APPENDIX F
Fish Habitat Module

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Introduction

The many elements of fish habitat that affect the production of salmonids during the freshwater phases of their life history can be organized into two general categories: elements of physical habitat and factors that affect food production. Physical habitat features include depth and velocity ranges (usually grouped by channel units, e.g., pools, riffles), cover, spawning gravels, and temperature ranges. Influences of forest management on these features as well as on other aspects of water quality and food production are extensively discussed in Meehan (1991).

A number of studies indicate that the characteristics of physical habitat influence the density and survival of salmonids during the freshwater phases of their life history (Salo and Cundy 1987, Fausch et al. 1988, and Meehan 1991 provide extensive reviews), and that forest practices directly affect these elements of physical habitat (Salo and Cundy 1987, Meehan 1991). At present, the strongest link between forest practices and their effect on fish habitat is the description of physical habitat characteristics. We therefore assume that degradation of physical habitat features will result in reductions in salmonid production.

One difficulty in assessing fish habitats in a watershed is that of the spatial scale at which the analysis is focused. Classification systems are frequently used to aid in describing habitat conditions and channel response at the reach scale (Cupp 1989, Beechie and Sibley 1990, Naiman et al. 1991, Montgomery and Buffington 1993), whereas limiting factors analyses are more properly approached at the scale of the WAU or larger (Reeves et al. 1989). The spatial scale at which to conduct the analysis is further complicated by the fact that different salmonid species have differing ranges during their freshwater life history phases. For example, coho salmon may occupy summer rearing habitats within a WAU and then move downstream beyond the WAU boundaries to find winter rearing habitats, whereas resident cutthroat trout can spend their entire life within a portion of a WAU. The complete assessment requires that both scales be considered, and that care be taken to avoid incorrect assumptions about seasonal migrations into or out of the WAU.

Temporal scale is also an important consideration in fish habitat management. Habitats in a reach or watershed can be degraded over short time periods and can recover over a variety of time scales, and disturbances can be either acute or chronic. It is therefore important to define the scales at which watershed assessments occur. This is an especially important concept when stock status is considered. When stocks are clearly at risk, habitat management measures may include immediate stop-gap measures in conjunction with more comprehensive watershed restoration. When stocks are relatively healthy, stop-gap measures

may not be cost-effective and habitat restoration may be focused on broader scale watershed management measures.

Another difficulty is that of multiple species management, where managing for a single species may be detrimental to other species. The idea that biodiversity can be conserved when managing for habitats preferred by a single species appears unlikely to succeed. We chose to approach the problem of watershed level fish habitat assessment with the idea that the range of potential habitat conditions at the reach scale is controlled by geomorphic setting, and that old-growth conditions most closely represent the conditions to which multiple species have adapted over the past several thousand years (Benda et al. 1992, Peterson et al. 1992). When possible, we have used data from undisturbed systems to develop habitat diagnostics that reflect habitat conditions preferred by salmonid species at their various freshwater life history stages. This approach does not imply that preferred fish habitat only occurs in old-growth forests. Rather the strategy is to use knowledge of habitat in old-growth forest as a basis for identifying changes in habitat conditions.

The analysis is structured around the habitat needs of individual species and life history stages on a temporal and spacial scale. Indices of habitat conditions are based on habitat utilization and on stream characteristics which have supported a multitude of species at healthy levels prior to extensive habitat changes. These two components of the approach are driven by 1) concept of limiting factors analysis (Reeves et al. 1989, Reeves et al. 1991) and 2) the understanding that the nature of stream habitats is strongly influenced by geomorphic setting (Benda et al. 1992). The result is a comprehensive understanding of the distribution of fish species in a WAU and the factors that appear to most strongly influence the abundance of individual species.

Because most salmonid species migrate seasonally within or beyond a WAU to occupy preferred habitats, most accessible reaches are considered to be important habitats for at least one species during any season. However, some reaches can be identified as reaches of greater importance due to concentrated use (e.g., a chum spawning reach), limited availability of a habitat type (e.g., a single area that accounts for most of the coho winter rearing habitat), habitat degradation (e.g., evidence indicates that pool quantity and quality have been dramatically reduced), or other factors. These reaches deserve special attention because they help to focus the efforts of channel assessment, they provide insight into the causes of degradation, and indicate reach types that may be especially sensitive to impacts. They also focus attention on reaches that require more careful prescriptions to address habitat protection and restoration.

The products produced by the fish habitat module are intended to identify and delineate the fisheries resources in the WAU. The vulnerability of fish habitat to potential impacts from the five input variables is not determined in this module

as was the case in Version 1.0. Habitat vulnerability is a function of fish habitat utilization, habitat condition, and the sensitivity of habitat to physical disturbance. The latter information is developed by the channel module for the purpose of assessing habitat vulnerability. The strategy is to use the results from the fish habitat and channel module during the Synthesis Phase to create habitat vulnerability calls for the five input variables.

Critical Questions

The goal of the fish module is to locate all accessible fish habitat in the WAU and to identify existing habitat conditions including habitats of special concern. The latter includes degraded habitats, habitats with a high use by fish, and habitats of limited availability. Critical questions addressed by the fish module are:

What is the distribution and relative abundance of salmonid fish species in the WAU?

Where are areas of degraded habitats in the WAU (by species and life history stage)?

Where are areas of high existing or potential habitat use (by species and life history stage)?

Where are areas of limited habitat availability.

To answer these critical questions the fish module will address the following objectives:

- Determine the historic and present fish distribution in the basin
- Identify the historic trends in fish abundance by stock.
- Determine the existing habitat conditions.
- Evaluate distribution changes, abundance trends, and existing habitat conditions to identify degraded habitats.
- Evaluate habitat utilization and habitat preference information to identify high use areas and habitats of limited availability.

Assumptions

The fundamental assumptions upon which the analysis is based are:

- Fish distribution is a function of the quantity and quality of habitat types available in a WAU. That is, reach type strongly influences the types of habitats available within the reach, which in turn influences the species use in the reach. The distribution of fish species in a WAU is therefore a function of the distribution of reach types in a WAU.

- The habitat conditions to which salmonid species have been exposed during the past several thousand years are accurately represented by conditions in streams in unmanaged forests, and where known, these conditions provide appropriate reference points for indices of habitat condition. (This does not necessarily imply that these conditions can be achieved only in old-growth forests.)

- Fish abundance is dependent on the success of each life phase, which is limited in part by the quantity and quality of habitat available for each life phase.

- Factors that limit salmonid abundance can be accurately described as the sum of reach level habitat conditions across the WAU. Therefore, habitat conditions within a reach accurately reflect incremental impacts to both salmonid habitat and production.

- No single measure of habitat is sufficient to describe habitat conditions in a reach. Nor is any habitat index accurate 100 percent of the time. Use of several habitat diagnostics to describe conditions is a more robust method of habitat evaluation.

Overview of Assessment and Products

During the fish habitat assessment, the analyst gathers information concerning the fisheries resources and habitat conditions in a basin, asks specific questions about habitat conditions that may limit fish production, identifies limiting factors (when possible) and areas of special concern in the basin. The assessment is an iterative process that requires repeated evaluation of information and testing of hypotheses. Habitat evaluation and hypothesis development is initially based on existing information, and follow-up analyses are targeted on verification of these hypotheses using new information from a field survey.

The method allows for Level 1 and Level 2 assessments, with the basic difference between the two levels being the degree of confidence with which the critical questions can be answered. The method encourages Level 2 effort to avoid incorrect interpretations of habitat conditions that stem from limited data. Because interpretations of habitat data are rarely simple, the analyst should constantly be aware of the objectives of the module and should apply the level of effort necessary to accomplish them with reasonably high confidence. The basic difference between Levels 1 and 2 is the level of field effort applied to the analysis. At Level 1 the analyst visits fewer sites and relies more on visual assessments of habitat conditions. Because of time limitations for Level 1, a set of habitat quality indices based on channel geomorphic characteristics is provided. This enables the analyst to evaluate potential habitat conditions when field data is not available. Level 2 involves broader coverage of stream reaches

in the WAU and generally requires field measurement of habitat parameters used as diagnostics. However, at both levels the same questions are asked and the same parameters are used. Confidence in the habitat assessment is lower for Level 1 because the results rely on assumed habitat potential rather than actual data.

The general process of fish habitat assessment is the same in all watershed analyses. However, because the nature of fish habitats and the availability of data within WAUs will vary widely around the state, the development of hypotheses and the focus of assessment efforts will vary from between individual watershed analyses. That is, the fish habitat assessment is intended to be focused differently depending species of importance in the WAU and on the types of habitat problems identified during the assessment. These differences will often be related to the location of the WAU (e.g., east side of Cascades vs west side of Cascades) and on interpretations of stock status (e.g., limiting wild stocks or stocks at risk).

The analyst begins by gathering as much existing data as possible (typically allowing several weeks lead time for responses to surveys of local biologists and requests for compiled or raw data). Data gathered at this phase of the analysis include species distributions, spawning and escapement data, habitat data, description of "critical" habitat areas, and descriptions of known habitat problems. Data are organized according to the reach stratification developed in the channel assessment (Map E-1, Form E-1).

The analyst examines the data with the critical questions in mind with respect to four life history phases; upstream migration, spawning and incubation, summer rearing, and winter rearing. When habitat data are available, the analyst examines them relative to the reference ranges and tentatively identifies areas of degraded and preferred habitats. Other data (e.g., spawner escapement trends) are used as supporting evidence to aid in interpreting the likely effects of habitat data on the populations in the WAU. Based on hypotheses of habitat degradation and habitat utilization, the analyst identifies further information needs and specific reaches where field examination is required. When habitat data are not available the analyst uses descriptions of critical habitat areas and areas of degraded habitat to formulate the initial working hypotheses and to direct field efforts toward the most important reaches.

During field surveys, the analyst should give special attention to diagnostics that are related to the important life history phases identified with the existing data. The analyst should always be mindful of the critical questions to be answered. More specifically, the analyst should try to 1) identify areas of degraded habitat and to locate other reaches with similar habitat functions that may have similar sensitivities to impacts, 2) locate reaches that are of greater importance to the species in the basin (e.g., high utilization or limiting habitats),

and 3) note other factors that indicate habitat problems, species of special importance, or potentially sensitive habitats.

Based on the new information, the analyst must identify and locate all habitats of special concern on a map overlay. Data supporting these decisions are summarized in a table that indicates the reach location and source of the data. This allows for easy data retrieval for each reach. A summary form will be used to condense the data results for all reaches so that the analyst can get a better understanding of habitat conditions in the entire WAU.

The products include four maps and short narrative descriptions for the general status of fish habitat by life history stage, plus additional details for each area of special concern. The map for each life history phase will show the Water Type 3 and 4 boundaries, species distribution, and areas of special concern for the specific life phase. The identification of areas of special concern are intended to focus the attention of other analysts and prescription writers on areas that require special attention for habitat protection or restoration. Areas not identified as a special concern should also receive a brief description of their functions as habitat and their relative importance in the WAU.

Whenever possible, the analyst should identify the perceived cause of habitat problems (i.e., which of the five input variables most influence a given habitat condition). This helps to focus the analysis and provides hypotheses that can be tested later in synthesis. At all times, the analyst must be communicating with those conducting the channel and riparian assessments so that data gaps can be filled as efficiently as possible.

Qualifications

Skills

- Familiarity with information and data bases (e.g., WARIS, SASSI) relevant to stream habitat.
- Knowledge of habitat requirements (at all life stages) of resident and anadromous fish common in the Pacific Northwest.
- Knowledge of the habitat forming processes active in stream channels in forested and mountainous terrain.
- Ability to evaluate stream habitat conditions.

Education and Training

- Bachelor's degree in fisheries biology, or in a related field such as zoology, wildlife biology, with a significant amount of course-work or other training (academic or commercial short courses, etc.) in stream habitat

characteristics relevant to freshwater fisheries (particularly in forested basins).

Experience

- Level 1 - At least one year of field experience in data collection and analysis, management, or research regarding fish habitat assessment in forested and/or mountainous areas.

- Level 2 - A minimum of two years experience conducting relevant independent research or fish habitat assessments in streams.

Background Information

Several types of information are used repeatedly throughout the habitat assessment. Gather this information from the respective sources during the startup process.

Maps

- Water-type maps are available from DNR's Photo and Map Sales. Revisions may be available from land owners, tribes, and agencies. These maps indicate the water type (a legal classification) of many streams and rivers in the state. They are also available on DNR's ARC-INFO-based Geographic Information System (GIS).

- WAU base map (from startup).

Other

- Washington Rivers Information System (WARIS) information is available from the state Department of Fish and Wildlife (WDFW). WARIS is essentially an updated GIS version of the Washington Department of Fisheries (WDF) stream catalogue with added resident fish data. It contains valuable information on fish distribution, migration barriers, passage facilities, and hatchery locations. Unless you have GIS capabilities, WARIS information will come to you in map form at the 1:24,000 scale.

- Limited numbers of the catalog of Washington Streams and Salmon Utilization are available from the state Department of Fish and Wildlife. Catalog 1 covers streams flowing into Puget Sound; Catalog 2 covers streams flowing into coastal waters. No Columbia River streams are included in the catalogs. All information in these catalogues is dated 1972 or earlier and includes data on the distributions of the five Pacific salmon species, the location of fish migration barriers, summer and winter wetted stream widths, spawning substrate characteristics, river mileage and stream lengths, timing information, passage facilities, and hatcheries. Only a limited number of these publications are available, so cooperators who already have them are

encouraged to share. Local cooperators may have updated sections of the catalogue.

- The Washington State Salmon and Steelhead Stock Inventory (SASSI) is available from the Washington Department of Fish and Wildlife.

- An inventory of resources within the watershed, a source of information on the presence/absence and location of vulnerable, threatened, and endangered fish species in the study area, is available from the Priority Habitats and Species Division of the state Department of Fish and Wildlife.

- Personal and first-hand knowledge of the area. Conduct interviews or request information from appropriate resource managers to acquire local knowledge. Use the form Fisheries Information Request for Watershed Analysis (Form F-1) as a guide for an interview or send the form to the appropriate person. This form provides a list of questions that should be answered as completely as possible. Contact the state Department of Fish and Wildlife to identify biologists with watershed analysis responsibility. In either agency, several biologists may have relevant expertise. Requests for fisheries information should be made to the appropriate respondents several weeks in advance of the watershed analysis.

- If the drainage is within the Usual and Accustomed Area of any federally recognized treaty tribes, contact these tribes to determine appropriate resource management personnel.

- Contact the Northwest Indian Fisheries Commission (206) 438-1180 to determine if any ambient monitoring stream surveys were conducted for the basin.

- If the U. S. Forest Service is a landowner in the WAU, they may have habitat inventory information and information concerning fish distribution.

Analysis Procedure

The procedure is performed in three steps; first, existing information is collected and evaluated to describe the fisheries resource conditions in the basin and to identify information gaps; second, new information is collected by a field survey to fill the information gaps; and third, all existing and new information is evaluated to identify and qualify habitat conditions in the basin.

Analysis of Existing Information

Fish Distribution and Abundance

All waters in the WAU utilized by salmonids are the primary areas of concern for the fish habitat assessment. The upstream extent of salmonid occurrence can

be initially identified using the state Department of Natural Resources Water Type 3/4 boundary. The distribution of salmonid species within Water Types 1, 2, and 3 is determined from a variety of sources, including WARIS, Stream Catalog, Tribal records, interviews, etc. The analyst should be aware that these maps and data base sources are often inaccurate and that interviews and field information may often be needed to update the information. The analyst is requested to get any updated information back to the sources for corrections to the maps and databases. Based on this information, prepare a mylar overlay map, indexed to the WAU base map, showing the distribution of salmonids by species in the WAU. This will be labeled Map F-1 and should show historical and present fish distribution throughout the WAU. If present and historical distribution is significantly different, please footnote Map F-1 with a brief description of the reasons(s).

Check for inconsistencies between fish distribution data and water type boundaries. If a conflict is detected, contact the regional Department of Natural Resources office for confirmation of a boundary or visit the site and determine the extent of fish use. Indicate the upstream boundaries for all Type 3 Waters and the species occurrence zones by using the species and water type coding scheme shown in Figure F-1. Complete Map F-1 using Figure F-1 as a reference for water type coding schemes and the following codes to identify fish species:

Table F-1: Species Code Table

Species	Code
Coho Salmon	CO
King Salmon *	K
Sockeye Salmon	S
Chum Salmon	CH
Pink Salmon	P
Steelhead Trout *	SH
Dolly Varden Char	DV
Bull Trout	BU
Cutthroat Trout	CT
Rainbow Trout	RB
Brook Trout	BK
Brown Trout	BR

*May be further distinguished by race, where SPK + Spring Chinook, SK = Summer Chinook, FK = Fall Chinook, SSH = Summer Steelhead, and WSH = Winter Steelhead.

Using the fish distribution information, partition the watershed into zones of dominant species/life history use. These zones are:

- resident
- anadromous with brief freshwater residence (i.e., pink and chum)
- anadromous with long term freshwater residence (i.e., coho, chinook, sockeye, steelhead, and other anadromous trout)

The mylar overlay is a working map, which will be used to formulate your initial hypotheses concerning fish occurrence and habitat conditions in the WAU.

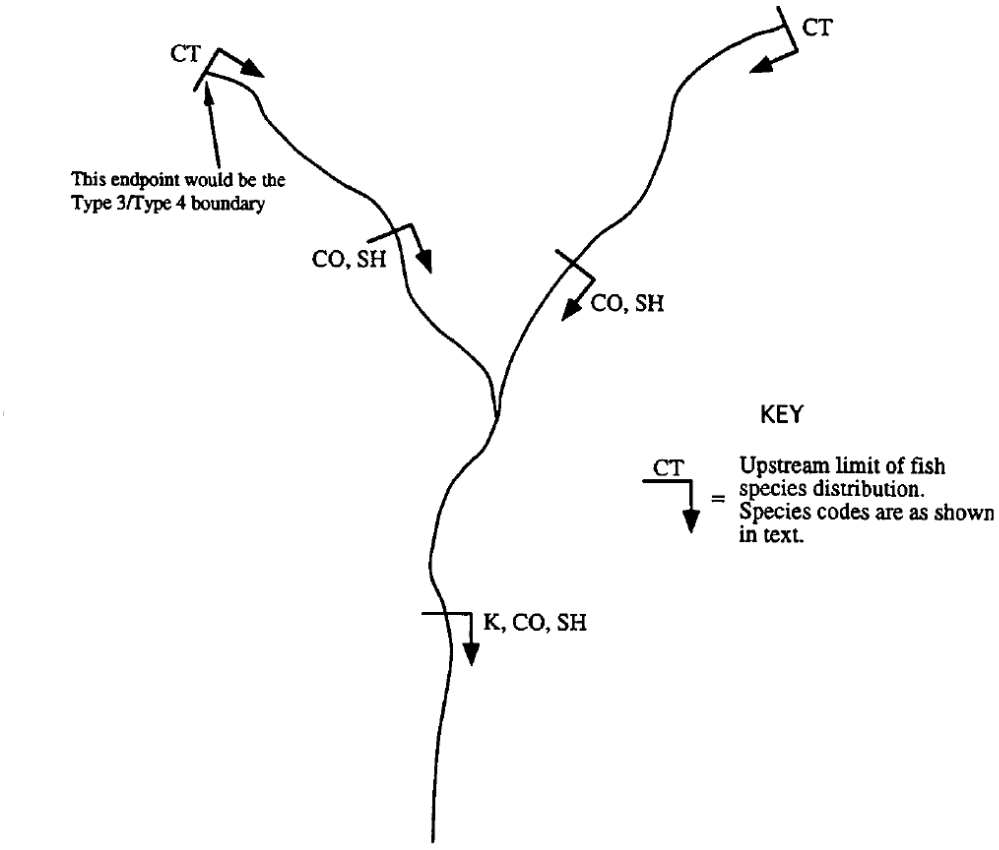


Figure F-1: Example map showing salmonid species distribution.

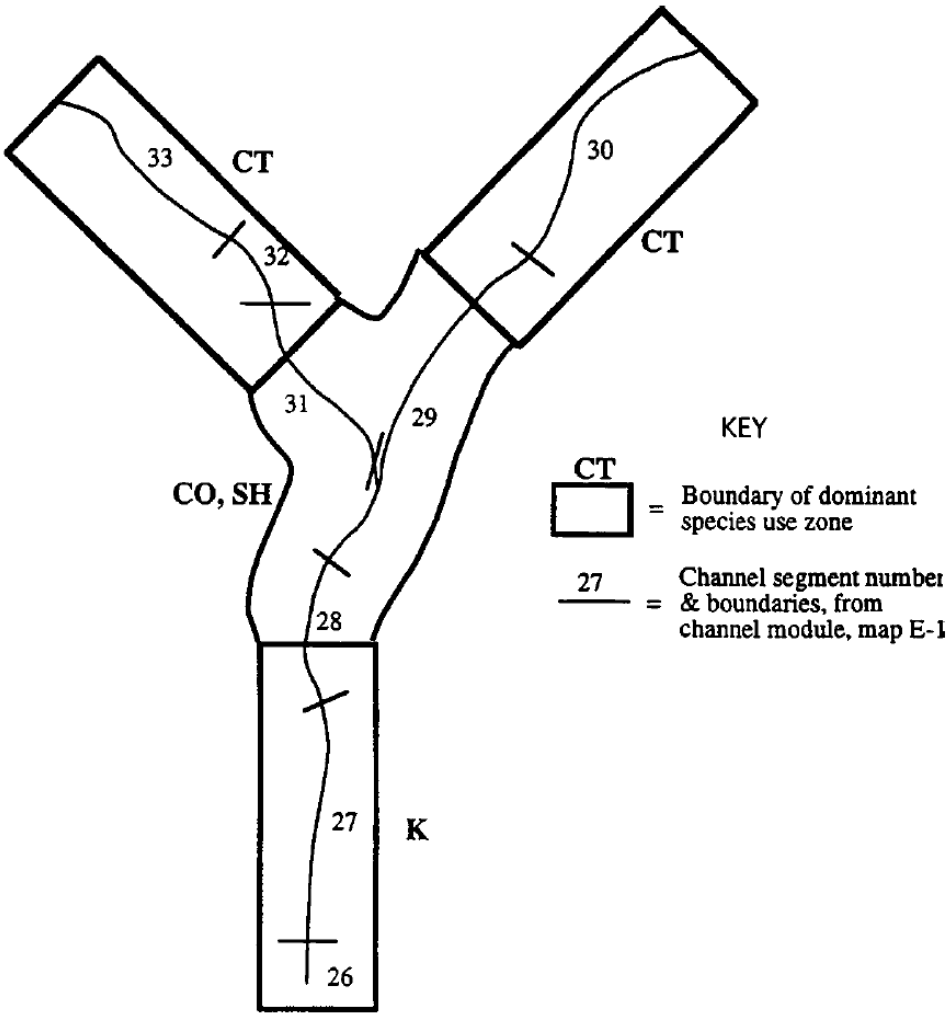


Figure F-2: Example map showing zones of dominant species use.

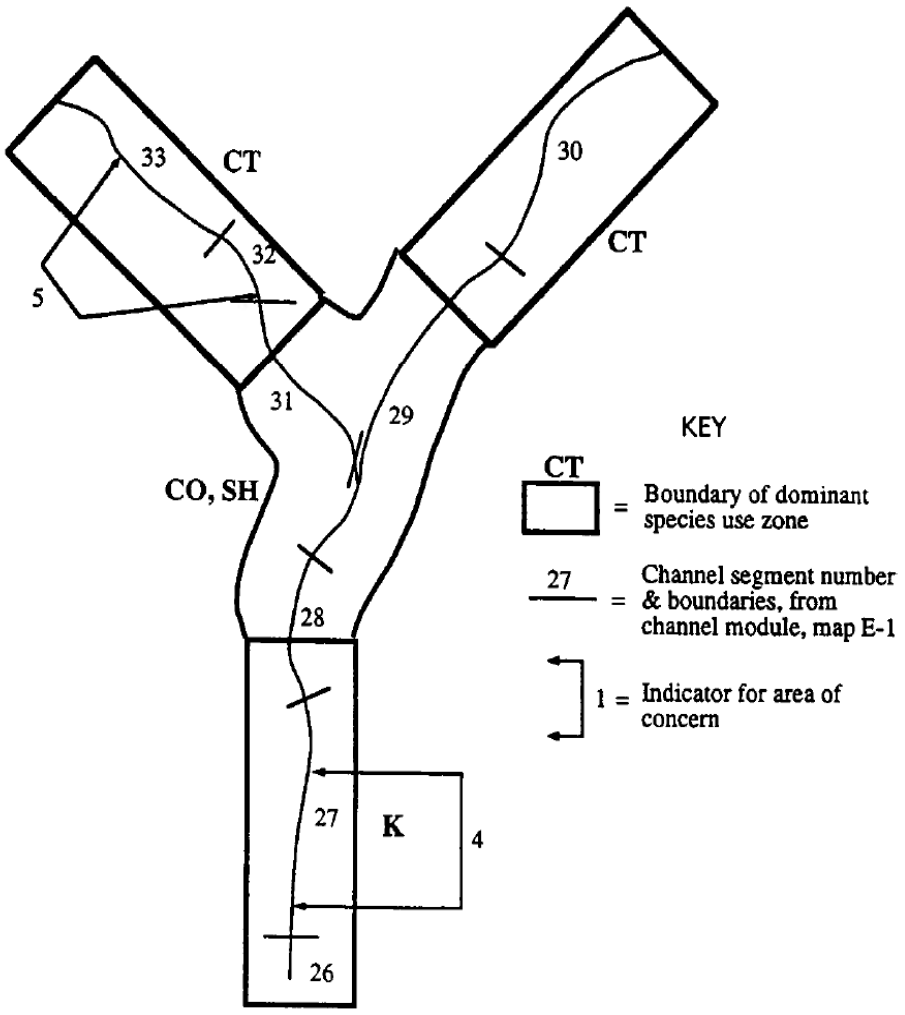


Figure F-3: Example map showing zones of dominant species use and areas of special concern for spawning habitat. Three additional maps are required to display concerns for upstream migration, summer rearing, and winter rearing habitats.

A summary of historic trends in fish abundance and the status of fish stocks in the WAU needs to be developed for the fish habitat assessment. Historic changes in fish abundance may be linked to habitat changes and may be used to identify specific historic events or locations within the WAU that are associated with population changes. Trends in fish abundance also indicate stocks that may be particularly sensitive to habitat degradation because of their low abundance at the present time.

Using agency/tribal documents and information from interviews with local biologists, prepare a tabular summary of historic trends in fish abundance for each salmonid species in the WAU. This summary should indicate the following information for each species:

- estimated historic population size
- estimated current population size
- current escapement goal
- general trends in relative abundance for past 30 years (i.e., increasing, decreasing, stable)

Annual escapement estimates based on spawner surveys or redd counts are the most likely information available. Some basins will have weir counts of adult migrants or smolt trap counts but this information is limited. Summarize the data by sub-basin if available. If data is not available at the WAU scale, use the next largest basin, where data is available. In the latter case, try to determine from interviews what proportion of the total population utilizes the WAU.

Because the time allowed to complete the watershed analysis is limited (21 days at Level 1 or 60 days at Level 2), do not spend more time than is necessary to briefly describe trends. Habitat information is the more important aspect of the fish habitat module.

Habitat Conditions and Habitat Use

An evaluation of present habitat conditions based on historic habitat survey and habitat use information is the primary information used to formulate initial hypotheses about habitat conditions in the WAU. Using agency/tribal documents and interviews with local biologists prepare a list of the habitat concerns by life phase and species. This list may include spawning and rearing habitats that have been degraded and habitats that are limited in availability or have high utilization by a particular species/life phase. Identify the location of special concern areas on the working mylar overlay. Use the segment stratification map developed by the channel assessment module (Map E-1) to index these areas on the reference list.

To develop a list of habitat special concerns review the following questions during the evaluation of information and during an interview with a local biologists. Responses to these questions will help to answer the critical questions. Summarize the findings of this evaluation by fish zones. Locate special concerns on the mylar overlay.

Adult upstream migration conditions

Is there evidence of obstructions to upstream migration? If yes, explain. Consider at least the following possible obstructions:

- Are there impassable culverts? Due to poor design? Due to inadequate maintenance? Is it perched?
- Are there impassable debris jams?
- Are there impassable reaches due to subsurface flow? What time of year are they present?
- Are there impassable reaches due to hydro projects or irrigation diversions?
- Are there reaches where upstream migration is blocked or impeded due to high water temperature or other water quality issues?

Is there evidence of reduced or inadequate quantity or quality of adult holding habitat? This is particularly important for summer steelhead, spring/summer Chinook, and resident species (or other species with prolonged periods of holding between stream entry and spawning). If yes, explain. Consider at least the following questions:

Is the frequency, size, or depth of pools along the migration corridor or in historical holding areas less than suitable for adult use?

Do the pools lack hiding cover?

Is there evidence of unsuitably high water temperatures in adult holding habitats?

Is there evidence of poaching? If yes, explain. This question is asked because forest road systems often permit poacher access to formerly remote areas.

Spawning and incubation conditions

Determine where fish spawn in a basin, by species. Spawner survey data can be especially helpful for this task as can performing field surveys during the spawning season. Check with channel module and knowledgeable biologists to determine if there have been past channel disturbances that may have altered the amount or composition of spawning habitat. Then respond to the questions to characterize availability, stability, and quality of spawning gravels.

Availability

- Is spawning gravel generally abundant or scarce in the WAU?

- Is there evidence that spawning gravels have been covered or replaced by sand, silt, or clay? If yes, explain.

- Is there evidence that the spawning gravels have been removed leaving a cobble, boulder, or bedrock substrate? If yes, explain.

Stability
- Is there evidence of increased severity or frequency of redd scour to egg pocket depth? If yes, explain.

- Is there evidence of extensive redd dewatering? If yes, explain.

Quality
- Is there evidence of reduced permeability or low dissolved oxygen due to fine sediment infiltration into spawning substrate?

Summer rearing conditions
- Is there evidence of diminished pool area, pool depth, or distribution? If yes, explain.

- Is there evidence of reduced cover for summer rearing habitat? If yes, explain.

- Is there evidence of unsuitably high water temperatures or low dissolved oxygen during the summer rearing period? If yes, explain.

- Is there evidence of reaches that dry up (subsurface flows) during the summer low flow period? If yes, explain.

Winter rearing conditions
- Is there evidence that large, deep pools with cover have been diminished? If yes, explain.

- Is there evidence that availability or suitability of off-channel over-wintering habitat has been diminished? If yes, explain.

- Is there evidence of reduced availability of winter hiding habitat in coarse substrate (increased cobble embeddedness)? If yes, explain.

Formulate Working Hypotheses

Using the working map, existing information, and a list of habitat concerns develop some initial working hypotheses to describe the habitat conditions in the WAU. These hypotheses are directed at answering the four critical questions by species and life phase. These hypotheses do not need to be recorded in any formal manner; they are used as an intermediate step for the final analysis. A

list of information needs to better address the questions should be identified with each hypothesis.

Collection of New Information

An inventory of the current habitat conditions can be used to evaluate the quantity and quality of habitat available for salmonid production in the WAU. Areas with degraded or undisturbed habitats can in some cases be delineated by comparing the values of specific habitat parameters under current conditions to a set of habitat values that indicate the relative quality or condition of the habitat. Evaluation of only one or two habitat parameters can be misleading, therefore the habitat survey is designed to include several habitat parameters that indicate the quality of habitat for a particular life phase. The survey is also designed to provide a representative sampling of all habitat conditions in the WAU, which gives a high probability that areas with a special habitat concern are detected.

Level 1 Assessment

Approach

The purpose of the Level 1 field survey is to obtain additional information to help confirm or revise the initial hypotheses that were developed from existing information. Because field time is limited (i.e., several days) the survey can only provide a synoptic view of fish habitat conditions in the WAU. The strategy is to visit as may areas as possible and to make quick observations or estimates of the habitat conditions. The emphasis is to survey areas that are know or suspected to be of special concern. Habitat parameters that need to be inventoried during the survey include:

- adult holding pools
- migration blockages
- spawning gravel quantity, quality, and stability
- canopy shade
- pool area and frequency
- wood cover in pools
- large woody debris
- dominant and subdominant substrate composition
- off-channel habitat

Selection of Field Survey Segments

Because time is limited for a Level 1 field survey, only stream segments with the highest priority can be visited. The analyst needs to review the information needs listed with the initial hypotheses and identify all of the locations that would need to be surveyed to obtain the required information. To make the best use of time the analyst will need to prioritize and select survey segments according to the following criteria:

- Segments with known or suspected habitat degradation
- Segments with known important, holding, spawning, and rearing areas
- Segments that may have the only habitat available for a particular species/life phase
- Segments that are likely to be considered sensitive to five input variables (consult channel module leader)
- Segments that are close to potential impact areas (consult team members from other modules)
- Segments with questionable migration barriers or where no barrier information is known

Identify the survey segments on the working map and check to see if all high priority areas are included in the survey.

Survey Procedure

The field survey should be conducted over the length of a stream segment or approximately 1000 ft (300 m). The survey is performed by a quick walk-through of the stream segment. The surveyor visually estimates the dimensions or conditions for each habitat parameter. Measurements of unit length and channel width at periodic points is recommended to calibrate visual estimates. Estimates and observation of habitat condition may be recorded on the form *Fish Habitat Conditions Field Inventory Data* (Form F-2) or on your own form.

Habitat parameter descriptions and data codes used for field inventories are included with Form F-2.

In addition to the information listed above, record the stream gradient, channel width, and canopy shade for the survey segment. Gradient should be measured with a clinometer and reported as a percentage slope. Channel width should be measured at the bankfull flow level and should be representative of the survey segment. Percentage canopy shade should be representative of the segment and can be estimated or measured with a densiometer.

Data Summary

A summary of fish habitat conditions for each segment should be prepared from the field data. The summary should specify the following data and/or ratings for each segment. The results of this analysis should be recorded on the form *Summary of Field Data Results and Habitat Diagnostic Calls* (Form F-3).

- segment number and distance surveyed percentage canopy shade and pool area
- channel widths per pool [Length of surveyed reach (m)/Average bankfull width (m)] / # Qualifying pools
- LWD count per channel width key piece count per channel width (W. WA only)
- percentage of pools with wood cover percentage occurrence of the dominant and subdominant substrate by size category
- percentage of habitat units with spawning gravel
- observations indicating the locations and conditions for adult holding pools, migration blockages, and off-channel habitat

The methodology for the collection of the above habitat condition parameters is obtainable through several forums. The TFW Ambient Monitoring Program Manual (**NWIFC**, 1993) for example, may provide a useful data collection format for: 1) stream segments delineation, 2) percent canopy shade, 3) pool area and frequency, 4) channel widths per pool, 5) LWD count, 6) off-channel habitat, and 7) spawning gravel quality. The USDA Forest Service Stream Survey Methodology may provide an effective framework for acquiring information on 1) spawning gravel size distribution, stability, and quality; 2) LWD cover in pools, 3) migrational blockages; and 4) fish population information. Other methodologies exist for the above data collection points, and it should be noted that many of them are sufficient in gathering various information.

Table F-2: Indices of resource condition for interpretation of field survey results and habitat analysis

Note: these indices may be applied to channel types not indicated in the table but with a lower degree of confidence. Also, these are not the only parameters that can be used to describe the condition of habitat in a reach. Other indices or habitat descriptions can be used when they are clearly documented.

Habitat Parameter	Channel Type	Life Phase Influenced	Habitat Quality		
			Poor	Fair	Good
Percent Pool	< 2%; < 15 m wide	Summer/winter rearing habitat	< 40%	40 thru 55%	>55%
	2-5%; < 15 m wide	Summer/winter rearing habitat	<30%	30 thru 40%	>40%
	> 5%; < 15 m wide	Summer/winter rearing habitat	< 20 %	20 thru 30%	>30%
Pool Frequency	< 2%; < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
	2-5%; < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
	> 5%; < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
Debris pieces / channel width * (> 10 cm diam. x 2m length)	< 20 m wide	Summer/winter rearing habitat	< 1	1 thru 2	> 2
Key pieces / channel width (for Western Washington only)	BFW < 10 m	Summer/winter rearing habitat	< .15	.15 thru .30	> .30
	BFW 10 - 20 m	Summer/winter rearing habitat	< .20	.20 thru .50	> .50
% wood cover in pools	< 2%; < 15 m wide	Summer/winter rearing habitat	Most pools in low category	Most pools in moderate category	Most pools in high category
	2-5%; < 15 m wide	Summer/winter rearing habitat	Most pools in low category 0-5%	Most pools in moderate category 6-20%	Most pools in high category > 20%
Substrate	all	Winter rearing habitat	Sand or small gravel is sub-dominant in boulder or cobble dominant units (i.e.,interstices filled)	Sand is sub-dominant in some units with cobble or boulder dominant (interstices reduced)	Sand or small gravel is rarely sub-dominant in any unit (interstices clear)

Table F-2: Continued

Habitat Parameter	Channel Type	Life Phase Influenced	Habitat Quality		
			Poor	***Fair***	***Good***
Off-channel	< 3%, all widths	Winter rearing habitat, especially coho salmon	*Few or no backwaters, no off-channel ponds*	*Some backwaters and high energy side-channels*	*Backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)*
Holding Pools	all types	Upstream Adult Migration	*Few pools/km (> 1 m deep with good cover, cool)*		*Sufficient pools / km (> 1 m deep with good cover, cool)*
Access to Spawning Areas	all types	Upstream Adult Migration	*Access blocked by low water, culvert, falls, temperature, etc.*		*No blockages*
Gravel Quality	all types	Spawning and Incubation	*Absent or infrequent*		*Frequent spawnable areas*
Fines in Gravel	all types	Spawning and Incubation	*> 17% (< 0.85 mm)*	*12 - 17% (< 0.85 mm)*	*< 12 % (< 0.85 mm)*
Gravel Quality	all types	Spawning and Incubation	*Sand is dominant substrate in some units*	*Sand is sub-dominant substrate in some units*	*Sand is never dominant or sub-dominant*
Redd Scour	all types	Spawning and Incubation	*Evidence and/or potential for extensive redd scour*	*Some scour evidence, or may have potential for scour*	*Relatively stable, low potential for scour*

Under the habitat condition of LWD in the indices matrix (Table F-2), counts of "Key Piece" information will provide a useful assessment for habitat quality in relation to wood for streams. Although overall debris piece count is important, it is also necessary for the stream channel to contain a few larger pieces that provide stability and function in unison with these smaller pieces. These larger pieces have been identified by some researchers as "Key Pieces". A Key Piece is defined as a log and/or rootwad that:

1) is independently stable in the stream bankfull width (not functionally held by another factor, i.e., pinned by another log, buried, trapped against a rock or bedform, etc.), and

2) is retaining (or has the potential to retain) other pieces of organic debris. Without the Key Piece, the retained organic debris will likely become mobilized in a high flow (approximately equal to or greater than a 10 year event).

To simplify this definition, the following table has been compiled (Fox, 1994) to define the minimum size necessary for a piece of wood to function as a Key Piece for a given channel width (Western Washington):

Minimum Size to Qualify LWD as a Key Piece		
BFW (m)	**Diameter (m)**	**Length (m)**
0 thru 5	0.4	8
6 thru 10	0.55	10
11 thru 15	0.65	18
16 thru 20	0.7	24

Table F-3

Conversion factor: 1m = 3.28 ft

It is recognized, however, that a piece of wood can function as a Key Piece without meeting both the above minimum diameter and length criteria, but in terms of volume. Therefore, the following table will also define a minimum size classification for Key Piece qualification.

Minimum Volume to Qualify as a Key Piece	
BFW (m)	Volume (m3)
0 thru 5	1
5 thru 10	2.5
10 thru 15	6
15 thru 20	9

Table F-4

$1\ m^3 = 35.3\ ft^3$

Volume is estimated with the mid-point diameter (OR^2 x length)

This table will enable an LWD piece to fall below the minimum diameter or length, and still be classified as Key because of its overall volume. To define a Key Piece in the field using Table F-4, it would be helpful to use a volume estimation table (see Estimated Wood Volumes for a Given Length and Diameter, Table F-5).

Level 2 Assessment

Approach

The purpose of the Level 2 field survey is to obtain sufficient habitat information to be reasonably confident that all areas of special concern can be delineated and that hypotheses developed for the WAU are based on current information. The strategy is to conduct a basin level habitat survey using an inventory procedure that will provide an objective measure of habitat conditions. The emphasis is to survey all areas that are know or suspected to be of special concern. Habitat parameters that need to be inventoried during the survey are the same as for Level 1. Other habitat data (e.g., percentage fines in spawning gravel) may be added to the field survey at the discretion of the fish biologist. Because this is a Level 2 analysis the habitat survey approach described below

is considered as a recommendation and may be supplemented with an alternate procedure provided methods are described.

Selection of Field Survey Segments

The criteria for selecting field survey segments described for Level 1 also applies for Level 2. The only difference is, more segments can be surveyed in Level 2, because more time is allocated for field surveys. Because most WAU's are relatively large, all segments with fish habitat can not be surveyed, therefore the survey segment should be prioritized as for Level 1.

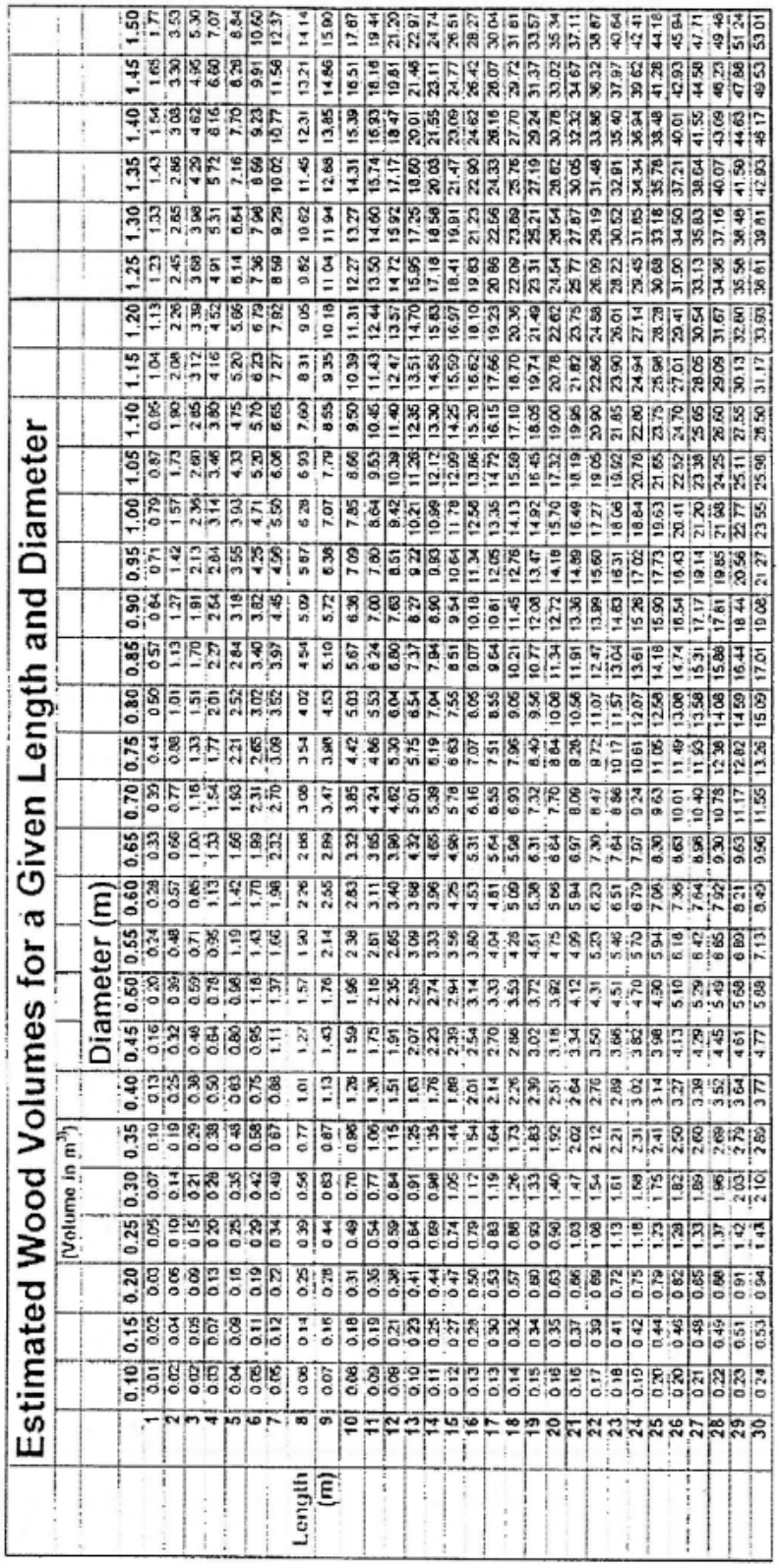
Survey Procedure

The recommended survey procedure for Level 2 is the same as for Level 1. Other basin level surveys and survey parameters may be used to provide the needed information. This procedure is recommended because it is designed to provide data compatible for the habitat diagnostic analysis. Alternative procedures must be well documented and performed by a qualified fisheries biologist.

Data Summary

A summary of fish habitat conditions for each segment should be prepared from the field data. The summary can be in a tabular and text format and should specify the information identified for Level 1. The results of this analysis can be recorded on Form F-3 if the habitat data was collected by the survey procedure defined for Level 1.

Table F-5: Table for Assessing Volumes of Individual LWD Pieces to Determine Qualification



Estimated Wood Volumes for a Given Length and Diameter

(Volume in m^3)

Length (m)	Diameter (m) 0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50
1	0.01	0.02	0.03	0.05	0.07	0.10	0.13	0.16	0.20	0.24	0.28	0.33	0.39	0.44	0.50	0.57	0.64	0.71	0.79	0.87	0.96	1.04	1.13	1.23	1.33	1.43	1.54	1.65	1.77
2	0.02	0.04	0.06	0.10	0.14	0.19	0.25	0.32	0.39	0.48	0.57	0.66	0.77	0.88	1.01	1.13	1.27	1.42	1.57	1.73	1.90	2.08	2.26	2.45	2.65	2.86	3.08	3.30	3.53
3	0.02	0.05	0.09	0.15	0.21	0.29	0.38	0.48	0.59	0.71	0.85	1.00	1.16	1.33	1.51	1.70	1.91	2.13	2.36	2.60	2.85	3.12	3.39	3.68	3.98	4.29	4.62	4.95	5.30
4	0.03	0.07	0.13	0.20	0.28	0.38	0.50	0.64	0.78	0.95	1.13	1.33	1.54	1.77	2.01	2.27	2.54	2.84	3.14	3.46	3.80	4.16	4.52	4.91	5.31	5.72	6.16	6.60	7.07
5	0.04	0.09	0.16	0.25	0.35	0.48	0.63	0.80	0.98	1.19	1.42	1.66	1.93	2.21	2.52	2.84	3.18	3.55	3.93	4.33	4.75	5.20	5.66	6.14	6.64	7.16	7.70	8.26	8.84
6	0.05	0.11	0.19	0.29	0.42	0.58	0.75	0.95	1.18	1.43	1.70	1.99	2.31	2.65	3.02	3.40	3.82	4.25	4.71	5.20	5.70	6.23	6.79	7.36	7.96	8.59	9.23	9.91	10.60
7	0.06	0.12	0.22	0.34	0.49	0.67	0.88	1.11	1.37	1.66	1.98	2.32	2.70	3.09	3.52	3.97	4.45	4.96	5.50	6.06	6.65	7.27	7.92	8.59	9.29	10.02	10.77	11.56	12.37
8	0.06	0.14	0.25	0.39	0.56	0.77	1.01	1.27	1.57	1.90	2.26	2.65	3.08	3.54	4.02	4.54	5.09	5.67	6.28	6.93	7.60	8.31	9.05	9.82	10.62	11.45	12.31	13.21	14.14
9	0.07	0.16	0.28	0.44	0.63	0.87	1.13	1.43	1.76	2.14	2.55	2.99	3.47	3.98	4.53	5.10	5.72	6.38	7.07	7.79	8.55	9.35	10.18	11.04	11.94	12.88	13.85	14.86	15.90
10	0.08	0.18	0.31	0.49	0.70	0.96	1.26	1.59	1.96	2.38	2.83	3.32	3.85	4.42	5.03	5.67	6.36	7.09	7.85	8.66	9.50	10.39	11.31	12.27	13.27	14.31	15.39	16.51	17.67
11	0.09	0.19	0.35	0.54	0.77	1.06	1.38	1.75	2.16	2.61	3.11	3.65	4.24	4.86	5.53	6.24	7.00	7.80	8.64	9.53	10.46	11.43	12.44	13.50	14.60	15.74	16.93	18.16	19.44
12	0.09	0.21	0.38	0.59	0.84	1.15	1.51	1.91	2.35	2.85	3.40	3.98	4.62	5.30	6.04	6.80	7.63	8.51	9.42	10.39	11.40	12.47	13.57	14.72	15.92	17.17	18.47	19.81	21.20
13	0.10	0.23	0.41	0.64	0.91	1.25	1.63	2.07	2.55	3.09	3.68	4.32	5.01	5.75	6.54	7.37	8.27	9.22	10.21	11.26	12.35	13.51	14.70	15.95	17.25	18.60	20.01	21.46	22.97
14	0.11	0.25	0.44	0.69	0.98	1.35	1.76	2.23	2.74	3.33	3.96	4.65	5.39	6.19	7.04	7.94	8.90	9.93	10.99	12.12	13.30	14.55	15.83	17.18	18.58	20.03	21.55	23.11	24.74
15	0.12	0.27	0.47	0.74	1.05	1.44	1.88	2.39	2.94	3.56	4.25	4.96	5.78	6.63	7.55	8.51	9.54	10.64	11.78	12.99	14.25	15.59	16.97	18.41	19.91	21.47	23.09	24.77	26.51
16	0.13	0.28	0.50	0.79	1.12	1.54	2.01	2.54	3.14	3.80	4.53	5.31	6.16	7.07	8.05	9.07	10.18	11.34	12.56	13.86	15.20	16.62	18.10	19.63	21.23	22.90	24.62	26.42	28.27
17	0.13	0.30	0.53	0.83	1.19	1.64	2.14	2.70	3.33	4.04	4.81	5.64	6.55	7.51	8.55	9.64	10.81	12.05	13.35	14.72	16.15	17.66	19.23	20.86	22.56	24.33	26.16	28.07	30.04
18	0.14	0.32	0.57	0.88	1.26	1.73	2.26	2.86	3.53	4.26	5.09	5.96	6.93	7.96	9.05	10.21	11.45	12.76	14.13	15.59	17.10	18.70	20.36	22.09	23.89	25.76	27.70	29.72	31.81
19	0.15	0.34	0.60	0.93	1.33	1.83	2.39	3.02	3.72	4.51	5.38	6.31	7.32	8.40	9.56	10.77	12.08	13.47	14.92	16.45	18.05	19.74	21.49	23.31	25.21	27.19	29.24	31.37	33.57
20	0.16	0.35	0.63	0.98	1.40	1.92	2.51	3.18	3.92	4.75	5.66	6.64	7.70	8.84	10.06	11.34	12.72	14.18	15.70	17.32	19.00	20.78	22.62	24.54	26.54	28.62	30.78	33.02	35.34
21	0.16	0.37	0.66	1.03	1.47	2.02	2.64	3.34	4.12	4.99	5.94	6.97	8.08	9.28	10.56	11.91	13.36	14.89	16.49	18.19	19.95	21.82	23.75	25.77	27.87	30.05	32.32	34.67	37.11
22	0.17	0.39	0.69	1.08	1.54	2.12	2.76	3.50	4.31	5.23	6.23	7.30	8.47	9.72	11.07	12.47	13.99	15.60	17.27	19.05	20.90	22.86	24.88	26.99	29.19	31.48	33.86	36.32	38.87
23	0.18	0.41	0.72	1.13	1.61	2.21	2.89	3.66	4.51	5.46	6.51	7.64	8.86	10.17	11.57	13.04	14.63	16.31	18.06	19.92	21.85	23.90	26.01	28.22	30.52	32.91	35.40	37.97	40.64
24	0.19	0.42	0.75	1.18	1.68	2.31	3.02	3.82	4.70	5.70	6.79	7.97	9.24	10.61	12.07	13.61	15.26	17.02	18.84	20.76	22.80	24.94	27.14	29.45	31.85	34.34	36.94	39.62	42.41
25	0.20	0.44	0.79	1.23	1.75	2.41	3.14	3.98	4.90	5.94	7.06	8.30	9.63	11.05	12.58	14.18	15.90	17.73	19.63	21.65	23.75	25.98	28.28	30.68	33.18	35.78	38.48	41.28	44.18
26	0.20	0.46	0.82	1.28	1.82	2.50	3.27	4.13	5.10	6.16	7.36	8.63	10.01	11.49	13.08	14.74	16.54	18.43	20.41	22.52	24.70	27.01	29.41	31.90	34.50	37.21	40.01	42.93	45.94
27	0.21	0.48	0.85	1.33	1.89	2.60	3.39	4.29	5.29	6.42	7.64	8.96	10.40	11.93	13.58	15.31	17.17	19.14	21.20	23.38	25.65	28.05	30.54	33.13	35.83	38.64	41.55	44.58	47.71
28	0.22	0.49	0.88	1.37	1.96	2.69	3.52	4.45	5.49	6.65	7.92	9.30	10.78	12.38	14.08	15.88	17.81	19.85	21.98	24.25	26.60	29.09	31.67	34.36	37.16	40.07	43.09	46.23	49.46
29	0.23	0.51	0.91	1.42	2.03	2.79	3.64	4.61	5.68	6.89	8.21	9.63	11.17	12.82	14.59	16.44	18.44	20.56	22.77	25.11	27.55	30.13	32.80	35.58	38.46	41.50	44.63	47.86	51.24
30	0.24	0.53	0.94	1.45	2.10	2.89	3.77	4.77	5.88	7.13	8.49	9.96	11.55	13.26	15.09	17.01	19.06	21.27	23.55	25.98	28.50	31.17	33.93	36.81	39.81	42.93	46.17	49.53	53.01

Habitat Condition Evaluation

The objective of habitat analysis is to identify and characterize fish habitat in the WAU. Emphasis is placed on identifying habitats of special concern (i.e., degraded habitats, habitats with high utilization, and habitats of limited availability) because impacts on these areas could have the greatest effect on the fisheries resources in the WAU. Habitats that are not a special concern are not ignored, but are appropriately identified for their contribution to the habitat network in the WAU. Habitats of special concern are identified by the analysis of existing information and by an analysis of the field survey data using a set of indices of resource condition (Table F-2). The habitat analysis is performed for each species/life phase within a dominant fish use zone and the results are recorded on mylar overlay maps (one for each life phase) and in a habitat condition summary.

If the evaluation is for a Level 1 assessment and limited data are available (i.e, from existing information or field surveys), then evaluation of potential habitat conditions may be determined from a habitat quality rating matrix (Table F-6). This matrix provides general guidelines for rating the habitat potential based on stream gradient and confinement. Segments of gradient and confinement are determined from the channel module Map E-1. This alternative evaluation is less reliable, therefore less preferred.

The standard assessment of habitat conditions is performed by comparing the results of the field data (summarized in Form F-3) to resource condition indices shown in Table F-2 and by recording these results on Form F-3. The value categories in the indices table indicate the relative quality of habitat (i.e., ranges from poor to good) for a particular parameter and life phase in a survey reach. Habitat values that fall into the poor range suggest that habitat conditions may be degraded and values in the good range suggest that habitat conditions may be fully functional. Values that fall into the fair range may indicate that conditions are changing either to poor or to good. The habitat condition indicated by the parameter value should be verified before concluding a special habitat concern exists. This can be done by identifying supporting evidence among related habitat parameters and from the analysis of existing information. For example, if percentage pool area values are in the poor quality range, it is likely that pool frequency and LWD are also in the poor or fair range. If this is the case the result from three diagnostic parameters are in agreement suggesting that pool area is low and that an absence of LWD may be responsible. Existing information may also lend support to this conclusion, for example, if the local biologist reported that historically the reach in question was a good juvenile rearing area with complex habitat. Based on a review of all available information, the analyst may conclude that the summer rearing habitat in a particular reach is de-graded. This approach can be used to evaluate each life phase for each reach or area of the basin where information is

available. Areas of good habitat need to be delineated as well as areas of poor habitat. If conflicting evidence exists the analyst must use professional judgment and make a decision about the habitat conditions in a reach. If no information is available for a particular area, additional new information may need to be collected. In the latter case, check with other module leaders to see if they may have pertinent information about the area.

Table F-6: Potential habitat quality rating based on gradient and confinement.

Note: this table should only be used for a Level 1 assessment when limited data are available. Rating in the upper left of each box applies to anadromous salmon species. Rating in the lower right of each box applies to anadromous and resident forms of trout and char species.

Spawning and Winter Rearing

CHANNEL CONFINEMENT	GRADIENT					
	<2%	2-4%	4-8%	8-12%	12-20%	>20%
Unconfined (VW>4CW)	GOOD GOOD	GOOD GOOD	FAIR GOOD	POOR GOOD	POOR FAIR	POOR POOR
Moderately Confined (2CW≤VW≤4CW)	GOOD GOOD	GOOD GOOD	FAIR GOOD	POOR GOOD	POOR FAIR	POOR POOR
Confined (VW<2CW)	FAIR GOOD	FAIR GOOD	POOR FAIR	POOR FAIR *E-GOOD*	POOR POOR *E-FAIR*	POOR POOR

E = rating for East of Cascade Crest

Summer Rearing

CHANNEL CONFINEMENT	GRADIENT					
	<2%	2-4%	4-8%	8-12%	12-20%	>20%
Unconfined (VW>4CW)	GOOD GOOD	GOOD GOOD	GOOD GOOD	FAIR GOOD	POOR FAIR	POOR POOR
Moderately Confined (2CW≤VW≤4CW)	GOOD GOOD	GOOD GOOD	GOOD GOOD	FAIR GOOD	POOR FAIR	POOR POOR
Confined (VW<2CW)	GOOD GOOD	FAIR GOOD	FAIR GOOD	POOR GOOD	POOR FAIR	POOR POOR

VW = Valley Width
CW = Channel Width (bankfull)

The results of the habitat analysis should be recorded on mylar overlay maps and in a text summary that is cross-referenced to the maps. Each mylar overlay for a life phase should show the salmonid species distribution and delineate the habitat areas of special concern. The latter areas are delineated by a bracket and a cross reference number to the text summary (see example in Figure F-2). Whenever possible, the areas of concern should be grouped to avoid repetitive summaries. That is, all areas with similar conditions or concerns can be grouped and summarized together in a single form or text summary. The text summary should include the following information:

- dominant fish use zone
- species/life phase
- map reference number
- segment location (identify segment or segments covered using Map E-1)
- segments visited during the field survey, if any
- description of special habitat concern using results of diagnostic analysis and other supporting information. This is a paragraph that should be thorough but concise.
- list sources of information used to develop the description of special habitat concerns.

An example of a text summary for a special habitat concern and the recommended format for preparing these summaries in shown in Figure F-4. These summaries constitute the final hypotheses for habitat conditions in the WAU. After the summaries are prepared, check to see if the critical questions are addressed for all species and all areas of WAU.

Chinook Salmon Spawning and Incubation Special Habitat Concerns

Map Reference Number 4

Segments 1-2

Segments Visited 2

Description: This is the only reach of the river utilized for spawning by fall chinook salmon as indicated by annual spawner surveys. The field survey indicated that in segment 2 gravel quantity and quality was good and fair, respectively. Observations of water visibility associated with spawner surveys conducted by WDF indicate turbid water and poor visibility conditions were more common during the past ten years than in earlier years of the survey.

Information Sources: Field Survey Summary, e.g., Form F-2
Mr. Jack Salmon, Wash. Dept. Fish & Wildlife, Olympia

Resident Cutthroat Spawning and Incubation Special Habitat Concerns

Map Reference Number 3

Segments: 6-8, 2324

Segments Visited: 7, 23

Description: These reaches are known to be cutthroat spawning areas. The gravel quality was poor in one of the segments visited (i.e, segment 6) indicating a potential problem in similar areas. All of the segments listed above are similar and need protection from potential degradation.

Information Sources: Field Survey Summary, e.g., Form F-2
Ms. Jill Bio, Wash Dept. Fish & Wildlife, Olympia

Figure F-4: Example of text summary for reporting special habitat concerns

Fish Habitat Assessment Report

The intent of the summary report for the fish habitat module is to provide a very brief but clear description of the results of the assessment. These results will be used in synthesis in two ways. First, the results of habitat assessments and the descriptions of areas of concern are a key component of making vulnerability calls. Second, the broader description of fish distribution and habitats in the WAU are used to develop a fish habitat context for synthesis and for completion of the resource sensitivity calls.

All text components of the summary should be as concise as possible. Supporting information, references, and data summaries are included in tables attached to the report. The summary report for the fish habitat module should include the elements listed in the following outline. When two or more areas have the same description they should be grouped and all segments which apply to the description should be listed in the summary.

Fish Habitat Assessment Report

I. Title page with name of watershed analysis, name of module, level of analysis, signature of qualified analyst(s), and date

II. Table of contents

III. Maps
- Fish distribution map (map F-1)
- Areas of concern maps for spawning habitat (map F-2)
- Areas of concern maps for upstreammigration habitat (map F-3)
- Areas of concern maps for summerrearing habitat (map F-4)
- Areas of concern maps for winterrearing habitat (map F-5)

IV. Summary Data
- Fisheries information request for watershed analysis (form F-1) - **optional**
- Habitat conditions field inventory data (form F-2)
- Field data summary and habitat diagnostic calls (form F-3)

V. Summary Text
- Study methods
- Summary of distribution and population information
- Descriptions of each habitat area of special concern, as shown on maps F-2-F-5
- Fish habitat vulnerability calls
- Descriptions of any deviations from the standard methods and why the changes were necessary

- Statement of the author's confidence level in the analysis and results
- Does module report address all critical questions?

VI. Other Information (optional)

- Monitoring strategies and design and implementation suggestions
- Learning resources (a.k.a., references, bibliography) section
- Acknowledgments section

Acknowledgments

This module was developed over a course of several years by numerous fish biologists representing, agencies, tribes, and private industry. This version was written by Douglas Martin, Tim Beechie, and Jeff Light. Helpful contributions were made by Kevin Bauersfeld, Kurt Beardslee, Ron Campbell, Martin Fox, Carl Hadley, Mark Hunter, Jim Mathews, Randy MacIntosh, and George Pess.

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Form F-1: Fisheries Information Request for Watershed Analysis

Basin: _____

WAU: _____

Boundary: _____

A watershed analysis is being conducted in the basin and WAU named above. Information on the fish habitat utilization, fish distribution, and habitat conditions are needed for this analysis. Your knowledge of this basin, professional judgements, and comments are important for the success of this assessment. Please answer the questions or identify (provide if available) any documents, maps, computer print outs, and other sources of information that would help the assessment. We appreciate your prompt attention to this matter.

Respondent Information

Name: _____

Affiliation: _____

Position: _____

Phone Number: _____

Fish Information

- What fish species occur in this WAU?
- What is species distribution (identify on map provided).
- What are boundaries for resident and anadromous bearing waters?
- What are the trends in relative abundance?
- What locations are important for adult holding, spawning, summer rearing and winter rearing?
- Are there threatened or endangered species?
- What are non-sport species?
- What juvenile and adult population data is available (e.g., smolt counts, spawner surveys, redd counts).

Habitat Information

- Identify locations of known or potential passage barriers (natural and man caused).
- Identify data on spawning gravel fines or sediment.
- Identify data on gravel scour or loss of spawning gravel.
- Identify data on pool area or frequency.
- Identify other habitat inventory data concerning habitat units, large organic debris, cover, riparian canopy shading, water temperature, substrate composition, embeddedness.
- Identify locations of side channels, beaver ponds, and other off-channel over-wintering habitat.
- Are there any special or unusual conditions in the basin.

Management

- Are there any habitat management problems in the WAU?
- Are there any fisheries management problems in the WAU?
- What is the escapement goal by species?

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU STREAM NAME SURVEY UNIT # CREW DATE PAGE

DISTANCE	HAB TYPE	---------- POOLS ONLY----------					-----SUBSTRATE-----			-----LWD TALLY-----			NOTES
		MAXDP	RFCDP	RESDP	FORM	%WCVR	DOM	SBDOM	SPGRV	10-20CM	20-50CM	>50CM	

SUMMARY:

		SUMMARY TOPICS	
WATER TEMPERATURE			
STREAM FLOW		OFF-CHANNEL REARING	
AVERAGE PERCENT SHADE		HOLDING POOLS	
AVERAGE CHANNEL WIDTH		REDD SCOUR POTENTIAL	
AVERAGE BED SLOPE		Provide summary paragraph describing survey reach characteristics and check box when done	

LWD:

FUNCTIONAL LWD			
10-20 CM		DISTANCE SURVEYED	
20-50 CM		NON FUNCTIONAL LWD	
>50CM			
TOTAL			

Form F-2: continued

DISTANCE

Distance indicated on a hip chain at the beginning of each distinct habitat type. Subtracting the previous measured distance will produce the total length of each habitat type.

HABITAT

To be classified as a distinct habitat type, the average pool area must equal or exceed the minimum unit size (Table 1) and the residual depth must equal or exceed the depth in Table 2.

Table 1.

Bankfull Channel Width	Min. Unit Size
0 – 2.5 meters	0.5 sq. meters
2.5 – 5 meters	1.0 sq. meters
5 – 10 meters	2.0 sq. meters
10 – 15 meters	3.0 sq. meters
15 – 20 meters	4.0 sq. meters
> 20 meters	5.0 sq. meters

Table 2.

Bankfull Channel Width	Min. Residual Depth
0 – 2.5 meters	0.10 meters
2.5 – 5 meters	0.20 meters
5 – 10 meters	0.25 meters
10 – 15 meters	0.30 meters
15 – 20 meters	0.35 meters
> 20 meters	0.40 meters

HAB TYPE	Habitat type	Pool or other (Only pools are used for data analysis)
MAXDP-	Maximum Depth	Maximum pool depth down to the gravel or cobble substrate.
RFCDP-	Riffle Crest Depth	Water depth measurement at the riffle crest (pool control).
RESDP-	Residual Depth	Subtract the riffle crest depth from the maximum depth.
FORM-	Pool Formation Feature	B – Bed feature, including rocks D – Beaverdam W – Wood (logs, rootwads).
%WCVR	Percent Wood Cover	Estimate the percent of woody material and brush covering the pool surface.

SUBSTRATE

Characterize the dominant and sub-dominant streambed substrates using the following codes:

1 – Sand, silt, clay, organic or other fine material.
2 – Gravel 2 – 64 mm (0.1" – 2.5")
3 – Cobble 64 – 130 mm (2.5" – 5.0")
4 – Boulder > 130 mm (5.0")
5 – Bedrock

SPGRV - Spawning Gravel Presence.

Using the following criteria, assess whether there is adequate spawning habitat available for salmonids. The gravel should be located in an area where water depth (>18 cm) and velocity (0.3 – 1.0 mps) conditions are expected to be favorable during the respective spawning seasons.

A – An area of gravel suitable for anadromous salmon (10 – 150 mm) of at least 1.5 m^2
R – An area of gravel suitable for resident trout (2 – 75 mm) of at least 0.1 m^2
AR – Both anadromous salmon and resident trout spawning habitat is available.

NOTES

Reference any comments relative to factors influencing fish habitat or migration. Water temperature and flow, channel width, bed slope and shade measurements should be taken as necessary and averaged in the summary section. Attach a description of off-channel rearing (access, condition), holding pools (number, distribution) and redd scour (evidence, potential). Large woody debris can be tallied in the columns provided and results entered below the summary statistics. Non-functional LWD can be counted or estimated. Functional LWD should be separated into the three size classes.

Form F-3: Summary of Field Data Results and Habitat Diagnostic Calls

Segment No.	Pool (%)		Pool Freq.		LWD No Pieces/CW		Key Piece* No Pieces/CW		Wood Cover (%)		Dom. Substrate		Off-Channel		Holding Pools		Gravel Quantity	
	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating

Form F-4: Fish Habitat Assessment Task Checklist

TASK	SCHEDULED	COMPLETED	REVIEWED
Assemble Startup Materials: •Water type map •WARIS, Stream catalogue info., WDFW data, research reports for the area •Mylar			
Identify local biologists, contact them & complete habitat evaluation questionnaire.			
Startup meeting to brief team on process and intent, assign tasks, set schedule.			
Complete office assessment of habitat conditions: •Identify fish species and their distribution (map f-1) •Delineate zones of dominant fish use (map f-2) •Identify preliminary hypotheses of habitat concerns by species and life history stage (draft map f-3)			
Team meeting: review results of office assessment			
Complete estimates of relative abundance, by spp. •Stock Status (SASSI) •Escapement goals and trends •Spawner survey results •Redd counts •Other abundance measures			
Conduct field work as needed to validate office assessment: •Obtain segment map from channel team •Indentify areas where field visits are necessary •Coordinate with channel and riparian teams •Visit field to examine habitat conditions, confirm or reject initial hypotheses, and develop new ones.			
Complete diagnostic summary sheet for habitat conditions (form f-3)			
Provide LWD and shade data to riparian team leader			
Are there any Type 4 Waters requiring assessment? •Talk with channel, riparian, and other team leaders			
Construct final map of habitat concerns by species zone and life history stage (map f-3)			
Team meeting: review results of assessments •If performing standard assessment, determine where additional, more detailed information (if any) would help clarify situations in the basin. •Identify potential monitoring opportunities			
Produce Module Report			
Review Module Report			
Prepare for meeting with channel team to identify habitat vulnerabilities.			
Complete and sign module completion sheet (team leader)			

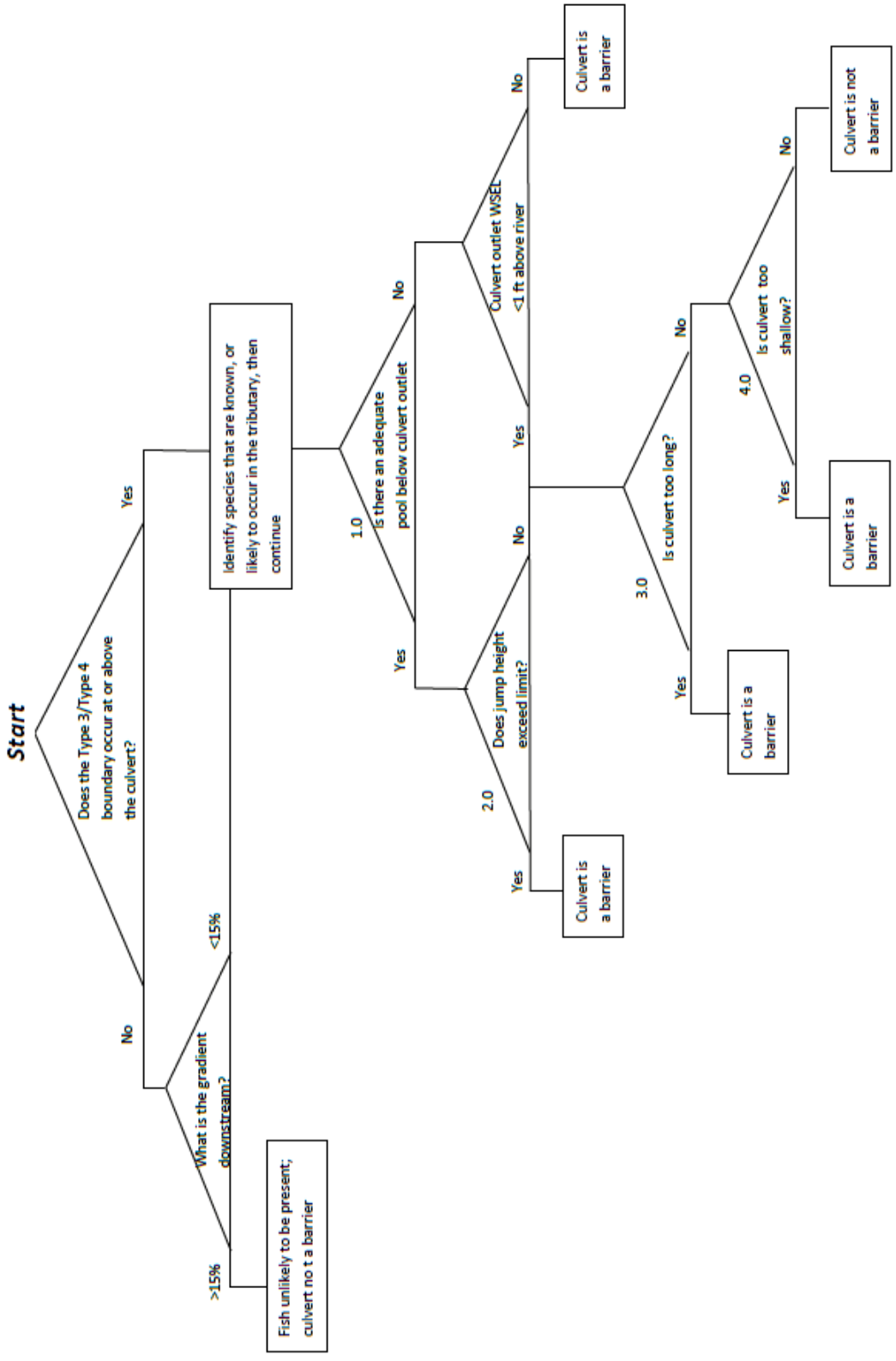

Figure F-5: Culvert Barrier Evaluation Decision System