X. Watershed Evaluation

The individual sections of this watershed assessment address the natural processes on a watershed scale and the human influences that have altered the landscape and aquatic habitats. Land use and resource management practices can result in alterations to the natural processes that influence aquatic habitat quality and quantity. Within the sections of the assessment key components of the environment are evaluated to determine if management objectives should include restoration of natural features and processes to improve habitat for anadromous salmonids. The following paragraphs summarize the key findings of the individual watershed assessment components.

Historical Conditions

The Lower Columbia-Clatskanie Subbasin is a 298 square mile area that is bordered by the Columbia River on one side (Section One, Figure 1.1). The term subbasin is used because the area encompasses multiple watersheds that are not directly connected. Many of the watersheds flow into the Columbia River or into sloughs that connect to the Columbia River. The subbasin is characterized by forest management across 77% of the landscape, with another 16% of the subbasin under agricultural land uses that are located primarily within the floodplains of the Columbia River. The forests of the subbasin were among the first to be harvested when Europeans settled the Northwest. By the early 1900's most of the forests had been cut over and uncontrolled fires had left scarred patches on the landscape. There are several small towns including Clatskanie, Rainier, and St. Helens. However, urban land uses only cover about 1% of the subbasin.

Most of the stream channels start in moderate to steep gradient headwater areas, with the mainstems occupying low gradient valleys with some floodplain development. Anadromous fish were historically abundant throughout many of the watersheds of the subbasin. Forest management and rural residential developments in the uplands, and agriculture and residential developments within the floodplains of the Columbia River have impacted stream channels throughout the subbasin. In addition to habitat modifications, hatchery programs within the lower Columbia River have been impacting anadromous fish populations of the subbasin for over 50 years. Historic anadromous fish use included fall chinook salmon, coho salmon, chum salmon, winter steelhead trout, sea-run cutthroat trout, and Pacific lamprey. Resident salmonid fish use included cutthroat trout and perhaps rainbow trout.

Channel Habitat Types

Channel habitat types have been assigned to all streams and sloughs within the subbasin. Channels were segmented and assigned a sensitivity rating based on gradient, confinement, valley form, and stream size. Sensitivity is the degree to which a channel will respond to restoration activities. Highly sensitive channels will have the greatest potential for restoration activities. The key findings from this assessment indicate that two thirds of the stream channels are highly to moderately responsive to land use impacts, hydrologic developments, and more importantly restoration efforts. The degree of response will depend on the type and level of impact as well as site specific

characteristics of the channel. The channel habitat types used within this assessment are artificial classifications and individual variation within each channel habitat type is common. Therefore, site-specific verification of channel characteristics is recommended before planning habitat restoration activities.

Hydrology and Water Use

The risk of peak flow enhancement as a result of land developments is low for most of the subbasin. This is based on an analysis of the individual impacts of forestry, forest and rural roads, agriculture, and urban areas. However, the analysis does not consider the cumulative impacts from these land development activities. No significant risk of peak flow enhancement was found as the result of timber harvest practices, but there have been substantial floods in the past due to rain-on-snow events. The aerial photographs used in this analysis were taken in 1994 and do not contain all of the areas that currently have less than 30% canopy cover. The Oregon Department of Forestry (ODF) stand exams were used to supplement the aerial photographs on state lands, but no information was available for private lands. Agricultural land uses within the subbasin are located primarily within floodplains of the Columbia River where levees, tide gates and pump stations are used as flood prevention measures. The risk of peak flow enhancement from agricultural lands is low because most of these areas are within diking districts and cutoff from stream channels. Although forest and rural roads were not found to have a significant impact on peak flows, the Lower Columbia River Watershed Council believes that the GIS data has underestimated the density of roads (Lower Columbia River Watershed Council Meeting, May 22, 2001). Urban and residential land uses pose a high risk to peak flow enhancement in three watersheds and a moderate risk in five watersheds. The Oregon Department of Fish and Wildlife (ODFW) has identified two of these watersheds, the Clatskanie Floodplain and Fox Creek, as containing habitat for anadromous fish. The Clatskanie Floodplain encompasses several sloughs and a large portion of the agricultural lands that are located within diking districts.

Water availability calculated by the Oregon Water Resources Department (OWRD) indicates that six watersheds have negative net water available mainly during the summer months. The OWRD has estimated that on average the Beaver Creek, Clatskanie River, Fox Creek, Graham Creek, Little Jack Falls, and Plympton Creek water availability basins do not have enough water to meet current water rights during several months of the year. Stream flow allotments for the instream water rights for salmonids within Beaver Creek, Clatskanie River, and Plympton Creek are not being met. However, the natural stream flow estimated by OWRD is not sufficient to meet the instream water rights during October and November (see Section IV: Hydrology and Water Use). Instream water rights may need to be adjusted to reflect natural stream flows. Analysis of the consumptive uses within these watersheds indicates that conservation measures, increased efficiency of use, and/or best management practices will not be enough to meet the needs instream water rights.

Riparian and Wetland Conditions

The riparian recruitment potential for large woody debris (LWD) and riparian shading are rated poorly throughout most of the subbasin. Riparian areas that have adequate large conifers and areas that under natural conditions are not expected to have

adequate large conifers (i.e. wet meadows and rock outcrops) amount to 13% of the total riparian areas of the subbasin. The riparian zones having adequate numbers of large conifers are spread throughout the subbasin with the watersheds of the northwestern corner having the highest percent of adequate recruitment situations. The watersheds with the highest percent of riparian zones that have adequate large conifers are West Creek and Plympton Creek, with 42% and 39% respectively. Only 9% of the riparian zones of the Clatskanie River watershed have an adequate supply of large conifers for recruitment of woody debris.

Land developments and resource management have also influenced the quality of riparian shading. Nearly half of the total riparian area for the subbasin does not provide adequate shade to maintain cool stream temperatures. The Oregon Forest Practices does not require trees to be left in the riparian zones of small non fish-bearing streams. However, temperatures within fish bearing streams are influenced by tributary streamflows.

The historic floodplains of the Columbia River had abundant wetlands but have been modified and no longer function as habitat for salmonids. The Clatskanie Floodplain and the land on which the city of Clatskanie sits are examples of historically important areas that contained abundant wetlands and secondary channels. The National Marine Fisheries Service has identified most of this area as critical habitat for threatened and endangered salmonids of the Columbia River. These wetlands would have provided valuable habitat during migrations of adult salmonids and for juvenile rearing. However, these low elevation flatlands were the first to be developed by settlers and many of the historic channels have since been modified to meet the needs of agricultural, urban, and residential land uses. Wetland losses are estimated to be in the range of 13,000 acres and are primarily within the floodplains of the Columbia River and tributaries. Riparian wetlands are not as severely impacted, but a number of roads have been built along channels cutting off streams from part of their floodplain. However, losses of this sort have not been evaluated within this assessment. Fieldwork is needed to verify the impacts to wetlands within the interior of the subbasin.

Sediment Sources

The primary source of sediments within the streams of the subbasin is forest and rural roads. The analysis of these features indicates that there is a low potential of sediment loading of streams from forest and rural roads. However, the Lower Columbia River Watershed Council believes that the GIS data for roads underestimates the density of the road network within forested areas (Lower Columbia River Watershed Council meeting, May 22, 2001). Road and slope instability are a potential concern within the subbasin but could not be quantified because of the incomplete information provided by ODF. PSU was unable to map slope failures and road washouts that occurred as a result of the 1996 and 1997 winter storms. However, debris flow hazard mapping by ODF indicates that the western half of the subbasin has the greatest potential for slope failures. The potential for sediments from urban areas, croplands, and pasturelands is low throughout the subbasin.

Channel Modifications

Numerous channel modifications have temporarily altered stream habitats, but in some cases the modifications are permanent. Of primary concern are the floodplains along the Columbia River and in the lower reaches of tributaries. As mentioned before these floodplain habitats and wetlands have been modified for agricultural, urban, and residential land uses and most of them no longer function as salmonid habitat. Beaver Creek once drained into Beaver Slough and connected to numerous other sloughs, but now the creek flows through a straight channel bordered by levees that is known as the Beaver Dredge Cut. Westport Slough once connected to numerous other sloughs that are now behind levees and tide gates and offer little value to anadromous salmonids. The town of Clatskanie is built at the mouth of the river where it drains into the Clatskanie Slough. Tide Creek has also been cut off from its historic floodplain on Deer Island. The stream historically flowed northeast through Deer Island and out to the Columbia River. Tide Creek has been relocated into a channel that runs south through Deer Island. The mouth of Fox Creek is currently channeled through a long culvert that poses a problem to fish passage. However, plans are being reviewed to remove the culvert and restore the lower reach of the creek.

Other significant channel modifications include stream cleaning that was conducted by ODFW as habitat enhancement during the 1950's through to the 1970's. The removal of woody debris and beaver dams did not improve fish returns but did result in channelization, increased rates of flow and scouring, and a reduction in key habitat features such as pools and sorted gravel. The Clatskanie River and Carcus Creek were cleaned more than once during the period of record.

Water Quality

Water quality is an area of concern within the subbasin where stream temperature, dissolved oxygen levels, and total nitrogen levels do not meet the state standards. During the summer of 1999 stream temperatures at seven out of fifteen sites were impaired based on the standard of 64°F for salmonids. Four out of five sites within the middle and lower reaches of the Clatskanie River exceeded the temperature standard for more than 29% of the period of record (July through September). Three sites within Goble Creek also had impaired stream temperatures. Data collected by LCRWC indicate that dissolved oxygen levels are moderately impaired in the lower Clatskanie River from around river mile 8 downstream, and at one site in the upper Clatskanie River above the confluence with the Little Clatskanie River. Potentially impaired sites were also found in Beaver Creek, Goble Creek, Westport Slough, and in tributaries of Clatskanie River. The Clatskanie River at Highway 30 tested high for total nitrogen 57% percent of the time in the year 2000. Several other sites also exceeded the water quality standard for total nitrogen but not enough data was available to conclude if these sites are impaired.

Other water quality parameters that may be of concern include E. Coli and pH. Both of these parameters are moderately impaired within Plympton Creek upstream of Highway 30. But the confidence in the data for pH is low because the device used to measure it was found to be inconsistent. E. Coli levels were also exceeded in Beaver Creek at Parkdale Road and the Clatskanie River near the sewage treatment plant.

However, these sites have too few samples to conclude that there is an impairment of this water quality parameter.

Fish and Fish Habitat

There are relatively few streams for which habitat surveys have been done within the subbasin, but for the few that have them insufficient levels of LWD, insufficient large conifers in the riparian zone for recruitment of LWD, and an abundance of fine sediments in riffles are common problems. Additionally, stream surveys rate canopy closure as adequate for instream shade but water quality data collected by the Lower Columbia River Watershed council clearly shows that temperatures are an issue. Results from the riparian analysis section of the watershed assessment correspond well with the water quality data showing poor riparian conditions for shade. Of the streams surveyed, Carcus Creek was the only one that rated good over most of the surveyed length for instream habitats. A random survey of one reach of Carcus Creek in 1998 indicated that instream conditions may have degraded from 1991. Several anadromous fish bearing streams within the subbasin have falls in their lower reaches that are barriers to fish passage. Plympton Creek, Beaver Creek, and Tide Creek have falls that are well-documented barriers that restrict anadromous fish use to the lower most section of these streams. Green Creek and Goble Creek have potential barriers that need to be field verified.

Fish use by anadromous salmonids includes 22% of the total length of streams mapped within the subbasin. This does not take into consideration all of the historically occupied channels such as the floodplains of the Columbia River and tributaries that have been modified for agricultural, urban, and residential uses. Coho salmon have the greatest distribution of an salmon within the subbasin. They utilize 22% of the total length of stream channels. Steelhead are the second most common salmon utilizing 19% of the total length of stream channels. Chum salmon were historically wider spread than chinook but whether or not these fish still spawn within the subbasin is questionable. Chinook salmon are limited to three streams of the subbasin. Distribution of sea-run cutthroat trout and Pacific lamprey is poorly documented but most likely mirrors the distribution of steelhead.

Plympton Creek is the only stream that consistently has large runs of spawning chinook salmon, although many of these fish are believed to be hatchery strays. Other than the chinook salmon in Plympton Creek, all runs of anadromous fish have declined substantially since European settlement. Recent trends show a decline in both coho and steelhead, and stability in chinook salmon for the Clatskanie River. Spawning surveys and pit tag recoveries for chinook salmon on the Oregon side of the Lower Columbia River found the highest proportion of hatchery strays to wild fish within the Clatskanie River (82% of the returning fish were hatchery strays). From this and other information the trend within the streams of the subbasin is overall a declining return of anadromous fish.

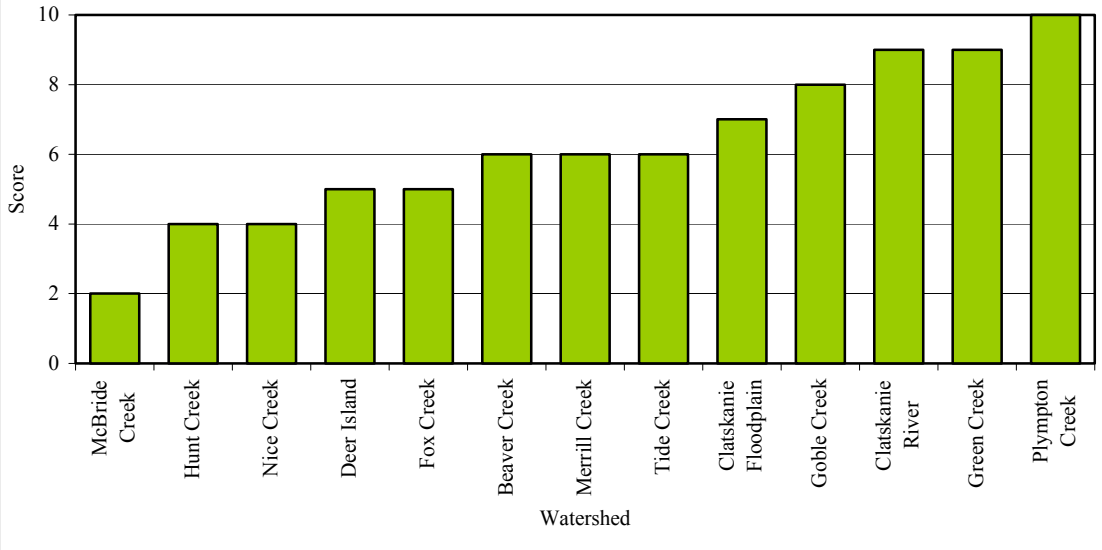
Priority Watersheds and Priority Stream Reaches

The primary purpose of this watershed assessment is to provide guidance for aquatic habitat restoration and preservation to protect and restore the populations of the

species of concern. Through an evaluation of the individual components of this watershed assessment, a list of priority stream reaches and priority watersheds has been created that will provide guidance for future actions that involve data gathering, habitat protection, and stream restoration projects. Watersheds have been prioritized based on the results of each component of the watershed assessment, with special attention paid to highly responsive channel habitat types (Table 10.1; Figure 10.1). The watersheds included in Figure 10.1 have highly responsive channel habitat types that overlap the distribution of one or more of the species of concern (Section IX, Fish and Fish Habitat Assessment). Restoration opportunities will focus on the highly responsive habitat types identified in the Channel Habitat Types Assessment (Section III). Watersheds that have documented use by the species of concern but do not have an overlap of highly responsive channel habitat types are not included in the list of high priority watersheds.

Within the components of this watershed assessment the impacts of human influences and natural processes on aquatic habitats have been evaluated (Table 10.1). Table 10.1 lists the ratings of each watershed as low, moderate, or high for each of the components of the watershed assessment. The low score can indicate that there have been substantial impacts to aquatic habitats or that natural conditions are not likely to support viable population so the species of concern. Figure 10.1 was created by assigning the following values to each rating: low=0, moderate=1, high=2. Watersheds that have experienced relatively low impacts and provide habitat for one or more of the life stages of the species of concern have the highest overall rating. The highest-ranking watersheds also contain the largest populations of one or more of the species of concern. The current and historical distributions of the species of concern are contained within the priority watersheds of the subbasin (Section IX, Fish and Fish Habitat Assessment).

Figure 10.1: Overall scores for watersheds containing habitat for the species of concern. Scores based on a summary of the results from the components of the watershed assessment.



Watershed	Historical Importance	Channel Habitat Types	Hydrology	Riparian	Wetlands	Sediment Sources	Channel Modifications	Water Quality	Fish	Fish Habitat
Aldrich Point	Low	Low	High	High	High	Low	High	High	Low	Low
Beaver Creek	Moderate	High	Moderate	Low	Moderate	Low	Low	Low	Moderate	Moderate
Clatskanie Floodplain	High	High	Moderate	Low	Low	Moderate	Low	Moderate	Moderate	Low
Clatskanie River	High	High	Moderate	Low	Moderate	Moderate	Moderate	Low	Moderate	Moderate
Clifton	Low	Low	High	High	High	Low	High	High	Low	Low
Deer Island	High	Moderate	Low	Low	Moderate	High	Low	High	Moderate	Low
Eilertsen Creek	Moderate	Low	High	Moderate	High	Low	High	High	Moderate	Moderate
Flume Creek	Moderate	Low	High	Low	High	Low	Low	High	Low	Low
Fox Creek	High	Low	Moderate	Low	High	Moderate	Low	High	Moderate	Moderate
Goble Creek	High	Moderate	High	Moderate	Moderate	Moderate	Moderate	Low	Moderate	Moderate
Graham Creek	Moderate	Low	Moderate	Moderate	High	Low	High	Moderate	Moderate	Moderate
Green Creek	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High	Moderate	Moderate
Harrie Creek	Low	Low	Low	Moderate	High	High	Low	High	Low	Low
Hunt Creek	Moderate	Moderate	High	Moderate	High	Low	High	High	Moderate	Low
Hunter	Low	Low	High	Low	High	High	High	High	Low	Low
McBride Creek	Moderate	Low	High	Low	High	Low	High	High	Moderate	Moderate
Merrill Creek	High	Moderate	High	Low	Moderate	Moderate	Low	High	Moderate	Moderate
Neer Creek	Low	Low	Moderate	Low	Moderate	Moderate	Low	High	Low	Low
Nice Creek	Moderate	Low	Low	Moderate	High	Moderate	High	Moderate	Moderate	Moderate
Niemela Creek	Low	Low	High	Moderate	High	Low	High	High	Low	Low
OK Creek	Moderate	Low	Moderate	Moderate	High	Low	High	High	Moderate	Moderate
Olsen Creek	Moderate	Low	High	Moderate	High	Low	High	High	Moderate	Moderate
Owl Creek	Low	Low	Low	Low	High	Moderate	High	High	Low	Low
Plympton Creek	High	Moderate	Moderate	High	Moderate	Low	Moderate	Low	High	Moderate
Rinearson Slough	Moderate	Moderate	Moderate	Low	Moderate	Moderate	Low	High	Moderate	Low
Ross Creek	Moderate	Low	High	Low	High	Low	Low	High	Moderate	Moderate
Speer Creek	Low	Low	High	Moderate	High	Low	High	High	Low	Low
Tandy Creek	Moderate	Low	High	Moderate	High	Low	High	High	Moderate	Moderate
Tank Creek	Low	Low	High	Moderate	High	Low	High	High	Low	Low
Ternahan Creek	Low	Low	High	Moderate	High	Low	High	High	Low	Low
Tide Creek	High	Moderate	High	Moderate	Moderate	High	High	High	Moderate	Moderate
West Creek	Moderate	Low	High	High	High	Low	High	High	Moderate	Moderate

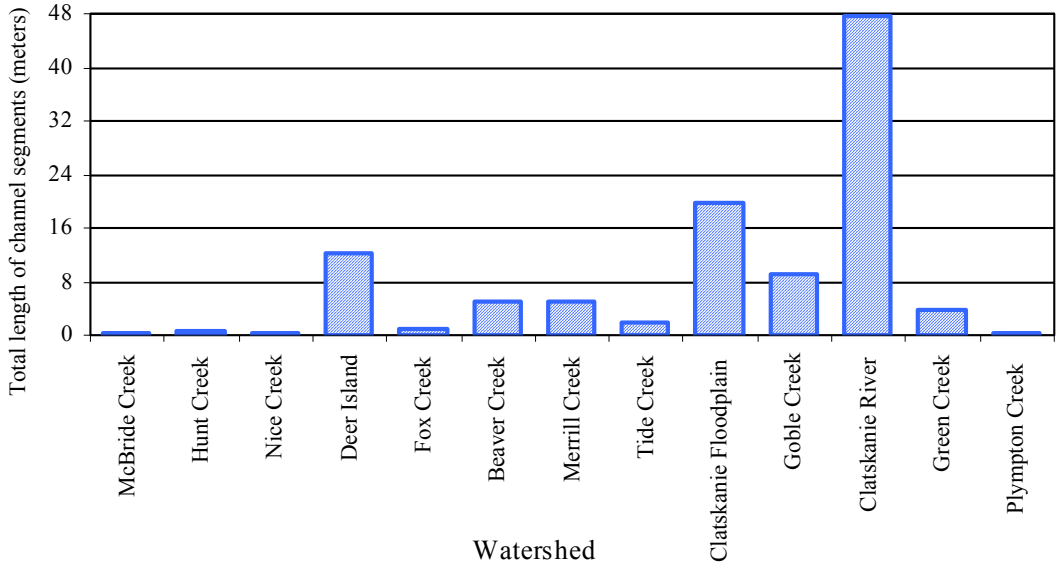
Table 10.1: Matrix of scores based on the results of each watershed assessment. Numerical values of 3 for high, 2 for moderate, and 1 for low were used to create Figure 10.1.

Priority stream reaches were identified by overlaying the anadromous fish distribution map onto the channel habitat types map. High priority stream reaches consist of the areas where the following conditions are found: channel habitat types that have a high sensitivity to changes in inputs and the presence of one or more of the species of concern (Figure 10.2 & 10.3). The stream reaches that have the highest priority are those that are most likely to respond positively to restoration (Section III, Channel Habitat Type Assessment). One factor not included in the analysis of priority stream reaches is the abundance and trends of the species of concern within each stream. Plympton Creek has about 5% of the total habitat for chinook salmon that is found within the Clatskanie River and a run that on average is fifty times larger than the run in the Clatskanie River. However, channel habitat types within Plympton Creek are steeper and more confined than the Clatskanie River, resulting in a lower channel habitat type sensitivity rating. This does not mean that restoration within Plympton Creek is unlikely to improve the habitat; most of the habitat accessible to anadromous fish within Plympton Creek is moderately sensitive to changes in inputs. The channel habitat type sensitivity indicates which habitats are most likely to respond to changes in coarse woody debris, sediment load, and other instream processes. However, riparian tree planting to restore shading and bank stability would be equally effective in both moderate and high sensitivity channel habitat types.

Data Gaps

During the assessment process several pertinent pieces of information were either unavailable or not evaluated. It is recommended that before proceeding with restoration and monitoring that efforts be made by the watershed council to fill in some of these data gaps. The watershed assessment provides guidance for identifying which types of information are needed and also to what extent. Within each component of the watershed assessment data gaps were identified. However, some of the data gaps may never be filled because the information does not exist. The primary pieces of information that are

Figure 10.2: Distribution of priority stream reaches. Scale is based on the total length of highly responsive stream channels within each watershed.



Data sources: Map contains data derived during the assessment of the Lower Columbia-Clatskanie Watershed.

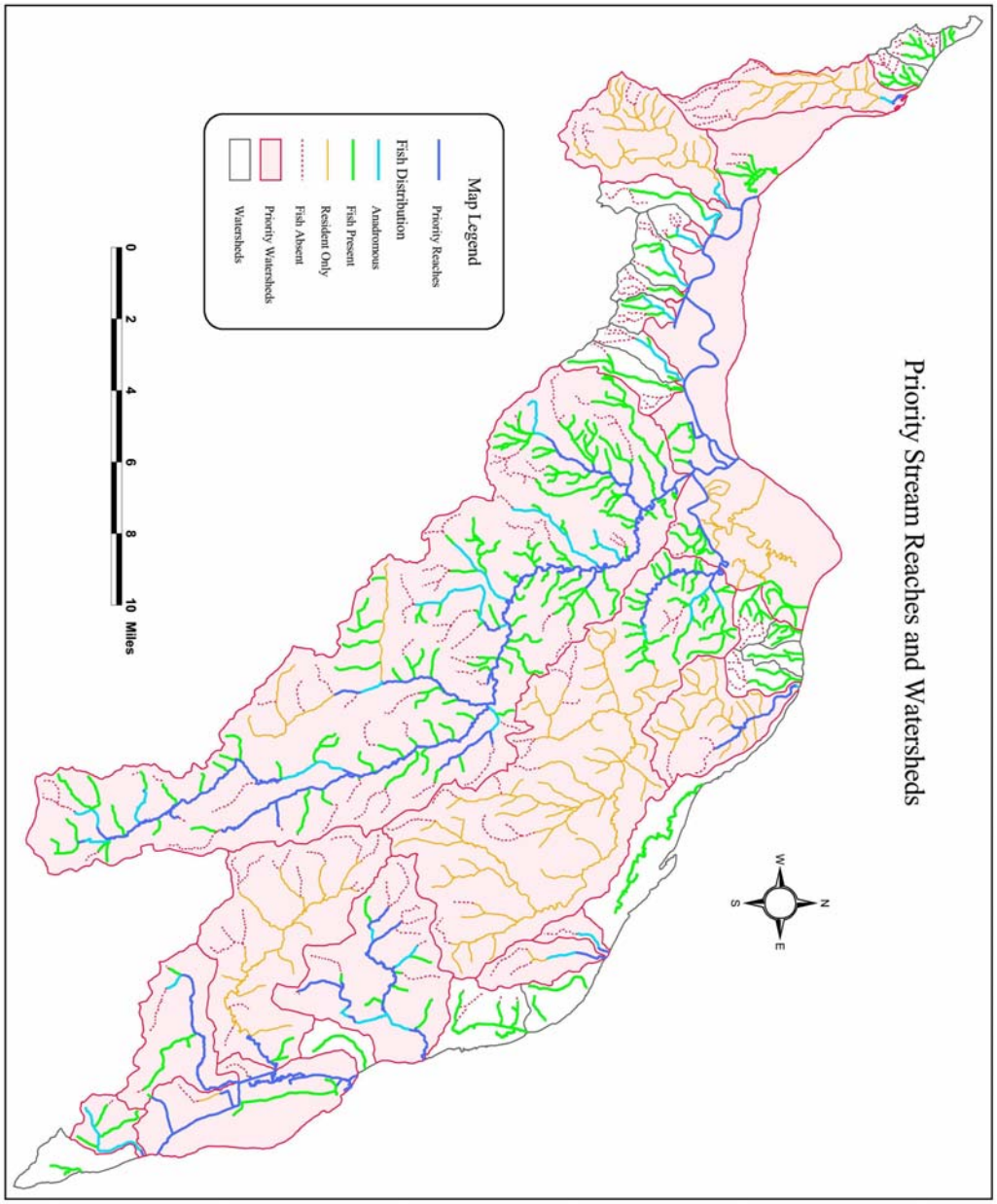


Figure 10.3: Priority stream reaches and priority watersheds identified by an evaluation of the watershed assessment compents.

needed to complete the assessment are listed Table 10.2 with the watershed assessment components.

The potential list of data gaps in Table 10.2 can be used to develop a monitoring program. A number of the activities that the watershed council can carry out following the completed watershed assessment will involve filling the information needs identified within the watershed assessment. The list of needs can be used in communications with state and federal agencies that may be able to fill these data gaps or to develop monitoring initiatives at the watershed council level.

Restoration and Monitoring

The primary purpose of this watershed assessment is to provide guidance for aquatic habitat restoration and preservation to protect and restore the populations of the species of concern. Habitat degradation is one of several causes for the declining populations of salmon, trout, and other species of concern. The components of this watershed assessment have identified watershed processes that are not properly functioning based on the guidelines outlined in the Oregon Watershed Assessment Manual and other documents as referenced in each component of this watershed assessment. Restoration activities should focus on watershed processes that have been clearly identified as nonfunctional within specific streams or watersheds. Where data gaps have been identified monitoring activities can be designed to fill the gaps and complete the evaluation of watershed resources and processes.

The emphasis of restoration is on watershed "processes" because it is rarely possible that aquatic habitats can be fully restored to historic conditions and we often do not know exactly what those historic conditions were. However by restoring watershed processes, improvements can be made to aquatic habitats that should lead to restoration of the populations of species of concern. This rationale makes one important assumption: the processes being restored are the most significant factors limiting restoration of the species of concern. To insure that restoration activities are fulfilling the goals of the Oregon Plan for Salmon and Watersheds, restoration and monitoring plans should include measures that monitor restoration activities to determine if activities are being carried out correctly and if the activities are successful. Restoration plans should include a clear purpose and a system for evaluating the success of the action. For example, if high stream temperatures are a problem and trees are to be planted as restoration, then long term temperature monitoring should be included in the restoration plan.

A monitoring program should be designed that incorporates the list of data gaps identified in each section of the watershed assessment. The monitoring program should also contain a prioritized list of monitoring studies. Table 10.2 lists the pertinent data gaps identified from the components of the watershed assessment and Table 10.3 prioritizes a potential list of monitoring studies. Since the watershed assessment relied in part on existing data, field studies to verify assumptions are an excellent follow-up activity to watershed assessment. The data gaps identified in Table 10.2 can be easily filled through well-planned monitoring programs. The individual components of this watershed assessment and the Oregon Watershed Assessment Manual provide guidance

Assessment Component	Data Gaps
Channel Habitat Type Classification	• Site specific verification of stream channel characteristics prior to stream restoration activities. • Field verifications were primarily conducted on public lands due to access constraints.
Hydrology and Water Use	• Forest inventories on private lands to assess risk of peak flow enhancement, and/or recent aerial photographs. • Stream flow records to assess the impacts of water use on instream flows.
Riparian and Wetlands	• Site specific verification/characterization of riparian conditions. • Field verification and inventory of potential wetlands identified in the assessment.
Sediment Sources	• Road and culvert inventories for streams and tributaries within the range of the species of concern. • Information that the ODF has regarding slope failures associated with roads on public and private forest lands.
Channel Modifications	• Field verification of channel modifications within streams and tributaries that contain habitat for the species of concern.
Water Quality	• Expand water quality sampling to all streams identified within the range of the species of concern. • Turbidity and suspended sediment sampling needs to be conducted during and immediately after winter storm events. • Identify the cause of low dissolved oxygen levels sampled during 1999-2000.
Fisheries	• Expand streams surveys and spawning surveys to include all of the streams identified within the range of the species of concern. • Conduct biological inventories of the species of concern to verify the distribution and status of the species of concern. • Evaluate natural barriers and culverts for fish passage. • Conduct studies to determine the impacts of introduced and/or predatory fishes on the species of concern.

Table 10.2: Data gaps identified within the components of the watershed assessment.

in filling many of these data gaps. Additionally, the Oregon Aquatic Habitat Restoration and Enhancement Guide has detailed information for planning restoration activities.

Before any habitat restoration should begin, culvert inventories and natural barrier evaluations need to be conducted to determine if all potential habitat is accessible and being utilized by the species of concern. Culvert inventories will consist of an evaluation of the condition and design of culverts within the distribution of the species of concern. In addition to fish passage, surveyors should look for excessive fill and potential culvert failures. Two of the streams within the distribution of the species of concern have falls that are questionable barriers to fish passage. Green Creek and Goble Creek have falls within the first two miles of the mainstem that need to be surveyed for fish passage.

Eight of the watersheds listed within Figure 10.1 need aquatic habitat surveys and biological surveys to determine the current status of habitats and to verify the assumptions made for the distribution of the species of concern. Stream surveys can also be used to evaluate barriers and culverts. The following watersheds need to be surveyed: Green Creek, Goble Creek, Beaver Creek (below the falls), Merrill Creek, Tide Creek, Fox Creek, Nice Creek, and McBride Creek. In addition to these watersheds, the

Table 10.3: Prioritized list of activities that involve filling data gaps, restoring habitat processes, and protection of valuable habitats.

1. Culvert inventories and evaluation of fish passage at falls.
2. Biological surveys to verify the distribution and status of the species of concern within the subbasin.
3. Additional habitat surveys to cover all streams in which species of concern are believed to exist.
4. Turbidity samples and road inventories to identify the sources high levels of fine sediments in riffle habitats. a. Check for clean and properly functioning ditches and culverts. b. Check for cut and fill slopes that are eroding into ditches. c. Check for road surface rilling, slumping, and slope failures related to roads.
5. Habitat Restoration a. Reconnecting floodplain habitats b. LWD placement c. Riparian tree planting
6. Habitat Protection a. Plympton Creek b. Carcus Creek c. Clatskanie River d. Wetlands along Westport Slough
7. Identify the causes of the low dissolved oxygen samples.
8. Evaluate instream flows for streams identified within the Hydrology and Water Use Assessment that have stream flows which do not meet instream water rights.
9. Improvements and expansion of water quality monitoring. a. Improved turbidity and suspended sediment sampling that involves sampling during and immediately after winter and spring storm events. b. Expansion of all water quality sampling to include all of the watersheds within the range of the species of concern.

following subwatersheds within the Clatskanie River watershed should be included in the surveys: Page Creek, North Fork Clatskanie River, and Little Clatskanie River.

The Water Quality Assessment identified an issue with the technique used for turbidity sampling. Recommendations were made for samples to be taken during and immediately following winter and spring storm events when stream flows are peaking. Most of the transport of sediments within stream channels occurs during the wettest months of the year.

Habitat restoration activities can be carried out simultaneously with the data filling activities. It is expected that the data filling activities will result in the identification of additional restoration needs. The primary habitat processes that need to be addressed are a lack of large woody debris for instream habitat complexity, high stream temperatures, a lack of large conifers within the riparian zone, and floodplain connectivity. Both the lack of large woody debris and the high stream temperatures within the Clatskanie River are high priority restoration activities. Placement of large woody debris within the Clatskanie River will enhance habitat that have been impacted by stream cleaning and timber management practices. Streamside shade was found to be

poor within several reaches of the Clatskanie River that coincide with the temperature exceedances (Sections V and IIIV, Riparian and Wetlands Assessment and Water Quality Assessment). Several tributary streams to the Clatskanie River also have poor shading and could be influencing stream temperatures within the Clatskanie River. Within areas that are severely impacted by high stream temperatures, an inner band of hardwoods and outer band of conifers may provide the best short-term shade relief while also providing conifers in the long term. Floodplain connectivity within the Lower Clatskanie River and the Clatskanie Floodplain watershed is an important issue for juvenile fish rearing, as are the floodplains within Deer Island, which were historically important for fish populations spawning in Tide Creek, and Merrill Creek.

Several streams have been identified which have good habitat and/or large populations of one or more species of concern. Plympton Creek has both good habitat and large annual returns of chinook salmon. Carcus Creek has good habitat but salmon populations have been declining over the years. The Clatskanie River holds the most available habitat for all of the species of concern as well as an abundance of highly responsive channel habitat types**.** Protection is a high priority in Plympton Creek and Carcus Creek where habitats and/or fish runs are currently functioning properly. Morgan and Fulop (1998) noted in their spawning survey report that logging operations upstream of the spawning grounds in Carcus Creek are potentially threatening to habitat quality. In addition to restoration activities within the Clatskanie River, habitat protection throughout the watershed is needed to recover the species of concern.

Dissolved oxygen samples for the lower and upper Clatskanie River were moderately impaired. The low dissolved oxygen within the lower river may be caused by an abundance of organic matter and subsequent microbial activity that lowers dissolved oxygen levels. However, the upper Clatskanie River does not have land uses that could lead to high levels of organic compounds. Studies need to be conducted to determine the cause of low dissolved oxygen levels, the degree of impact and the extent of the problem.

Instream flows calculated by the Oregon Water Resources Department are over allocated for Beaver Creek, Clatskanie River, Plympton Creek, and Fox Creek. The first three streams have instream water rights for fish that would not be met during several months of the year if other water rights are being fully exercised. Stream gages and streamflow records are virtually non-existent within the subbasin. Either stream gages or water quantity surveys need to be conducted within the months of the year April through November to evaluate instream flows.

The Lower Columbia River Watershed Council is continuing to conduct water quality surveys. These surveys should be expanded to all watersheds that have identified habitat for the species of concern.

Conclusion

The data gaps and monitoring needs outlined in this section can be used to develop a monitoring program. The steps leading to the development of a monitoring plan will involve workshops and consultations with agency personnel and resource

management specialists. One of the first tasks that the watershed council will be involved in is filling data gaps. Guidance for filling the data gaps has been offered in the components of the watershed assessment. Additional sources of guidance will include agencies, universities, and professional consultants. The Oregon Watershed Assessment Manual has been referenced often within this watershed assessment and should be considered as another source of information and guidance in designing monitoring programs.

Restoration activities should focus on placement of large woody debris (LWD) in the stream channels and planting of trees within the riparian zones. The Clatskanie River, Carcus Creek, and Conyers Creek rated poorly for instream LWD. Stream temperatures were identified as a significant problem within the Clatskanie River and Goble Creek. Riparian tree planting should be used to provide a long term remedy for high stream temperatures. It may be possible to plant an inner band of fast growing alders near the stream channel and an outer band of conifers. The faster growing alders should provide some shade relief within a few years of planting. In coastal streams of Oregon, the natural plant associations within the riparian zone often consist of an inner band of hardwoods surrounded by conifers.