III. Channel Habitat Types

The introduction of this watershed assessment described the physical characteristics of the landscape as well as the processes that have shaped the landscape. Classification of streams into channel habitat types is useful for evaluating the complex, cumulative impacts of changing land use on stream habitats and biological communities, and assessing the effectiveness of fish habitat improvement projects and other mitigation procedures (Frissel et al., 1986). Stream habitats are, in part the products of interaction among climate, hydrologic responses of watersheds, and hillslope and channel erosion processes (Swanston, 1991).

A wide variety of stream classification systems have been developed that differ in scale and detail. Many of these classification systems have been designed for a single purpose or management goal. Stream classification systems range in scale from as large as an entire stream network to units as small as pools or the microhabitats within a pool. The most detailed classification systems involve field surveys where a team of specialists measures the intricacies of stream channels and adjacent landscapes as well as the abundance and diversity of aquatic life. The classification system used in this assessment falls into the middle of this range in scale. This watershed assessment uses a channel habitat typing classification based on stream size, gradient, and valley form. These variables remain relatively constant within the time span of concern to watershed management. The scale is small enough to predict patterns in channel physical characteristics, yet large enough to be identified from topographic maps and limited fieldwork (WPN, 1999). By describing these characters of the stream channels we can gain insight to the potential habitat for aquatic species and the potential impacts from natural processes and human influences.

The classification system used in this assessment is taken from the OWEB watershed assessment manual, with minor modifications made to meet the goals of this assessment. The OWEB manual recommends that a minimum segment length of 1,000 feet be used in order to avoid an unmanageable number of segments. With the aid of GIS we have been able to delineate stream segments much smaller than this. Features as small as fifty feet in length such as falls, dams, and ponds have been delineated as separate segments. The goal of the channel habitat assessment is to determine the distribution of channel habitat types throughout the basin and to identify those areas that are most sensitive to changes.

Channel Habitat Type Sensitivity Ratings

The purpose of the channel habitat type classification is to determine the channel type distribution throughout the subbasin and more importantly to identify those portions of the channel network that are most responsive to changes. The response of stream channels to disturbance is largely dependent on three physical characteristics of the terrain: gradient, confinement, and valley form, as well as stream size. Natural processes and human influences that adjust channel pattern, location, flow, and instream structure will trigger alterations of aquatic habitat conditions to a varying degree dependent on gradient, confinement, and valley form. By segmenting the stream network based on these three characteristics we can identify areas that will have the highest potential for a positive response to restoration projects.

Channel habitat type sensitivity ratings are indicators of the responsiveness of a channel to adjustment. Table 3.1 describes the level of response expected of different sensitivity ratings to adjustment in flow, sediment load, and large woody debris. Natural processes and human influences can alter the character of a stream channel by increasing or decreasing sediment loads, peak flows, and large woody debris. Landslides are an example of a natural process that increases sediment load and alters large woody debris contents. The high sensitivity rating indicates that a channel type generally has a significant response to changes in channel inputs. Responsive portions of the channel are generally unconfined to moderately confined and low to moderate gradient. A rating of high serves to signify that a channel habitat type can be altered with a minimum of effort compared to a low rating.

Rating	Large Woody Debris	Fine Sediment	Coarse Sediment	Peak Flows
High	Critical element in maintenance of channel form, pool formation, gravel trapping/sorting, bank protection.	Fines are readily stored with increases in available sediment resulting in widespread pool filing and loss of overall complexity of bed form.	Bedload deposition dominant active channel process; general decrease in substrate size, channel widening, conversion to planebed morphology if sediment is added.	Nearly all bed material is mobilized; significant widening or deepening of channel.
Moderate	One of a number of roughness elements present; contributes to pool formation and gravel sorting.	Increases in sediment would result in minor pool filling and bed fining.	Slight change in overall morphology; localized widening and shallowing.	Detectable changes in channel form; minor widening scour expected.
Low	Not a primary roughness element; often found only along channel margins.	Temporary storage only; most is transported through with little impact.	Temporary storage only; most is transported through with little impact.	Minimal change in physical channel characteristics; some scour and fill.

Table 3.1: Channel response descriptions (Watershed Professionals Network, 1999).

Channel Habitat Type Descriptions

The channel habitat types used in this assessment are based on the framework provided in the OWEB watershed assessment manual (1999). Gradient and confinement are the primary factors used to delineate separate channel types, although valley form and stream sizes also are used. The channel habitat types used in this assessment are composed of the most commonly found channel types in Oregon. Not all stream segments will fit cleanly into one of these channel types. Field reconnaissance and watershed council review has helped to refine the channel habitat types.

Although channel type characteristics are relatively consistent, there will be variability within mapped stream segments. Therefore, site-specific channel characteristics and management interpretations should be field-verified for project planning.

Table 3.2 outlines the basic characteristics of the channel habitat types. The steep moderately confined channel habitat is the only one that was not included in the OWEB framework. Detailed descriptions of each channel habitat type follow Table 3.2. Figure 3.1 shows the relative position and general topographical features of the channel habitat types as outlined in the OWEB watershed assessment manual. No reaches within the Lower Columbia-Clatskanie Subbasin were characterized as alluvial fan, estuarine habitat or large floodplain channels.

Table 3.2: Channel habitat types adapted from the OWEB watershed assessment manual (1999).

Channel Habitat Type	Gradient	Confinement	Stream Size	Sensitivity Rating
FP2 - Low Gradient Medium Floodplain	<1%	Unconfined	Medium to Large	High
FP3 - Low Gradient Small Floodplain	<2%	Unconfined	Small to Medium	High
LM - Low Gradient Moderately Confined	<2%	Moderate	Variable	High
LC - Lower Gradient Confined	<2%	Confined	Variable	Moderate
MM - Moderate Gradient Moderately Confined	2-4%	Moderate	Variable	High
MC - Moderate Gradient Confined	2-4%	Confined	Variable	Moderate
MH - Moderate Gradient Headwater	1-6%	Moderate to Confined	Small	Moderate
MV - Moderately Steep Narrow Valley	4-8%	Confined	Small to Medium	Moderate
SM - Steep Moderately Confined	8-16%	Moderate	Variable	Low
SV - Steep Narrow Valley	8-16%	Confined	Small to Medium	Low
VH - Very Steep Headwater	>16%	Confined	Small	Low

Low Gradient, Medium Floodplain Channel (FP2)

FP2 channels are mainstem streams in broad valley bottoms with well-established floodplains. Channels are often sinuous, with extensive gravel bars, multiple channels, and terraces. Dominant substrates are sand and cobble, however fine sediment deposition is prevalent due to low stream flows and position in the watershed. Floodplains are fed by moderate gradient habitats with higher streamflow. Floodplain channels are among the most responsive types in the basin. The combination of limited influence from confining terrain and fine substrates allows the stream to move both laterally and vertically. Riparian enhancement opportunities are limited by the unstable nature of these channels. Opportunities will occur where lateral channel movement is slow.

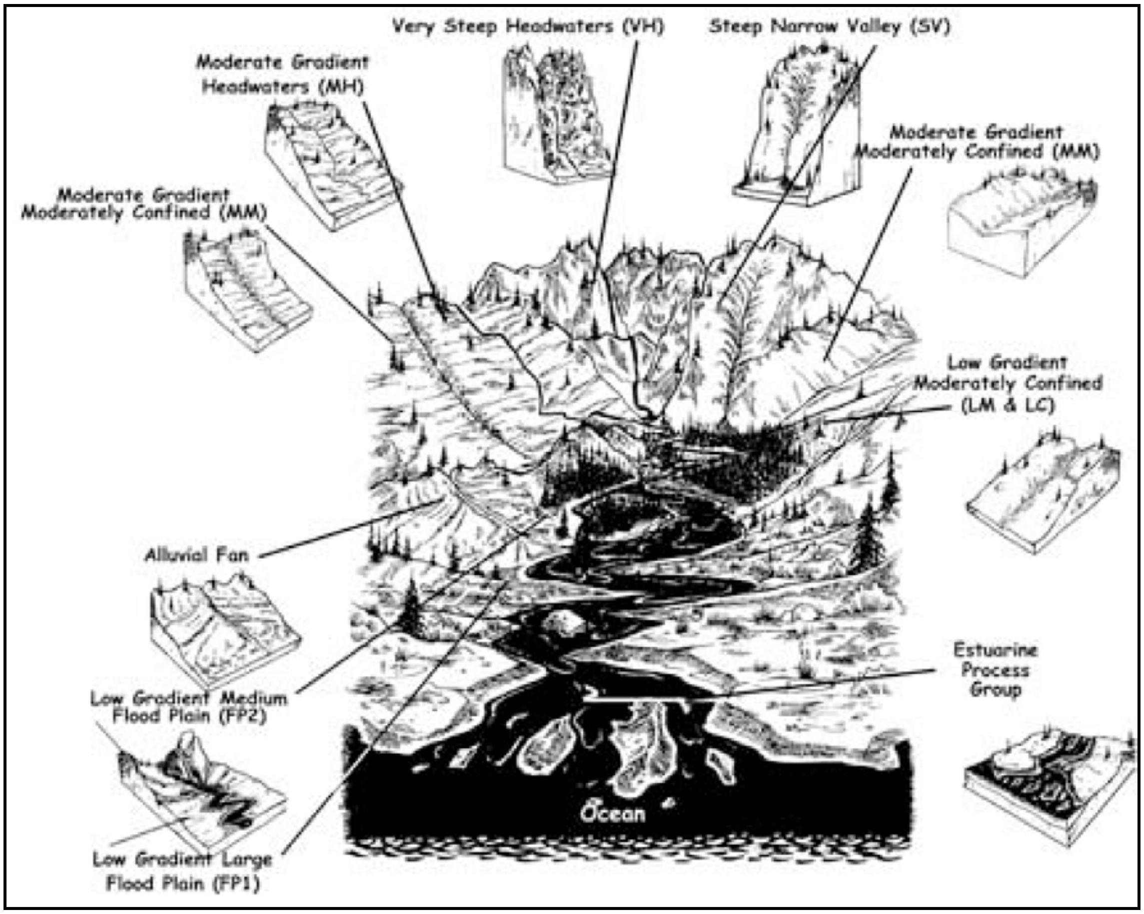

Figure 3.1: Topography and relative position in the watershed of each channel habitat type.

Low Gradient, Small Floodplain Channel (FP3)

FP3 stream channels are located in valley bottoms and flat lowlands. They are typically associated with small to medium sized streams located in broad valley bottoms. Stream channels are single to multiple and have relatively low confinement. The dominant substrate is cobble, though this habitat is susceptible to deposition of smaller sediments from upstream channel disturbances. Floodplain channels are among the most responsive in the basin. The combination of limited influence from confining terrain and fine substrates allows the stream to move both laterally and vertically. Riparian enhancement opportunities are limited by the unstable nature of these channels. The limited size and flow of these floodplains offers a better chance for success of channel enhancement activities than the larger floodplain channels.

Low Gradient, Moderately Confined (LM)

LM stream channels consist of low-gradient reaches that display variable confinement by low terraces or hill slopes. The channel tends to be slightly to moderately sinuous with occasional islands and side-channels. Substrates vary from fine gravel to bedrock. A narrow floodplain is commonly associated with this habitat type.

Bedrock, large boulders, and wood are common, generating a variety of aquatic habitats within the stream network. The unique combination of an active floodplain and hillslope or terrace controls acts to produce channels that can be among the most responsive in the basin. The presence of confining landform features often improves the accuracy of predicting channel response to restoration efforts and disturbances.

Low Gradient, Confined Channel (LC)

These channels are incised or contained within adjacent, gently sloping landforms or incised in volcanic flows or uplifted coastal landforms. Channels are confined and lateral migration limited by the landscape. Narrow floodplains are not uncommon, particularly on the inside of meander bends. Local geology is an important factor in dictating bank erosion. These low gradient habitats may be actively eroding in the softer geologic material of alluvial terraces. High flows in these well-contained channels tend to move all but the most stable wood accumulations downstream or push debris to the channel margins. The presence of confining terraces or hill slopes and control elements such as bedrock limit the type and magnitude of channel response to change in input factors. Consequently these channels are not highly responsive to habitat restoration, though establish of riparian vegetation can be successful. The confined nature of these channels lends them to riparian vegetation enhancement projects.

Moderate Gradient, Moderately Confined (MM)

MM channels have variable confinement from valley terraces, mountain-slope, and hill-slope landforms. Channel migration is constrained by the landscape, though a narrow floodplain similar to LC channels often exists. There is usually a single channel with low to moderate sinuosity. The dominant substrates are gravel to small boulder. Large woody debris, boulders, and bedrock are common leading to a diversity of aquatic habitats. The combination of a narrow floodplain and hill-slope or terrace controls acts to produce channels that are of the most responsive in the basin. The presence of confining landform feature improves the accuracy of predicting channel response to activities that may affect channel form.

Moderate Gradient, Confined (MC)

MC channels flow through narrow valleys with very little floodplain development or they may be deeply incised into valley floors. Moderate gradients, well-contained channels, and large substrates are characteristic of these habitats. Channels are single, relatively straight and conform to the slope of the landscape. Response to restoration activities is poor; in channel enhancements may not yield the desired results. Despite this the channels are relatively stable and stream banks lend themselves to establishment of riparian vegetation.

Moderate Gradient Headwater (MH)

These moderate-gradient headwater channels are common to plateaus in Columbia River Basalt, young volcanic surfaces, or broad drainage divides. Gradient and position in watershed dictate that these habitats will be above the range of anadromous fishes. MH channels are small, confined streams located in the upper watershed where streamflow volumes are low and sediment transport limited. Stream banks generally lend themselves to establishment of riparian vegetation, though the channel is only moderately responsive to aquatic habitat restoration.

Moderately Steep, Narrow Valley (MV)

MV channels are confined by steep narrow valleys. A narrow floodplain may develop locally, however high flows are generally contained within the channel banks. These channels efficiently transport sediments and coarse materials. Dominant substrates range from small cobble to bedrock. Channel patterns are relatively straight, single channels. These channels are not highly responsive to in stream habitat enhancements, due to steep gradients and the potential for high-energy flows. Despite this the channels are relatively stable and stream banks lend themselves to establishment of riparian vegetation.

Steep, Moderately Confined (SM)

These steep, moderately confined channels are found in the mid to upper reaches of watersheds. Channel migration is constrained by valley terraces, mountain-slope, and hill-slope landforms. There is usually a single, straight channel with minimal floodplain development. The dominant substrates are small cobble to boulder. High-energy stream flows are common resulting in efficient transport of sediments and coarse materials. These channels are not highly responsive to in stream habitat enhancements, due to steep gradients and the potential for high-energy flows. Stream banks generally lend themselves to successful establishment of riparian vegetation, though in stream habitat restoration is highly unpredictable.

Steep Narrow Valley (SV) and Very Steep Headwater (VH)

These two channel types are very similar, save for the difference in gradients, therefore they are presented together. SV channels are found in constricted valley bottom bounded by steep mountain or hill slopes. Vertical steps of boulder and wood with scour pools, cascades, and falls are common. VH channels are found in the headwaters of most drainages or side slopes to larger streams, and commonly extend to ridge-tops and summits. These steep channels may be shallowly or deeply incised into the steep mountain or hill slope. SV and VH channels are not highly responsive to in channel enhancements. The steep gradient and confining landscape features limit the type and magnitude of channel response to changes in input factors. Stream channels are very stable. These channels are also considered source channels supplying sediment and wood to downstream reaches, sometimes via landslides. Despite this, the stability of these channels lends them to successful riparian vegetation enhancement projects.

Methodology

Several steps were involved in the assignment of channel habitat types and sensitivity ratings. Initial assignment of channel habitat types was done on maps, which were later digitized into a GIS layer. Materials included Oregon Department of Forestry stream class maps, USGS 1:24,000 scale digital line graphs (GIS streams layer), 10 meter digital elevation models, and USGS digital orthophoto quadrangles. The steps used to assign channel habitat types are as follows:

Step 1: Break out stream segments based on gradient.

Channel Gradient Classes	
<1%	>4-8%
1-2%	>8-16%
>2-4%	>16%

The Oregon Department of Forestry stream class maps were used to break out stream segments based on gradient. These maps are USGS 7.5-minute quadrangle maps with the streams highlighted and segmented by size and fish distribution. Stream size is used in step 3 where initial channel habitat types are assigned, fish distribution is used in the fish and fish habitat assessment. All of the maps used in this assessment have a contour interval of 20-feet. Gradient has been divided into one of six different classes (as shown in the box). Stream segments with a gradient greater than sixteen percent are largely unresponsive to habitat restoration, for this reason sixteen percent is chosen as the upper limit of the channel network. Figure 3.2 shows the gradient patterns throughout the subbasin.

Step 2: Estimate Channel Confinement.

For the purposes of this assessment, channel confinement is defined as the ratio of the bankfull width to the width of the modern floodplain. Bankfull describes the condition where stream flow fills the active stream channel; an increase in stream flow will result in overflow onto the floodplain. The modern floodplain is the flat area adjoining a stream channel constructed by the stream in the present climate and overflowed at times of high discharge (Dunne, 1978).

Channel confinement is broken into three classes: confined, moderately confined, and unconfined. The degree of confinement was estimated from the maps. The angle at which contours approach the stream and the pattern of the stream channel were used to estimate confinement. Figure 3.3 illustrates the technique used to assign confinement classes to stream channels. Segment SC1 has a low gradient, meandering and sinuous channel pattern that is indicative of streams with wide floodplains. This segment is considered unconfined. For segment SC2 in the figure note how the contour lines approach the stream at approximately right angles forming a U-shaped pattern around the stream. The initial estimate of confinement for SC2 is moderately confined. Segment SC3 on the map is in a confined valley. The v-shaped pattern of contour lines is characteristic of confined stream channels. Confinement patterns will often follow gradient closely; high gradient streams will be relatively straight due to gravitational constraints. Figure 3.4 shows the channel confinement patterns within the subbasin.

Data source: USGS 7.5 minute topographic maps; USGS 10 meter Digital Elevations Models; ODFW stream surveys; and Field visits.

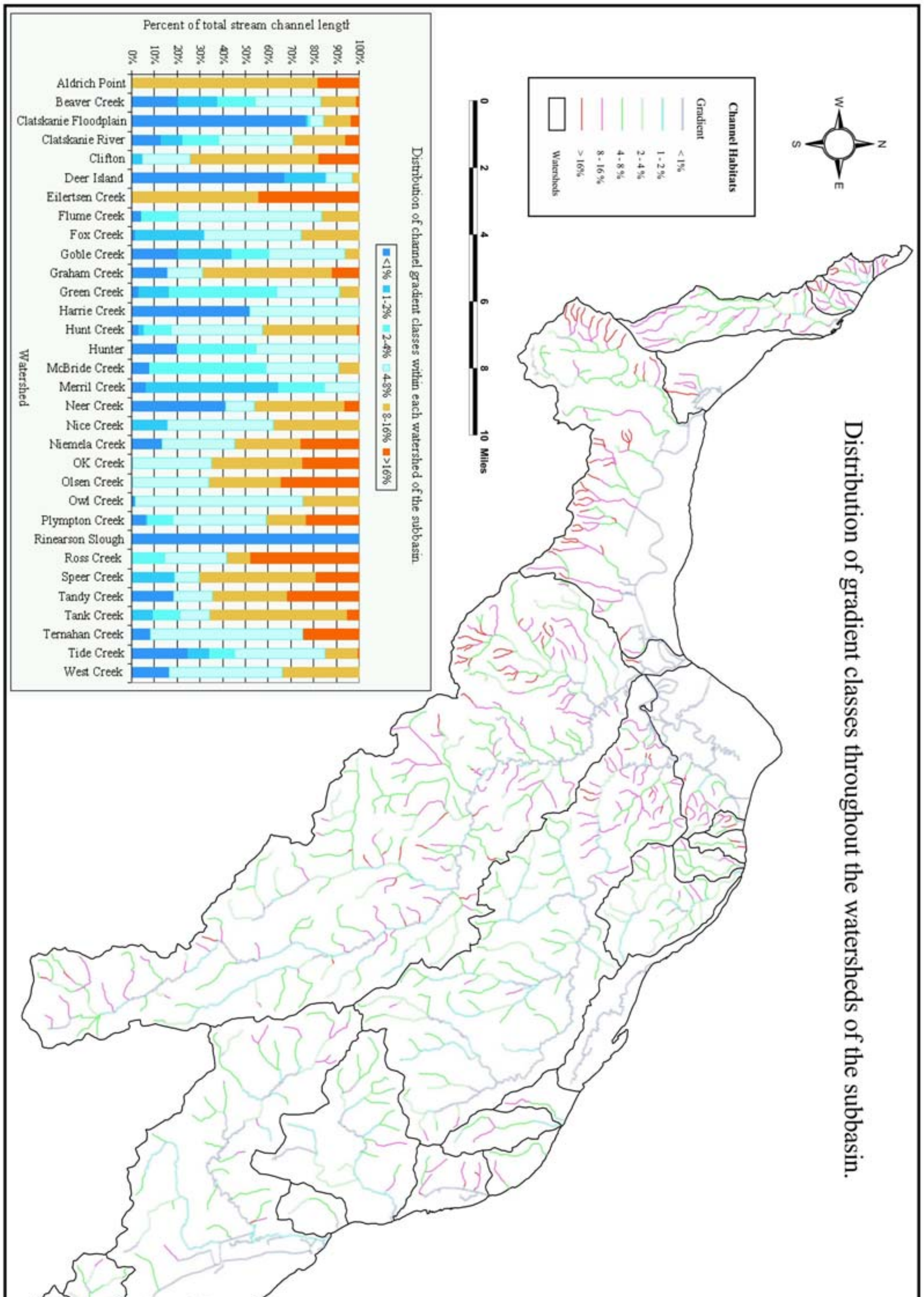

Figure 3.2: Gradient class distribution throughout the stream channels of the watersheds.

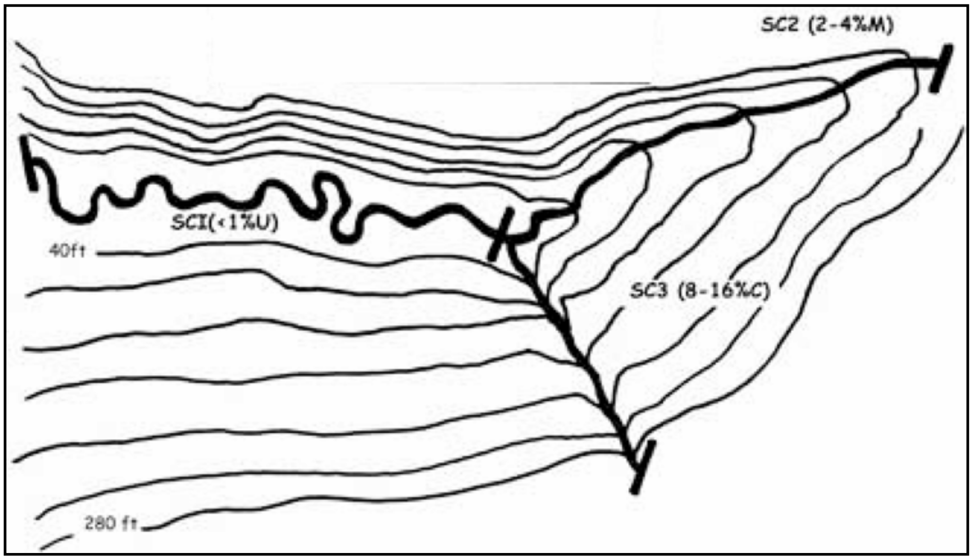

Figure 3.3: Example of channel confinement and gradient classes.

Step 3: Assign Initial Channel Habitat Types.

Based on the channel habitat type definitions previously described, stream segments were assigned to one of the eleven channel habitat types of Table 3.2. Channel habitat types are initially assigned based on gradient, confinement, stream size, and valley form. Variation within channel habitat types is common and stream segments do not always fit cleanly into one channel habitat type.

Step 4: Digitize stream segments into a GIS layer.

A GIS layer of the streams within the subbasin was developed in the beginning of the assessment from USGS 1:24,000 (scale) digital line graph data. Upon completion of the gradient, confinement, and channel habitat typing steps, the stream segments were digitized onto the pre-existing streams GIS layer. The 1:24,000 USGS digital line graph data are created by digitizing the hydrologic features of USGS 1:24,000 (7.5-minute) maps. Given that the ODF stream class maps are derived from the same source as the digital line graph data, there is a high level of consistency between the two. The channel habitat maps were digitized in ArcView by displaying the data layers on screen.

Step 5: Improving the initial channel habitat type designations.

The initial channel habitat types were presented to the watershed council for review. In addition to this step a variety of data sources were used to confirm and improve upon the initial channel habitat typing. Field visits were conducted within selected reaches throughout the subbasin. Sites were selected that represent the diversity of conditions found within the subbasin. Factors considered when selecting field sites included a range of gradient and confinement, the presence of key fish habitat, and a range of land management intensities.

Data source: USGS 7.5 minute topographic maps; USGS 10 meter Digital Elevations Models; ODFW stream surveys; and Field visits.

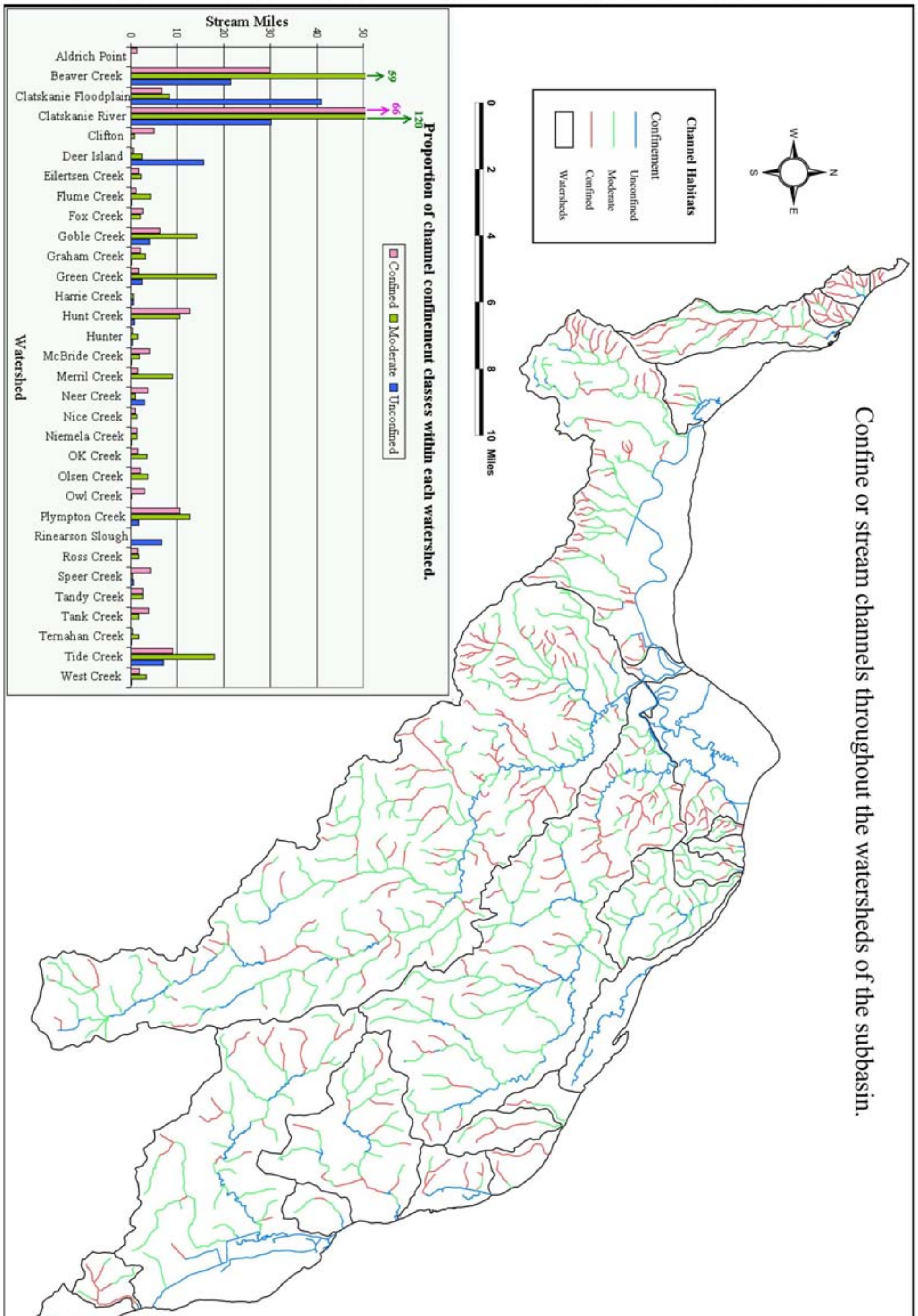

Figure 3.4: Conefinement class distribution throughout the stream channels of the watersheds

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The channel habitat types were also compared to stream survey data. Reach level stream survey data was used to cross check channel habitat type designations. ODFW and ODEQ performed these stream surveys. There are stream surveys for twelve streams within the subbasin. The majority of these surveys were conducted in the western half of the subbasin. Streams surveyed include: Clatskanie River; Conyers Creek and one of its' tributaries; Carcus Creek; Keystone Creek; Plympton Creek; Hunt Creek; West Fork Hunt Creek; West Creek; Beaver Creek; and Goble Creek. Corrections were made to the initial channel habitat types when inconsistencies existed between them and the field data, with priority given to the field data.

Digital aerial photographs were used on a wide scale to cross check channel habitat typing, especially in hard to reach areas. Access is limited in many areas due to private ownership. The channel habitat type GIS layer was overlain on digital aerial photographs allowing for examination of confinement and valley form. In addition to the aerial photographs, digital elevation models (DEM's) were used as an additional check on channel habitat types. The DEM's display topographical features of the landscape from a three-dimensional perspective and can be displayed in conjunction with the streams.

Step 6: Assigning a sensitivity rating.

Channel sensitivity is defined as the potential for a given natural or human process to result in a change in the structure or function of a stream channel. The ratings were defined in the introduction to this section. Ratings are based on the level of control imparted on the habitat by the landscape. As can be seen in the channel habitat descriptions, the controls are typically confinement and gradient. The sensitivity rating and corresponding channel habitat types are diagrammed in Figure 3.5 and mapped in Figure 3.6.

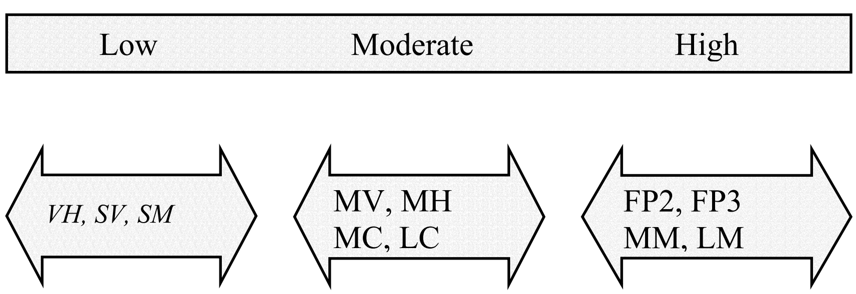


Figure 3.5: Potential responsiveness of channel habitat types to natural process, land management, and restoration activities.

Results

A summary of the distribution of channel sensitivity ratings within each watershed is presented in Figures 3.6, 3.7, and 3.8. These are the same watersheds identified in the introduction of this watershed assessment. Of the 636 linear miles of streams and sloughs within the subbasin 234 miles (37%) are rated highly sensitive to

Data source: USGS 7.5 minute topographic maps; USGS 10 meter Digital Elevations Models; ODFW stream surveys; and Field visits.

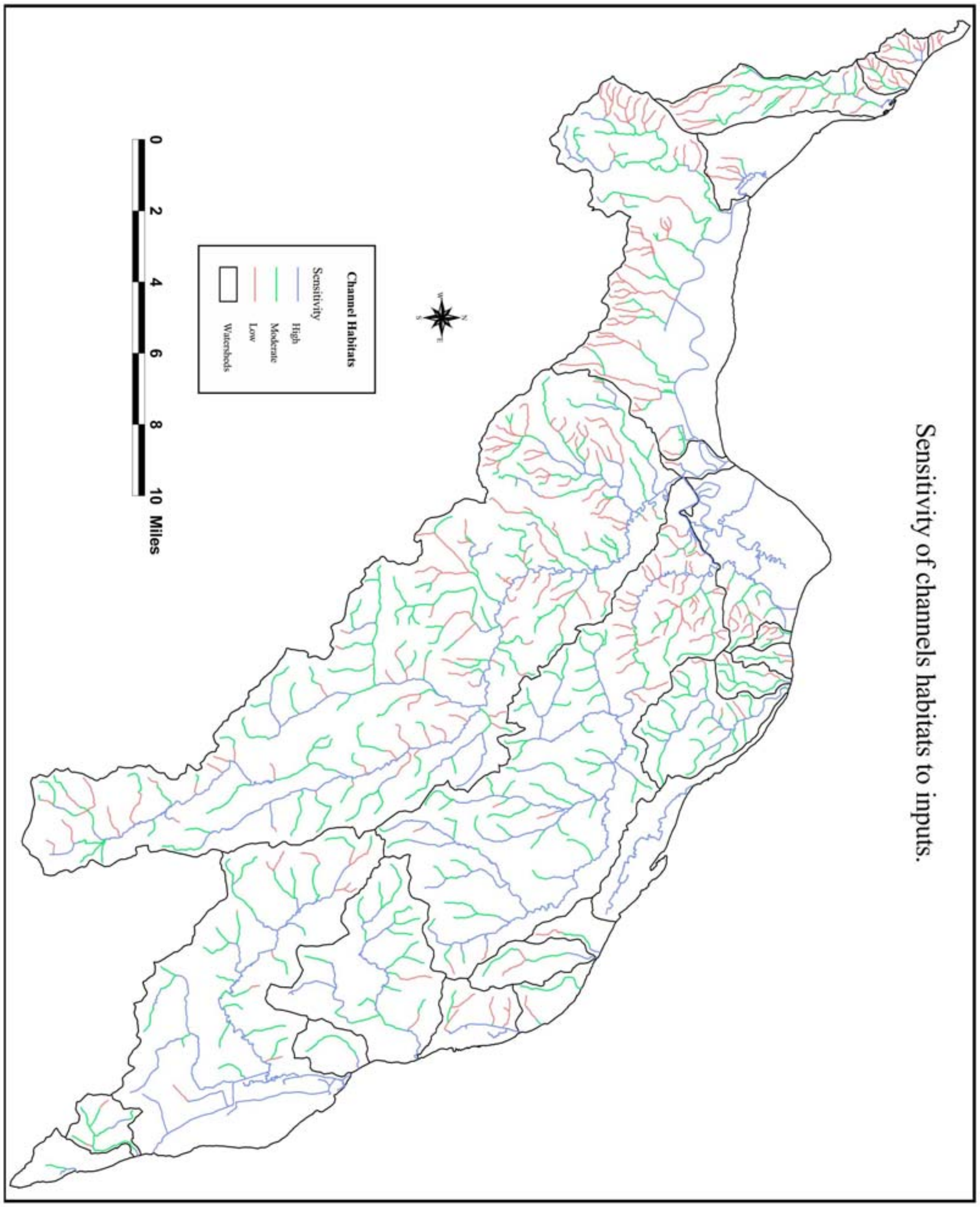


Figure 3.6: Sensitivity rating distribution throughout the stream channels of the watersheds.

changes based on the OWEB guidelines. Most of these highly sensitive areas are mainstem channels of large streams and sloughs. The moderately sensitive classification contains 238 miles (37%) of streams and the low sensitivity 164 miles (26%). The western arm of the subbasin has the greatest concentration of low sensitivity segments, which corresponds to higher stream gradients.

The Hunt Creek and Westport watersheds have a high proportion of low sensitivity channel habitats. Gradient within the northwestern arm of the subbasin is a significant factor. Nearly half of the stream channels in the Westport and Hunt Creek watersheds have a gradient of 8% or greater. On the other side of the subbasin, within the Tide Creek and Beaver Creek watersheds highly sensitive channels are common. Tide Creek has 38.2 miles and Beaver Creek 55.9 miles of highly sensitive channels in mainstem and tributary reaches (Figure 3.8). The Clatskanie River and its tributaries have 89.5 miles of moderately sensitive and 63.8 miles of highly sensitive stream channels.

A significant amount of highly sensitive stream channels can be found in the sloughs of the Columbia River floodplains. Because of the classification scheme these habitats are considered highly sensitive due to low gradients and confinement (i.e. they are within an active floodplain). The northern boundary of the subbasin is comprised of a complex of sloughs including Driscoll, Westport, Clatskanie, and Beaver sloughs. This complex contains nearly 40 miles of slough habitats that are by definition highly sensitive channels. The Rinearson Slough and Deer Island slough (Tide Creek watershed)

Figure 3.7: Proportions of channel sensitivity ratings within each watershed.

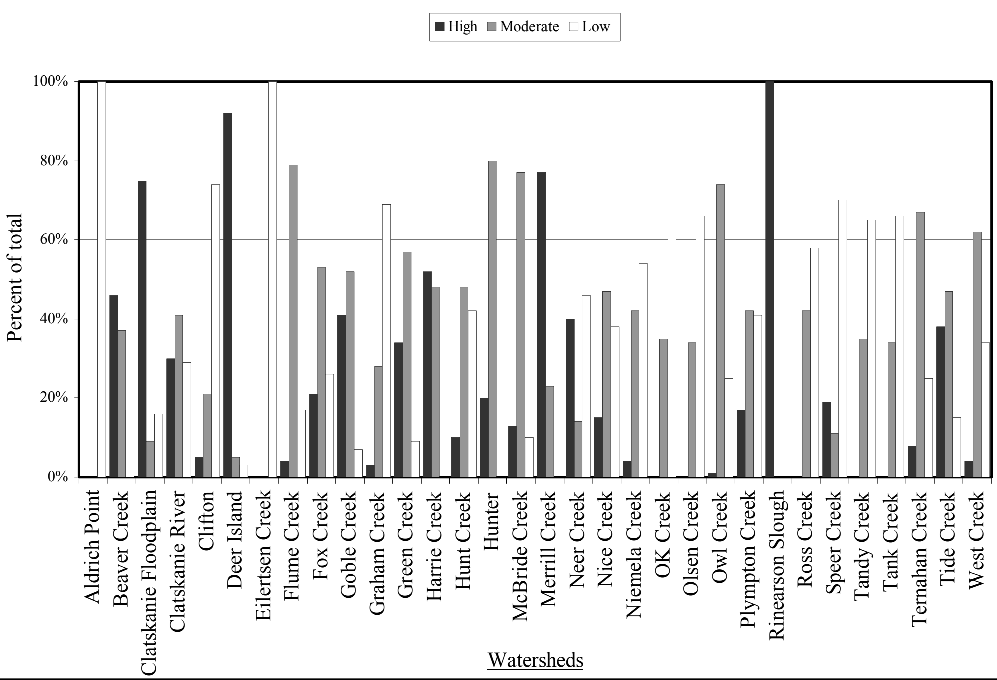
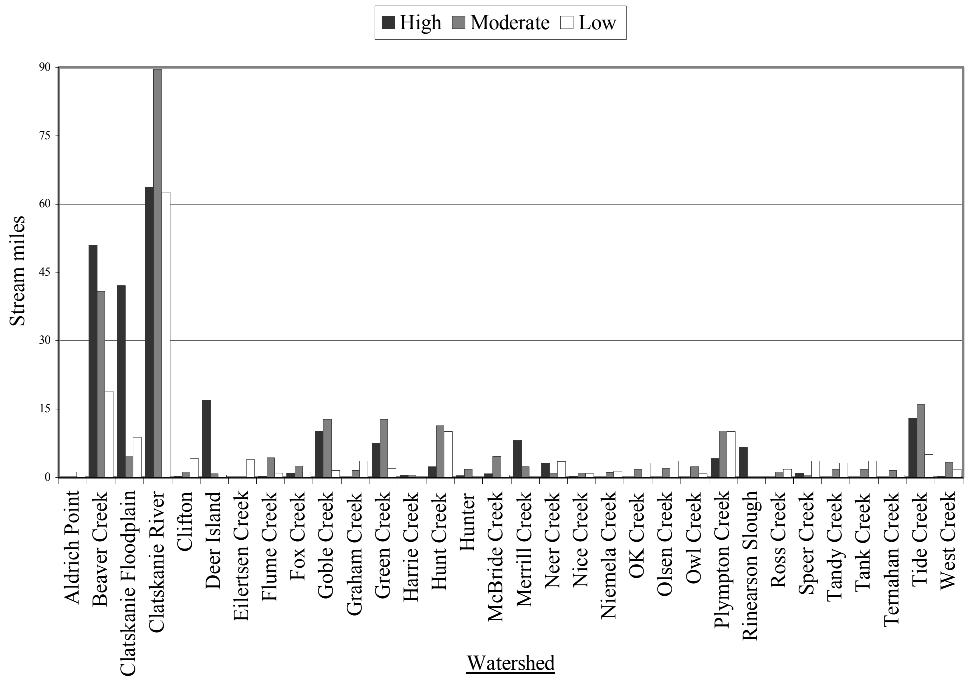


Figure 3.8: Miles of channel habitat type sensitivity ratings within each watershed.



complexes contain another twenty miles of highly sensitive channels.

Conclusions

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. Highly sensitive channels will have the greatest potential for restoration activities. The key findings from this analysis are as follows:

1. 32% of stream channels within the subbasin are highly responsive to channel inputs; 39% moderately responsive; and 29% have low responsiveness.
2. There are 64 miles of highly responsive stream channels within the mainstem and tributaries of the Clatskanie River. An addition 90 miles of moderately responsive channels are contained within the watershed.
3. The Beaver Creek watershed has 56 miles of highly responsive and 42 miles of moderately responsive channels.
4. The Tide Creek watershed has 38 miles of highly responsive channels and an additional 19 miles of moderately responsive channels.
5. Sloughs of the Columbia River found within the subbasin comprise about 60 miles of the highly responsive channel habitat types.

The key findings 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. Individual variation within each channel habitat type is common, therefore site-specific verification of channel characteristics is recommended before planning habitat restoration activities.

Data Gaps

Stream surveys are extremely useful to watershed assessments. Twelve streams have been surveyed within the subbasin and only two of these surveys were conducted in the streams of the eastern watersheds. Though the surveys spanned a wide breadth of habitats they do not represent the eastern half of the subbasin very well.
Access to stream channels is limited due to the preponderance of privately owned lands; many of the forest roads are gated. Most of the field verification of channel habitat types was limited to streams accessible from county roads.

Confidence Evaluation

High. The channel habitat types presented here are based on variables that remain relatively constant within time scales of concern to land management. The scale is small enough to predict patterns in channel physical characteristics, yet large enough to be identified from topographic maps and limited fieldwork (WPN, 1999). The field visits and stream surveys covered the range of habitats from the steep terrain of the Hunt Creek and Westport watersheds to the low rolling terrain of the Beaver Creek and Tide Creek watersheds. In addition to field data 10 meter DEMs and digital aerial photographs were used to improve upon the channel habitat typing.

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