveys. One hundred meter baseline transect azimuths are randomly selected from a random numbers table. Ten perpendicular 30 meter transects are established at 10 meter intervals along the baseline transect to form a 100m x 30m rectangle (sample unit). Micro plot and shrub intercept data are collected at systematic intervals on the perpendicular transects.

By systematically collecting and analyzing plant species frequency, abundance, density, height, and percent cover data, vegetative trends through time can be described. Likewise, the effectiveness of exotic weed control methods can be evaluated and weed control plans can be adjusted accordingly.

Presence of all exotic weeds i.e., knapweeds, yellow starthistle, etc. will be mapped in GIS using Global Positioning System (GPS) equipment. This information will be used to develop an annual exotic vegetation control plan.

Causes of seeding or planting failure will be identified and planting methods/site preparation will be modified as necessary. Data will be collected and analyzed, and, where necessary, changes in the management plan (adaptive management) will be identified and implemented.

General and site specific M&E protocols, outlining monitoring goals and objectives and specific sampling designs are included in the following monitoring section.

In addition to defining habitat and species population trends, monitoring will also be used to determine if management actions have been carried out as planned (implementation monitoring). In addition to monitoring plan implementation, monitoring results will be evaluated to determine if management actions are achieving desired goals and objectives (effectiveness monitoring) and to provide evidence supporting the continuation of proposed management actions. Areas planted to native shrubs/trees and/or seeded to herbaceous cover will be monitored twice a year to determine shrub/seeding survival, and causes of shrub mortality and seeding failure i.e. depredation, climatic impacts, poor site conditions, poor seed/shrub sources.

Monitoring of habitat attributes and focal species in this manner will provide a standardized means of tracking progress towards conservation, not only within the Okanogan subbasin, but within a national context as well. Monitoring will provide essential feedback for demonstrating

adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in the subbasin planning process.

The Role of Research

Subbasin plans can be used to help list key uncertainties and assumptions to test.

Monitoring can be designed to answer some research questions, in the sense of adaptive management. Implementing the subbasin plans can be done as management experiments to track and test.

As an example, the main hypotheses and key assumptions pertaining to the “key ecological functions” part of the IBIS database can be listed (see http://www.spiritone.com/~brucem/kef1.htm#Hypotheses) as a basis for selected research studies.