Component IX
Fish and Fish Habitat Assessment

Table of Contents

Table of Contents (continued)

Component IX
Fish and Fish Habitat Assessment

INTRODUCTION

This component of the Oregon Watershed Assessment Manual helps the user compile and evaluate available information on fish populations, in-stream habitat, and migration barriers through the following four-step process:

1. Document the temporal distribution and abundance of fish species within the watershed.

2. Identify potential interactions between species of concern, such as those species listed under the Endangered Species Act (ESA).

3. Compile existing Oregon Department of Fish and Wildlife (ODFW) and other habitat data that have been collected on the watershed, and compare them with established ODFW benchmarks to provide an evaluation of in-stream habitat conditions.

4. Identify and prioritize human-caused barriers to fish passage in the watershed.

The information gathered in this component is then integrated into the Watershed Condition Evaluation, where users evaluate impacts to important areas of current fish use and habitat.

Critical Questions

1. What fish species are documented in the watershed? Are any of these currently state- or federally listed as endangered or candidate species? Are there any fish species that historically occurred in the watershed which no longer occur there?

2. What is the distribution, relative abundance, and population status of **salmonid** [1]species in the watershed?

3. Which salmonid species are native to the watershed, and which have been introduced to the watershed?

4. Are there potential interactions between native and introduced species?

5. What is the condition of fish habitat in the watershed (by sub-basin) according to existing habitat data?

6. Where are potential barriers to fish migration?

[1] Terms found in bold italic throughout the text are defined in the Glossary at the end of this component.

Assumptions

- Salmonid fish are typically the most sensitive fish species occurring within a stream network. If habitat conditions are suitable for salmonid fish, then they reflect "good" habitat conditions for the watershed.

- Fish distribution is a function of the quantity and quality of habitat types available in the watershed. **Channel Habitat Types** (CHTs) have predictable habitat conditions that influence the potential fish use within a **stream reach**. The distribution of fish species in a watershed is a function of the distribution and condition of the CHTs found there.

Materials Needed

This assessment relies on finding and compiling existing information to develop distribution maps for **resident** and **anadromous** salmonid fish. You will need to have the following items handy:

- Any available fisheries information for the watershed, including basin plans, data reports, etc.

- A copy of historical fish information from the Historical Conditions Assessment component

- Forms found in Appendix IX-D

- A copy of the CHT map (from the Channel Habitat Type Classification component)

- Two or three copies of watershed base maps (from Start-Up and Identification of Issues component) (two copies for watersheds with only resident fish, three copies if watershed has resident and anadromous fish)

- Habitat survey data from ODFW, US Forest Service (USFS), Bureau of Land Management (BLM), Oregon Forest Industry Council (OFIC) or others

The Fish Information sidebars on this page and the next will help you gather information.

Necessary Skills

This assessment does not require any specialized skills. It is helpful to have a persistent nature to track down and

FISH INFORMATION CONTACTS

Oregon Department of Fish and Wildlife

General Information:
(503) 229-5222

Home Page:
http://www.dfw.state.or.us

Regional Offices:
Northwest Region, Corvallis
(541) 757-4186

Southwest Region, Roseburg
(541) 440-3353

Central Region, Bend
(503) 388-6363

Northeast Region, LaGrande
(541) 963-2138

Southwest Region, Ontario
(541) 573-6582

Marine Region, Newport
(541) 867-4741

Columbia Region, Clackamas
(503) 657-2000

Oregon Department of Forestry

Northwest Area, Forest Grove
(503) 357-2192

Southern Area, Roseburg
(541) 440-3412

Eastern Area, Prineville
(541) 447-5658

sort through information from a wide variety of sources.

Field evaluations of road crossings require the physical ability to scramble down potentially steep road embankments and take measurements. Field work also will require use of a level and **stadia rod** to measure culvert elevations.

Final Products of the Fish and Fish Habitat Component

This assessment will result in the following completed forms and maps:

- Form F-1: Fisheries Information Summary
- Form F-2: Habitat Condition Summary
- Form F-3: Fish Passage Evaluation
- Form F-4: Fish Passage Field Assessment (optional)
- Form F-5: Confidence Evaluation
- Map F-1a: Resident Fish Distribution (current and historical)
- Map F-1b: Anadromous Fish Distribution (current and historical)
- Map F-2: Migration Barrier Identification

ASSESSMENT METHODOLOGY

Step 1: Identify Fish Species and Populations (Form F-1)

The goal of this step is to compile all available information on fish that are documented to occur in the watershed, and to evaluate the status of the fish populations. With this information, you can start thinking about the habitat needs of the watershed's fish species, document when anadromous fish occur in the watershed, and help identify which species have the lowest population

FISH POPULATION AND DISTRIBUTION INFORMATION

- **Oregon Plan**: Anadromous fish core area and distribution information is available in the Oregon Plan (Chapter 15). This can be accessed through the ODFW Web site. http://www.dfw.state.or.us/
- **ODFW Basin Plans**: These reports are in various stages of completion and some plans may be outdated. Nevertheless, these are often the most accessible source of information relevant to fish management. ODFW District Offices should have copies of the plans as appropriate to their basins, or contact ODFW, Basin Planning Coordinator at (503) 872-5252, x 5421.
- **Biennial Report on the Status of Wild Fish in Oregon**: This report includes information on all wild freshwater and estuarine fish species in Oregon. Most of the report comes from ODFW files, particularly annual reports filed by ODFW district biologists or from research projects. This report can be accessed through the ODFW home page at http://www.dfw.state.or.us under Research and Reports. These reports also contain some information on historic abundance and distribution.
- **Bull Trout Distribution**: This information is available on GIS and can be accessed through the ODFW Web site. This information will not apply to coastal watersheds or private lands. Contact ODFW at (503) 872-5252 x 5602.
- **Other Trout and Steelhead Distribution**: Contact ODFW at (503) 872-5252, x 5412.
- **Stocking History**: The records from 1983 are in a database. The codes they used to identify the location of stocking are unique to the hatchery; it may be difficult to access all information specific to your watershed. Contact ODFW at (503) 872-5252, x 5415.
- **Migration Barriers and Culverts**: This data is in several places and you will have to make multiple phone calls to locate what if anything is available for your watershed. For fish passage information, contact (503) 872-5252 x 5582; for culvert information, (503) 872-5252 x 5590; for ODFW Coho Spawning Project, (541) 737-7636.

numbers or may be the most sensitive.

The sources listed in the sidebar on page 5 will provide a good start toward compiling the information you need. They may also be able to point you to other sources. Find as much information as you can, then sit down and complete Form F-1 with as much detail as possible. The form may collect duplicate information, so be sure to note if the information recorded on the form can be found in multiple sources. Make notes of any conflicting information. Where you do not have any information, you may need to interview local OFDW and other agency (i.e., USFS, BLM, etc.) fish biologists.

Form F-1: Species of Concern, Fish Presence, and Population Status

Item 1 in Form F-1 asks for information on species of concern, including ESA and ODFW status, and population trends. Item 2 documents whether any species that historically occurred in the watershed are no longer found. Various sources listed in the sidebar contain current and historic fish distribution information. Usually, ODFW basin plans are the best source of this information. Your local ODFW fish biologist should able to help acquire and sort through the data.

Consult with the assessment team member performing the Start-Up and Identification of Watershed Issues component for a list of species in the watershed compiled using the Natural Heritage Database. In addition, look for the ODFW's comprehensive review of threatened, endangered, and sensitive (TES) species (terrestrial and aquatic). This ODFW project is no longer active, but copies of the report are available from the ODFW's Fish Conservation Program Leader, (503) 872-5242, extension 5405.

Form F-1: Stocking History

The goal of Item 3, Form 1 is to summarize what species have been stocked in the watershed and how extensive the stocking efforts were/are. This information will help identify potential interactions between native and stocked species, and help you understand if hatchery fish have an influence on current population trends. ODFW basin plans are usually the best source for this type of summary information, although such information may not be up-to-date. Table 1 provides an example of a completed stocking history summary.

Form F-1: Life History Patterns, Important Habitat Areas

Items 4 and 5 of Form 1 ask for information about the timing of anadromous and resident fish spawning and migration. Again, this information can be found in the local basin plan or other ODFW documents. This information will help you understand how and when fish use specific portions of the watershed. This knowledge may be important when planning the timing of specific development or enhancement activities. Table 2 provides an example record of fish life history patterns from Big Elk Watershed in the Yaquina Basin.

Table 1. Example of a completed stocking history summary.

Species	Stocking Notes	Native or Exotic?	Source
Chinook	Historically 1902–1990		Yaquina River Basin Plan
Coho	Historically 1902–1990		Yaquina River Basin Plan
Steelhead	1905–1939 Average 31,000 smolts/year since 1978		Yaquina River Basin Plan
Cutthroat	Historically 1925-1960		Yaquina River Basin Plan
Pink Salmon	Historically 1977–1982 (OSU Experiment)	Exotic	Yaquina River Basin Plan
Rainbow Trout	Historically 1950– 58, no resident rainbows present		Yaquina River Basin Plan
Brook Trout	Historically stocked in 1904, no longer present	Exotic	Yaquina River Basin Plan
American Shad	Stocked in Columbia 1800s, later became established in Yaquina	Exotic	Yaquina River Basin Plan

Notes: Hatchery at Elk City 1902–1950, OreAqua Hatchery 1974 – 1990

Table 2. Example summary of fish life history patterns.

Species	A-Anadromous R-Resident	Location	Spawning	Outmigration
Chinook	A – fall	Mainstem, lower reaches of large tributaries	Oct. to Jan., peak in Nov.	June/July to estuary Summer/fall to ocean as under-yearling smolts
Coho	A – fall	Low-gradient tributaries	Nov. to Feb.	2nd spring after hatching, peak in May; limited estuary time
Steelhead	A – winter	Low-/moderate-gradient tributaries	Oct. to March, peak Dec. and Jan.	2 to 3 years in freshwater, outmigrate in March to June*
Cutthroat	A – summer/fall R Fluvial	1st and 2nd order tributaries	Dec., peaks in Feb.*	Age 1+ and 2+ fish outmigrate April or May to estuary/tidewater Age 3 fish go to ocean in May Adults overwinter in estuaries of origin*

* Based on information from Alsea Watershed; local data not available.

Form F-1: Known Migration Barriers

The initial data compilation and search will likely turn up some information on known migration barriers. Indicate these in item 7 of Form F-1 and mark them on the draft fish distribution maps.

During the assessment of potential migration barriers, you will work with the Sediment Sources analyst to map and identify potential fish passage barriers.

Form F-1: Species Interactions

Did you answer yes to question 7 on Form F-1? If so the following species interactions may be occurring. Consult with the regional ODFW fisheries biologist to determine the potential extent of the following species interactions.

- Brook trout/bull trout (competition, interbreeding)
- Rainbow/cutthroat (competition/ interbreeding)
- Hatchery/wild-stock interactions

Step 2: Create Fish Distribution Maps

After you've collected all the pertinent information for Form F-1, you are ready to create the fish distribution maps. These color-coded maps will visually document where fish are known to occur in the watershed and where areas of important habitat occur. This information will help the watershed council evaluate how potential impacts may or may not affect fish habitat, and will help visually illustrate where enhancement activities may have the greatest benefit. If your watershed has anadromous and more than one species of resident fish, you may want to make one map for anadromous fish distributions (Map F-1a) and one for resident fish (Map F-1b). Typically, the base map you are using will be the Oregon Department of Forestry (ODF) stream classification maps, which show the upstream extent of fish utilization. Be aware that these maps are not always based on current data, and you may want to ask local ODFW or ODF staff if any recent data collection has been performed to validate the mapped information. In addition, these maps do not identify fish species; look for fish species information in the raw data or talk to local fish biologists and make an educated guess about which fish species potentially occur.

Not only may data sources be outdated or inaccurate, you may find that specific distribution information is simply not available. Creating a fish distribution map will help you identify such data gaps. As a first cut, look at all available information and indicate what is known on the draft maps. It is often useful to take a copy of the map to local fish biologists and ask them to indicate what they know about the fish distributions. Typically, the upstream extent of fish utilization by species has not been identified or mapped, but you can make an educated guess at where these fish may occur in the watershed by using the CHT map and general information about the species occurring in the watershed (see Introduction). Table 3 summarizes potential fish use within each CHT. This information can help you make decisions on potential fish distributions within the watershed.

Once you have developed a draft map you will probably have numerous questions to ask local ODFW, USFS, or other agency fish biologists who have worked in the watershed. They can help review the data you have compiled, and make the necessary judgment calls in developing the fish distribution maps. They can also provide insight on locations of important spawning and rearing areas. Usually it is more effective to develop a draft map before asking for help; it is easier to discuss key locations with a map in front of you. If the information on current and historical fish distributions is significantly different, place a footnote on the map explaining the reasons. Figure 1 shows an example of a completed map from a coastal watershed.

Table 3. Potential fish utilization of Channel Habitat Types.

Channel Habitat Type	Gradient Range	Oregon Stream Size	Additional Description	Fish Use
Low gradient large floodplain (FP1)	1%	Large	Lowland and valley bottom channels; can include small adjacent wetlands	**Anadromous**[1]: Important[2] spawning, rearing, and migration corridor **Resident:**[3]: Important spawning, rearing, and overwintering
Low gradient medium floodplain (FP2)	≤2%	Large to medium	Mainstem streams in broad valley bottoms	**Anadromous**: Important spawning, rearing, and migration corridor **Resident**: Important spawning, rearing, and overwintering
Low gradient small floodplain (FP3)	≤2%	Small to medium	Low-gradient floodplain channels occupy the floodplains of larger streams	**Anadromous**: Important spawning, rearing, and migration corridor **Resident**: Important spawning, rearing, and overwintering
Alluvial fan (AF)	1-12%	Small to medium	Transition from steep mountain slopes to valley floor	**Anadromous**: Important rearing, migration corridor; potential[4] spawning in lower gradients **Resident**: Important spawning and rearing
Low gradient moderately confined (LM)	<2%	Usually medium to large	Alternating hillslopes and terraces limit floodplain	**Anadromous**: Potential spawning and rearing **Resident**: Potential spawning, rearing, and overwintering
Low gradient confined (LC)	<2%	Usually medium to large	Relatively straight channel, limited floodplain; partial or complete barriers may occur at bedrock knickpoints	**Anadromous**: Potential spawning and rearing **Resident**: Potential spawning, rearing, and overwintering
Moderate gradient moderately confined (MM)	2-4%	Usually medium to large	Limited floodplain; bedrock steps with cascades may form partial or complete barriers	**Anadromous**: Potential steelhead and coho spawning and rearing; limited[5] chinook **Resident**: Potential spawning, rearing, and overwintering
Moderate gradient confined (MC)	2-4, 6%	Variable	Narrow open to moderate V-shaped valley; hillslope or terrace confined	**Anadromous**: Potential steelhead and coho spawning and rearing; limited chinook **Resident**: Potential spawning, rearing, and overwintering
Moderate gradient headwater (MH)	1-6%	Small	Common to plateaus or broad drainage divides; sites of headwater beaver ponds	**Anadromous**: Potential steelhead and coho spawning and rearing; limited chinook **Resident**: Potential spawning, rearing, and overwintering
Moderately steep narrow valley (MV)	4-8%	Small to medium	Narrow valley	**Anadromous**: Potential steelhead, coho, sea-run cut spawning and rearing **Resident**: Potential spawning, rearing, and overwintering
Bedrock canyon (BC)	>4%	Variable	Very narrow V-shaped channel; migration barriers, may be anywhere	**Anadromous**: Lower-gradient areas provide limited rearing (if accessible) **Resident**: Limited resident spawning and rearing
Steep narrow valley (SV)	8-16%	Small		**Anadromous**: Lower-gradient areas provide limited rearing (if accessible) **Resident**: Limited resident spawning and rearing
Very steep headwater tributaries (VH)	>16%	Small		**Resident**: Very limited rearing

1 **Anadromous** refers to chinook, coho, steelhead, and sea-run cutthroat trout unless specifically stated.
2 **Important** designates CHTs that potentially contain large areas of preferred habitat conditions.
3 **Resident** refers to native redband, cutthroat trout and/or bull trout.
4 **Potential** designates CHTs that may have suitable habitat conditions depending on site-specific factors.
5 **Limited** designated CHTs that may have pockets of suitable habitat conditions depending on site-specific factors.

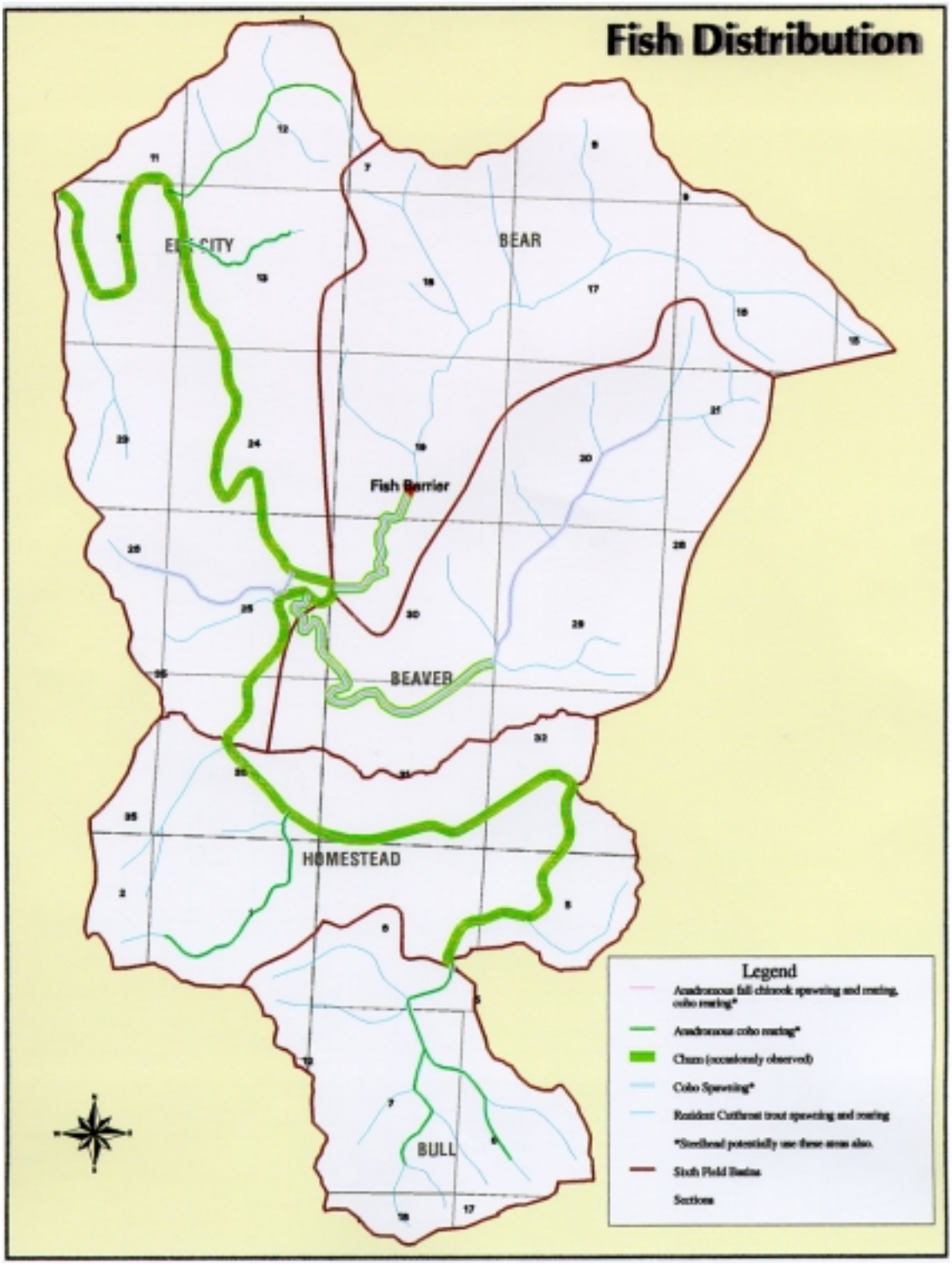


Figure 1. An example of a completed map from a coastal watershed.

Step 3: Complete Habitat Condition Summary (Form F-2)

In this step, you will compile existing ODFW fish habitat data. The ODFW has developed a standard stream habitat survey methodology (Moore et al. 1997). ODFW, ODF, and large private landowners have used this methodology to collect extensive amounts of fish habitat data. Data collected in cooperation with ODFW is available in **Geographic Information Systems** (GIS) format from the ODFW Web site, or can be obtained in a spreadsheet format by calling the Habitat Division of ODFW at (541) 757-4263. The assessment will be most straightforward if you request the data summary files, and the maps showing the locations of sampled segments.

The approach presented here provides a format for organizing the data and determining how habitat conditions vary throughout the watershed, and for comparing watershed conditions with "benchmark" conditions for the State of Oregon. This comparison allows you to look for patterns in habitat conditions throughout the watershed or to identify specific portions of the watershed where problems may exist. For example, in the Big Elk watershed habitat condition summary (Appendix IX-B) there are low numbers of large wood throughout the watershed, a condition which also appears to contribute to a lack of **complex pools**. In addition, in the Wolf Creek sub-watershed reach #4 pool conditions ranked as undesirable conditions, indicating a need to revisit that stream reach and determine if there are site-specific conditions to explain this data.

> CAUTION: Stream survey data is like a single photograph of a dynamic system. Stream channel conditions may change drastically between years, especially if there has been a high-flow flood event. Also, the survey methodology has evolved, and older data may have been collected using slightly different methodologies. It is important to be aware of changes that may have occurred in the stream system; the analysts of the Hydrology and Water Use, Riparian/Wetlands, and Sediment Sources assessment components can provide insights. In addition, some surveyed stream reaches have been found to be inconsistently sampled, and the summary data do not necessarily reflect actual conditions. If the condition evaluations based on comparisons to benchmark conditions do not seem to fit with observed conditions, then those reaches and parameters should be identified for field verification.
>
> Also remember that the CHT breaks may not correspond with ODFW reaches. If a reach includes more than one of your preliminary segment breaks, or extends beyond an obvious change in channel gradient or **confinement**, then you can report the summary information for the combined CHT classifications. If you are comfortable with doing spreadsheet analyses, you can consult the line-by-line field data for the stream and break it at the CHT breaks, then resummarize the data.

Forms F-2a, b, and c are organized to follow the general format of the ODFW data summary files and use the same column headings as you will find in the ODFW files. Form F-2a summarizes pool conditions, F-2b summarizes **riffle** and woody debris conditions, and Form F-2c summarizes **riparian** conditions. If you collect extensive data, you may wish to fill out a separate set of forms for each subwatershed. You will need to provide an overall pool rating: Using the most current benchmark values for your area, indicate whether the sampled conditions fall into the undesirable (U), desirable (D), or in-between range (B) (Appendix IX-A). The overall condition rating is developed using the following criteria:

- **Desirable (D)**: All parameters rated desirable or in-between
- **Between (B)**: Parameter ratings were mixed
- **Undesirable (U)**: Most of the parameters rated undesirable
- **ND**: No data

After you have completed a summary for a watershed or subwatershed, you can examine the data for trends. Is there one parameter that consistently rates undesirable or desirable? Is there one reach that has consistently good or bad conditions? Make notes of any general trends or conclusions you see in the data (see guidelines in ODFW Habitat Benchmarks sidebar). This summary will be used in the Watershed Condition Evaluation. Appendix IX-B provides examples of completed summary forms and illustrates the types of general conclusions that can be drawn from the data.

If you use data that was not collected using the ODFW protocol (i.e., from USFS or BLM), you will need to look at the collection methods and decide if the parameters are comparable. You may need to enlist the local ODFW fish biologist for assistance in determining how to complete an evaluation of habitat conditions for other data sets.

ODFW HABITAT BENCHMARKS

The ODFW habitat benchmark values (Appendix IX-A) are designed to provide an initial context for evaluating measures of habitat quality. While the natural regime of a stream depends on climate, geology, vegetation, and disturbance history, it is useful to know whether a value of a habitat feature in a reach of stream is high or low. For example, knowing whether a reach has a lot of large woody debris (LWD) or fine sediments is useful for understanding the condition of aquatic habitat and its influence on the life history of fishes. The determination of whether the "value" of a habitat feature is "good" or "bad" depends on the natural regime of the stream and the fish species of interest. The habitat benchmark values for desirable and undesirable conditions are derived from a variety of sources. Values for specific parameters were derived for appropriate stream gradient, and regional and geologic groupings of reach data (see Moore et al. 1997). This assessment is designed to look at combinations of features rather than to single out individual values. This approach should help identify patterns within these features that can then be interpreted in a broader watershed context.

The benchmark values of habitat features are listed as desirable or undesirable, but we emphasize that the values should be viewed on a sliding scale, and that the watershed context should be considered. For example, eight pieces of LWD per 100 meters may be very low for a stream in the Cascade Mountains, but extremely high for a stream in the high desert of southeast Oregon. The stream must be viewed within its natural environment. Similarly, a reach in the Cascade Mountains may have eight pieces of LWD per 100 meters, but neighboring reaches may have 25 pieces of LWD per 100 meters. Variability within a watershed may reflect normal disturbance and hydrologic cycles in addition to management history. The assessment of habitat conditions should look to other components of the watershed assessment to find if there are historic or current activities influencing these measures. This provides the basis for linking the findings from the broader assessments of upslope and upstream activities and impacts to actual in-channel conditions.

Step 4: Migration Barrier Identification (Forms F-3 and F-4)

Stream channel crossings by roads have been the cause of serious losses of fish habitat due to improperly designed culverts. Assessment of migration barriers is important, because anadromous salmonids migrate upstream and downstream during their lifecycles; in addition, many resident salmonids and other fish move extensively upstream and downstream to seek food, shelter, better water quality, and spawning areas. Where these barriers occur, fish can no longer reach suitable habitats. By reducing the amount of accessible habitat in a watershed, fish populations may be limited.

Culvert road crossings can create barriers to fish migration in the following ways (Figure 2):

- Culvert is too high for the fish to jump into.
- The water velocity in the culvert is too fast for the fish to swim against.
- The water in the culvert is not deep enough for the fish to swim, or has a disorienting turbulent flow pattern, making it difficult for fish to find their way through.
- There is no pool below the culvert for the fish to use for jumping and resting, so they cannot make it into the culvert, or there are no resting pools above the culvert, so the fish are washed back downstream.

A combination of these conditions may also impede fish passage. It is not always clear when a culvert blocks fish passage. Some culverts may be velocity barriers during high flows but pass fish successfully during low flows. Other culverts may not be deep enough during summer low flows to pass fish, but fish can pass successfully during higher flows. Large, adult anadromous fish may be able to pass through culverts that are total barriers to smaller juvenile or resident fish. For these reasons it is important to understand what fish species occur in the watershed and when they will be migrating.

In this step of the fish assessment, you will map and document what is known about the road crossings in the watershed. This information will provide the basis for evaluating where fish passage barriers potentially occur, and will help prioritize efforts to survey and/or replace problem culverts.

Create Stream Crossing Map

The Sediment Sources Assessment component will create an updated road map that identifies all known road crossings of streams. Obtain a copy of the this map from the Sediment Sources analyst and label is Map F-2: Migration Barriers. The Sediment Sources analyst also may have developed a spreadsheet numbering system for all road crossings. This spreadsheet will be a good tool to help consistently compile data on road crossings. All road crossings should be considered potential fish passage barriers until field-verified. Develop a color-coding system to identify bridges and culverts, and then classify the culvert crossings as definitive barriers, potential barriers, passable, or unknown.

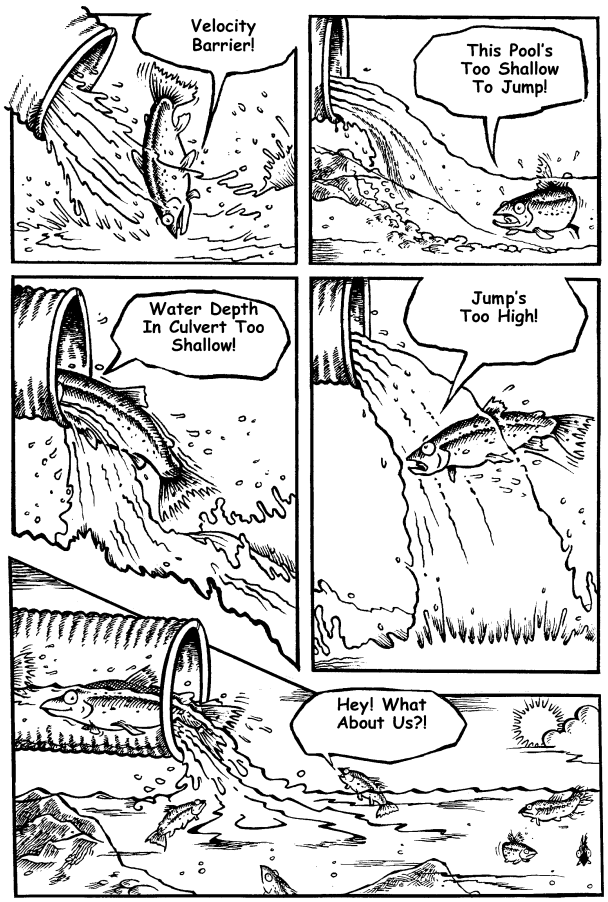


Figure 2. Culverts under roads can block fish passage through a number of factors, including excessive water velocity, insufficient depth, excessively high jumps, or a combination of these factors.

The ODFW data on stream crossings and culverts may note which crossings have been field-verified; however, these data are not typically available for an entire watershed. The Sediment Sources analyst may have compiled information from private landowners or other sources on the condition of road crossings. Check with other analysts to see what they have found on the condition of road crossings. From the information summarized on Form F-1 and compiled from other analysts, mark the locations of all known fish passage barriers (natural and man-made) and all crossings that have been checked and are passable on Map F-2. Incorporate this information into your crossing summary database on Form F-3, Fish Passage Evaluation.

Determine Crossing Status

Culverts come in round, square, elliptical, and other shapes. Culverts can be made of various materials, including concrete, but metal pipe is the most common material. Because of the variability in culvert type and design, it is often difficult to definitively determine if a culvert blocks fish passage. Table 4 summarizes basic criteria for determining fish passage based on ODF guidance (Robison 1997). Table 4a lists the culvert conditions that would block passage of juvenile salmonid fish, defined by ODF as "impeding fish passage." Table 4b lists the culvert conditions that would block passage of most adult fish. It is important to remember that these criteria are not minimum values; they describe the conditions in which passage of most fish is blocked. Other conditions may still prevent some fish from passing through a specific culvert.

Comparing these criteria to culvert conditions summarized on Form F-3 and using the fish distribution map, rate each road crossing as a juvenile barrier (JB), adult barrier (AB), potential partial/seasonal barrier (PB), passable (P), or unknown (U). You will also list on Form F-3 which species are blocked.

If time allows, you may field-verify those road crossings for which no data exist. Form F-4 provides a form for field verification of road crossings; this form is based on the ODFW Culvert Evaluation Form. Any field effort should start with a check of road crossings that are in the lower portion of the stream network, and then continue upstream.

Table 4. Criteria for determining fish passage through culverts.

a. Impeding Fish Passage Criteria (blocking juvenile salmonid fish passage)

- Velocity $\leq$ 2 feet per second
- Outlet perching $\leq$ 6 inches with little or no inlet constriction or drop
- Flow depth $\geq$ 12 inches, or streambed conditions similar to the natural channel
- Free from debris that may concentrate flows and increase velocities

	Bare (nonembedded culverts)	**Embedded Culverts**	**Baffled Culverts**
Slope	< 0.5% (unless backwatered – see Robison 1997).	At grade – with material simulating natural channel. Material should be > 1 foot deep.	See Robison 1997 for specific design criteria.
Outlet Drop	< 6 inches, with residual pool 1.5 times deeper than the jump.	None.	< 6 inches, with residual pool 1.5 times deeper than the jump.
Inlet Condition	Diameter >1/2 bankfull channel width; no inlet drop.	Width 2/3 bankfull channel width, with tapering material, not a sudden drop.	Little or no inlet drop. Top wier should backwater into upstream natural channel.
Length	< 100 feet long.		
Outlet Backwatering	Minimum 8 inches deep at baseflows.		

b. Fish-Blockage Criteria

- Velocity $\leq$ 10 feet per second
- Outlet perching $\leq$ 4 feet with adequate jump pool
- Outlet perching $\leq$ 1 foot without adequate jump pool
- Severe inlet constriction or drop
- Flow depth $\geq$ 8 inches, or streambed conditions similar to the natural channel

	Bare (nonembedded culverts)	**Embedded Culverts**	**Baffled Culverts**
Slope	< 4% (unless backwatered or less than 50 ft long–see Robison 1997).	At grade – with material simulating natural channel. Material should be > 1 foot deep.	See Robison 1997 for specific design criteria.
Outlet Drop	< 4 feet, with residual pool 1.5 times deeper than the jump or 2 feet deep.	None.	< 4 feet, with residual pool 1.5 times deeper than the jump.
Inlet Condition		Width 2/3 bankfull channel width.	Little or no inlet drop. Top wier should backwater into upstream natural channel.
Length	< 200 feet long.		

The final task in the assessment will be to estimate the length of potential fish habitat upstream of the barriers. You can use a map wheel to measure the upstream extent of potential fish habitat; record this in the last column of Form F-3 (see example of completed form in Appendix IX-C). If you have been working with a spreadsheet program, it will be simple to sort the road crossings identified as barriers by the amount of habitat blocked. Prioritize remediation opportunities by listing those barriers that block the largest areas of fish habitat, and incorporate this priority list into the Watershed Condition Evaluation

Step 5: Evaluate Confidence in the Assessment (Form F-5)

You can evaluate the strength of your fish use and habitat assessment by considering the resources used, whether information was field-verified, and so on. Form F-5 provides criteria for the evaluation. If the type or quality of information used to map the fish distributions differs significantly from area to area, fill out one form for each general area.

REFERENCES

Moore, K.M.S., K.K. Jones, and J.M. Dambacher. 1997. Methods for stream habitat surveys. Oregon Department of Fish and Wildlife, Portland, Oregon.

Robison, G.E. 1997. Interim fish passage and culvert/bridge sizing guidance for road crossings. Oregon Department of Forestry Memorandum, Salem, Oregon.

GLOSSARY

anadromous fish: Fish that move from the sea to fresh water for reproduction.

Channel Habitat Types (CHT): Groups of stream channels with similar gradient, **channel pattern**, and **confinement**. Channels within a particular group are expected to respond similarly to changes in environmental factors that influence channel conditions. In this process, CHTs are used to organize information at a scale relevant to aquatic resources, and lead to identification of restoration opportunities.

channel pattern: Description of how a stream channel looks as it flows down its valley (for example, braided channel or meandering channel).

complex pool: Portion of stream with reduced velocity, a smooth surface, and deeper water; usually with undercut banks, thick bank vegetation and/or associated with large woody debris.

channel confinement: Ratio of bankfull channel width to width of modern floodplain. Modern floodplain is the flood-prone area and may correspond to the 100-year floodplain. Typically, channel confinement is a description of how much a channel can move within its valley before it is stopped by a hill slope or terrace.

Geographic Information System (GIS): A computer system designed for storage, manipulation, and presentation of geographical information such as topography, elevation, geology etc.

resident fish: Nonmigratory fish that remain in the same stream network their entire lives.

riffle: Shallow section of stream or river with rapid current and a surface broken by gravel, rubble, or boulders.

riparian vegetation: Vegetation growing on or near the banks of a stream or other body of water in soils that are wet during some portion of the growing season. Includes areas in and near wetlands, floodplains, and valley bottoms. (from Meehan 1991)

salmonid: Fish of the family *Salmonidae*, including salmon, trout, char, whitefish, ciscoes, and grayling. Generally, the term refers mostly to salmon, trout, and char.

stadia rod: Surveying rod used for measuring changed in elevation from one point to another.

stream reach: A section of stream possessing similar physical features such as gradient and confinement; usually the length of stream between two tributaries.

Appendix IX-A
ODFW Habitat Benchmarks

APPENDIX IX-A: ODFW HABITAT BENCHMARKS

	UNDESIRABLE	DESIRABLE
POOLS		
Pool Area (% total stream area)	<10	>35
Pool Frequency (channel widths between pools)	>20	5-8
Residual Pool Depth		
Small Streams (<7-m width)	<0.2	>0.5
Medium Streams (≥7-m & <15-m width)		
Low Gradient (slope <3%)	<0.3	>0.6
High Gradient (slope >3%)	<0.5	>1.0
Large Streams (≥15-m width)	<0.8	>1.5
Complex Pools (pools w/wood complexity >3 km)	<1.0	>2.5
RIFFLES		
Width/Depth Ratio (active-channel based)		
East Side	>30	<10
West Side	>30	<15
Gravel (% area)	<15	≥35
Silt-Sand-Organics (% area)		
Volcanic Parent Material	>15	<8
Sedimentary Parent Material	>20	<10
Channel Gradient <1.5%	>25	<12
SHADE (reach average %)		
Stream Width <12 m		
West Side	<60	>70
Northeast	<50	>60
Central-Southwest	<40	>50
Stream Width >12 m		
West Side	<50	>60
Northeast	<40	>50
Central-Southeast	<30	>40
LARGE WOODY DEBRIS* (15 cm X 3 m min. size)		
Pieces/100-m Stream Length	<10	>20
Volume/100-m Stream Length	<20	>30
"Key" Pieces (>60-cm and 10-m long)/100 m	<1	>3
RIPARIAN CONIFERS (30 m from both sides)		
Number >20-in dbh/1,000-ft Stream Length	<150	>300
Number >35-in dbh/1,000-ft Stream Length	<75	>200

* Values for streams in forested basins

Appendix IX-B
Example Habitat Condition Summary Forms

Example Form F-2a: Pool Habitat Condition Summary Big Elk Watershed

Name: Karen Kuzis **Date:** September 1998 **Data Sources:** ODFW
Data Dates: Elk Creek & Spout Creek 1992, Devils Well 1995, Wolf Creek 1994
Rating Codes: D: Desirable**, U:** Undesirable**, B:** Between

Site	Length Sampled (Prichnll)	Lane Use (Luse1)	Gradient	CHT	Width	Pool Area		Pool Frequency		Residual Pool Depth		Complex Pools		Overall Pool Rating
						Pctpool	Bench-mark	CWpool	Bench-mark	Residpd	Bench-mark	Compool_km	Bench-mark	
Elk Creek 1	5687	ST	0.8	LC	18.7	16.2	B	16.2	B	1.6	D	0	U	B
Elk Creek 2	2420	ST	0.3	LC	12.6	75.8	D	15.7	B	1.3	D	0	U	D
Elk Creek 3	7719	MT	0.4	LC	15.6	57.7	D	8.4	B	1.2	B	0	U	B
Elk Creek 4	4082	HG	0.3	LC	16.7	47.7	D	9.1	B	1.3	B	0	U	B
Elk Creek 5	7628	MT	0.3	LC	15	56.2	D	6.2	D	1.3	B	0	U	D
Elk Creek 6	9861	LG	0.2	LC/LM	11	53	D	7.2	D	1.1	D	0	U	D
Spout Creek 1	2945	TH	1.3	LC	6.2	60.7	D	4.4	D	0.4	B	0	U	D
Spout Creek 2	1161	TH	0.8	LC	4.8	68.8	D	4.2	D	0.4	B	0	U	D
Spout Creek 3	1279	ST	1.1	LM	4.1	62.8	D	5.6	D	0.3	B	0	U	D
Spout Creek 4	1509	AG	0.5	LM	4.2	88.6	D	10.4	B	0.3	B	0	U	B
Spout Creek 5	1056	MT	1.8	LM	4.2	55.6	D	5.4	D	0.3	B	0	U	D
Spout Creek 6	1152	MT	0.4	LM/MV	5.4	92.4	D	5	D	0.2	B	0	U	D
Devils Well	1081	ST	4.1	MV	1.3	30.2	B	40.9	U	0.5	D	0	U	B
Wolf Creek 1	412	ST	1.1	LM/FP3	4.4	26	B	4.3	D	0.4	B	0	U	B
Wolf Creek 2	1060	LT	1.4	FP3	4.7	32.4	B	5.1	D	0.5	D	0	U	B
Wolf Creek 3	1059	OG	1.8	FP3	6.2	73.7	D	3.2	D	0.5	D	0	U	D
Wolf Creek 4	678	OG	3.1	FP3/LM	1.7	1.6	U	78.8	U	0.3	B	0	U	U
Wolf Creek Trib a 1	590	ST	3.3	LM	2.7	37.8	D	9.1	B	0.4	B	0	U	B
Wolf Creek Trib a 2	1716	ST	5.6	MC/MV	2.2	25.8	B	36.3	U	0.5	D	0	U	B

Conclusions:

- 60% of the sampled reaches are in the LC category.
- 54% of the sampled reaches have desirable pool conditions.
- 45% of the sampled reaches have in-between conditions.
- Complex pools were low in all reaches– related to general lack of large woody debris.
- Wolf Creek #4 is the only reach with undesirable conditions– may want to revisit data or field-verify site.

Example Form F-2b: Riffle and Woody Debris Habitat Condition Summary

Site	Width/Depth Ratio		Gravel (% area)		Silt-sand-organics (% area)		Overall Riffle Rating	LWD Pieces/100 m		Volume LWD/100m		Key Pieces/100 m		Overall LWD Rating
	WDratio	Bench-mark	Pctgravel	Bench-mark	Pctsndoc	Bench-mark		LWDpiece1	Bench-mark	LWDvol1	Bench-mark	KeyLWD 1	Bench-mark	
Elk Creek 1	90.5	U	15	B	22	B	B	4.1	U	2.8	U	0	U	U
Elk Creek 2	52.5	U	17	B	27	U	U	4	U	1.8	U	0	U	U
Elk Creek 3	45	U	9	U	12	D	U	3.1	U	2.7	U	0	U	U
Elk Creek 4	67.5	U	8	U	9	D	U	3.6	U	1.4	U	0	U	U
Elk Creek 5	78.5	U	8	U	11	D	U	5.4	U	2.9	U	0	U	U
Elk Creek 6	54	U	16	B	22	B	B	5.8	U	3.1	U	0	U	U
Spout Creek 1	51	U	10	U	16	B	U	7.7	U	4	U	0	U	U
Spout Creek 2	48	U	22	B	33	U	U	9	U	11.4	U	0	U	U
Spout Creek 3	31	U	14	U	29	U	U	7.2	U	3	U	0	U	U
Spout creek 4	22	B	26	B	53	U	B	4.3	U	2.3	U	0	U	U
Spout Creek 5	32	U	17	B	28	U	U	12.3	B	7.1	U	0	U	U
Spout Creek 6	11	B	18	B	74	U	B	8	U	5.8	U	0	U	U
Devils Well	32.2	U	27	B	51	U	U	6.8	U	8.4	U	0.2	U	U
Wolf Creek 1	20.9	B	34	B	44	U	B	7.5	U	5.8	U	0	U	U
Wolf Creek 2	0	?	21	B	37	U	U	15.5	B	9.8	U	0	U	U
Wolf Creek 3	24.8	B	15	U	82	U	U	9.5	U	7.8	U	0	U	U
Wolf Creek 4	0	?	48	D	18	B	B	4.9	U	8.2	U	0	U	U
Wolf Creek Trib a 1	28.4	B	18.0	B	23.0	U	B	5.8	U	3.7	U	0.00	U	U
Wolf Creek Trib a 2	20.2	B	29.0	B	42.0	U	B	7.4	U	7.1	U	0.20	U	U

Conclusions:

- All sampled reaches in all CHTs are deficient in LWD.
- Width:depth ratios are higher than anticipated throughout the watershed.
- The percent area of gravel is low everywhere except Wolf Creek #4 (which was the site deficient in pools). *High flow event in 1996 may have cleaned gravel – may want to spot-check*.
- The percent of sand-silt-organics is higher than desirable in all reaches.

Example Form F-2c: Riparian Habitat Condition Summary.

Site	CHT	Width	Conifers # >20-in dbh Con_20plus	Conifers # > 35-in dbh Con_36plus	Bench-mark	Opensky	Shade = 180-Open sky	Benchmark	Overall Riparian Benchmark	Bank Erosion Bankerosi*	Percent Secondary Channels Pctscchnls*
Elk Creek 1	LC	18.7	0	0	U	49	131	D	*	5.3	0
Elk Creek 2	LC	12.6	0	0	U	35	145	D	*	14	1.3
Elk Creek 3	LC	15.6	0	0	U	30	150	D	*	11.3	0.1
Elk Creek 4	LC	16.7	0	0	U	35	145	D	*	12.3	12.9
Elk Creek 5	LC	15	0	0	U	30	150	D	*	7.2	0.5
Elk Creek 6	LC/LM	11	0	0	U	30	150	D	*	45.7	1.4
Spout Creek 1	LC	6.2	0	0	U	9	171	D	*	28.8	0.7
Spout Creek 2	LC	4.8	0	0	U	12	168	D	*	38.8	0.5
Spout Creek 3	LM	4.1	0	0	U	3	177	D	*	54.6	2.1
Spout creek 4	LM	4.2	0	0	U	7	173	D	*	76.3	0.3
Spout Creek 5	LM	4.2	0	0	U	5	175	D	*	24.1	1
Spout Creek 6	LM/MV	5.4	0	0	U	11	169	D	*	5.7	33.5
Devils Well	MV	1.3	0	0	U	26	154	D	*	0	0
Wolf Creek 1	LM/FP3	4.4	0	0	U	31	149	D	*	37.6	0.6
Wolf Creek 2	FP3	4.7	42	0	U	14	166	D	*	17.4	1.1
Wolf Creek 3	FP3	6.2	30.1	30.1	U	33	147	D	*	4.3	9
Wolf Creek 4	FP3/LM	1.7	121	181	U	1	179	D	*	5.2	0.4
Wolf Creek Trib a 1	LM	2.7	0.0	0	U	3.0	177	D	*	22.3	1.6
Wolf Creek Trib a 2	MC/MV	2.2	0.0	0	U	15.0	165	D	*	1.1	0.5

* Benchmarks do not exist for these parameters; however they provide some interesting information on general observed conditions.

Conclusions:

- Low numbers of riparian conifers – check Riparian assessment to verify.
- Plenty of shade in all sampled reaches – check Riparian map.
- Spout Creek reaches have high bank erosion, Elk Creek #6 and Wolf Creek #1 (USFS notes recent bank erosion Elk Creek 1995, Lower Savage with high proportion of unstable banks).
- Spout Creek #6 and Elk Creek #4 have >10% secondary channels, indicating good complex habitat.

Appendix IX-C
Example Fish Passage Evaluation

Example Form F-3: Fish Passage Evaluation

Road Crossing Number	Crossing Type[1]	Crossing Slope	Outlet Drop	Outlet Pool Residual Depth	Inlet Drop	Inlet Diameter	Stream Bankfull Width	Crossing Length	Crossing Rating[2]	Species Blocked	Estimated Habitat Blocked
LBC01	B	na	na	na	na	na	40'	na	P	0	0
LBC 02	A	na	na	na	na	na	38'	na	P	0	0
LBC03	C	1%	10'	1.8'	0	72"	8'	50'	AB	Coho	2 miles
CC01	EC	4%	0	10"	0	18'	21'	60'	P	0	0
CC02	C	1%	3'	0	0	72"	7.5'	40'	AB	Cutthroat	0.25 miles
CC003	C	2%	1'	1'7"	0	8'	8'	15'	JB	Cutthroat	0.2 miles

1 Crossing Types: B-Bridge, A- Arch, BC-Bare Culvert, EC-Embedded Culvert, BC-Baffled Culvert

2 Crossing Ratings: JB-Juvenile Barrier, AB-Adult Barrier, PB-Potential Partial/Seasonal Barrier, P-Passable, U-Unknown

Appendix IX-D
Blank Forms

Form F-1: Fisheries Information Summary

Analyst's Name: **Date:**

This sheet summarizes key information about fish populations, important habitat areas, and the locations of known barriers. This information will provide the basic information needed for mapping fish distributions in the watershed.

1) List all salmonid or other fish species of concern occurring in the watershed:

Species	ESA Status	ODFW Status and Population Trends	Source (data quality)

Make notes on any documented or anecdotal changes in historic fish distribution (cite your sources):

2) List fish species that occurred historically in the watershed and are no longer present:

Species	Source

3) List species that have been or are currently stocked in the watershed:

Species	Stocking Notes	Native or Exotic?	Source

4) Identify life history patterns of key fish species:

Species	A-Anadromous R-Resident	Location	Spawning Timing	Outmigration Timing

Notes:

5) Identify important locations for adult holding, spawning, summer, and winter rearing:

Location	Species/Purpose	Source

6) Identify locations of known migration barriers:

Location (subwatershed, trib., site)	Barrier: Type: C- culvert, N-natural, D-dam	Source

7) Does the watershed contain the following combinations of fish?

- Brook trout/bull trout (competition, interbreeding) **YES NO**
- Rainbow/cutthroat (competition/ interbreeding) **YES NO**
- Hatchery/wild-stock interactions ? **YES NO**

If you answered yes to any of these items consult with a local ODFW fisheries biologist to determine the extent of the potential interactions. If this is unknown, more analysis may be warranted.

Notes:

Form F-2a: Pool Habitat Condition Summary

This form will be filled out for each subwatershed where ODFW or other comparable habitat data exist. Measured values are recorded and compared to rating criteria.

Analyst's Name: **Date** **Page of**

Subwatershed: **Data Sources:** **Data Dates:**

Site	Length Sampled (Prichnll)	Land Use (Luse1)	Gradient	CHT	Width	Pool Area		Pool Frequency		Residual Pool Depth		Complex Pools		Overall Pool Rating
						Pctpool	Bench-mark	CWpool	Bench-mark	Resid pd	Bench-mark	Compool _km	Bench-mark	

Conclusions:

Form F-2b: Riffle and Woody Debris Habitat Condition Summary

This form will be filled out for each subwatershed where ODFW or other comparable habitat data exist. Measured values are recorded and compared to rating criteria.

Analyst's Name: **Date** **Page of**

Subwatershed: **Data Sources:** **Data Dates:**

Site	Width/Depth Ratio		Gravel (% area)		Silt-sand-organics (% area)		Overall Riffle Rating	LWD Pieces/100 m		Volume LWD/100 m		Key Pieces/100 m		Overall LWD Rating
	WDratio	Bench-mark	Pctgravel	Bench-mark	Pctsndor	Bench-mark		LWDpiece1	Bench-mark	LWDvol1	Bench-mark	KeyLWD1	Bench-mark	

Conclusions:

Form F-2c: Riparian Habitat Condition Summary

This form will be filled out for each subwatershed where ODFW or other comparable habitat data exist. Measured values are recorded and compared to rating criteria.

Analyst's Name: **Date** **Page of**

Subwatershed: **Data Sources:** **Data Dates:**

Site	CHT	Width	Conifers # >20- in dbh Con_20plus	Conifers # >35- in dbh Con_35plus	Benchmark	Opensky	Shade = 180- Opensky	Benchmark	Overall Riparian Benchmark	Bank Erosion Bankerosi*	Percent Secondary Channels Pctscchnls*

* Benchmarks do not exist for these parameters; however, they provide some interesting information on general observed conditions.

Conclusions:

Form F-3: Fish Passage Evaluation

Analysts Name:

Date: **Page of**

Subwatershed:

Road Crossing Number	Crossing Type[1]	Crossing Slope	Outlet Drop	Outlet Pool Residual Depth	Inlet Drop	Inlet Diameter	Stream Bankfull Width	Crossing Length	Crossing Rating[2]	Species Blocked	Estimated Habitat Blocked

1- Crossing Types: B-Bridge, A- Arch, BC-Bare Culvert, EC-Embedded Culvert, BC-Baffled Culvert

2- Crossing Ratings: JB-Juvenile Barrier, AB-Adult Barrier, PB- Potential Partial/Seasonal Barrier, P-Passable, U-Unknown

Form F-4: Fish Passage Field Assessment.

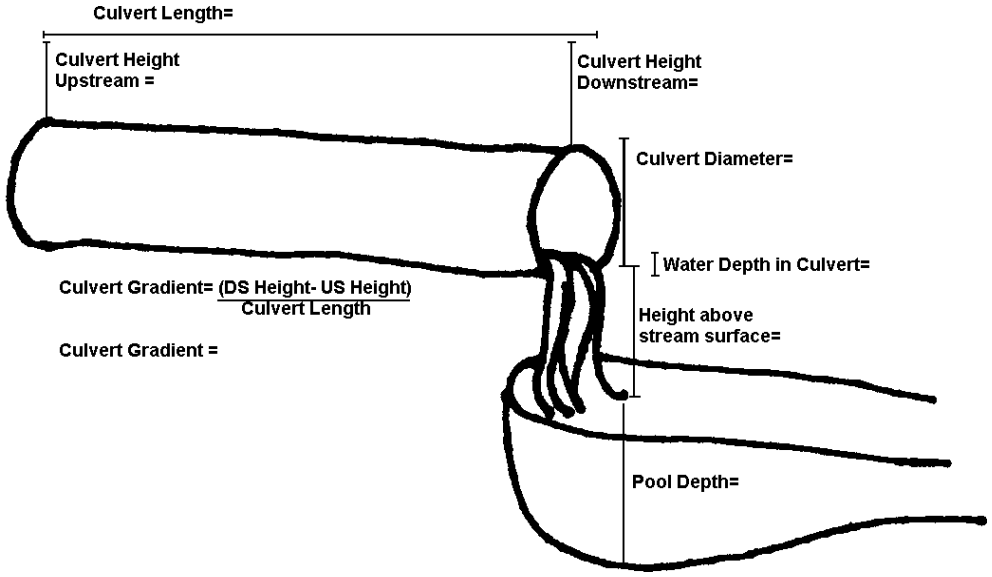
Watershed:

Analyst's Name: **Date:**

Crossing Number:

The culvert height measurements are taken to calculate culvert slope. These measurements require that a level be set up on the road crossing between the upstream and downstream end of the culvert. The upstream and downstream measurements are made by placing a stadia rod on the end of the culvert and reading the measurement through the level. As an alternative, culvert slope can be measured using a string attached to the culvert inlet. Level the string and measure the height of the string above the outlet (rise). The culvert slope can be calculated by dividing the rise by the length of the culvert (run).

Hike down to the culvert and take the illustrated measurements and fill in the measured values:



	Measurement	Units
Length of Culvert		Feet
Culvert Diameter		Inches
Outlet Drop (height above stream surface)		Inches
Pool Depth (outlet pool residual depth)		Feet
Culvert Gradient/Crossing Slope		Drop in inches or % slope
Culvert Inlet Width		Inches
Culvert Inlet Drop		inches
Stream Gradient Above Culvert		% slope
Stream Gradient Below Culvert		% slope
Stream Bankfull Width Above the Culvert		feet

Form F-4: page 2

Culvert Material (circle one):

galvanized steel tarred galvanized steel concrete

wood aluminum other

Describe any internal baffles, weirs, or bedload materials:

Who owns/maintains the culvert?

Is the culvert in good physical condition?

Fish species present above culvert?

Fish species present below culvert?

Describe upstream adult or juvenile passage problems, if any:

In your opinion, what improvements may be needed:

Form F-4: page 3

Other comments, observations:

Photo:

Form F-5: Fish Assessment Confidence Evaluation

Watershed:

Analyst's Name:

Technical expertise or relevant experience:

Resources used:

- ☐ ODFW personnel (list):
- ☐ ODF personnel (list):
- ☐ federal (USFS, BLM, NMFS) (list):
- ☐ stream surveys (list):
- ☐ newspaper archives
- ☐ private landowners (list):
- ☐ others (list):

Published surveys or reports: *(examples: ODFW stream surveys for ___ miles of stream in the ([sub]watershed, or USFS/BLM watershed analysis report for [sub]watershed):*

Confidence in distribution maps:

- ☐ Local expert says high / low (circle one) degree of accuracy based on field experience (provide name of local expert):
- ☐ High degree of accuracy as field verification of fish presence/absence were available (provide source of info/mapping):
- ☐ No verification; map based on recommendations of local professional (provide name):
- ☐ No verification; map based on personal judgement
- ☐ Additional criteria/relevent information (describe):

Form F-5: page 2

Confidence in habitat assessment:

- ☐ **Low:** Unsure of procedures; didn't consult expert; no field verification
- ☐ **Low to moderate:** Understood and followed procedures; no field verification
- ☐ **Moderate:** Some field verification and found field conditions different from data descriptions
- ☐ **Moderate to high:** Field surveys available and useful for many streams; no field verification
- ☐ **Moderate to high:** Some field verification on questionable segments only
- ☐ **High:** Used field surveys and field-verified many segments
- ☐ **If none of above** categories fits, describe your own confidence level and rationale:

Confidence in barrier identification:

- ☐ **Low:** Unsure of procedures; didn't consult expert; no field verification
- ☐ **Low to moderate:** Understood and followed procedures; no field verification
- ☐ **Moderate:** Some field verification
- ☐ **Moderate to high:** Some field verification; few unknowns
- ☐ **High:** Field-verified most crossings or good data available
- ☐ **If none of above** categories fits, describe your own confidence level and rationale:

Recommendations for additional field verification, or habitat or fish population surveys, if any, and why: