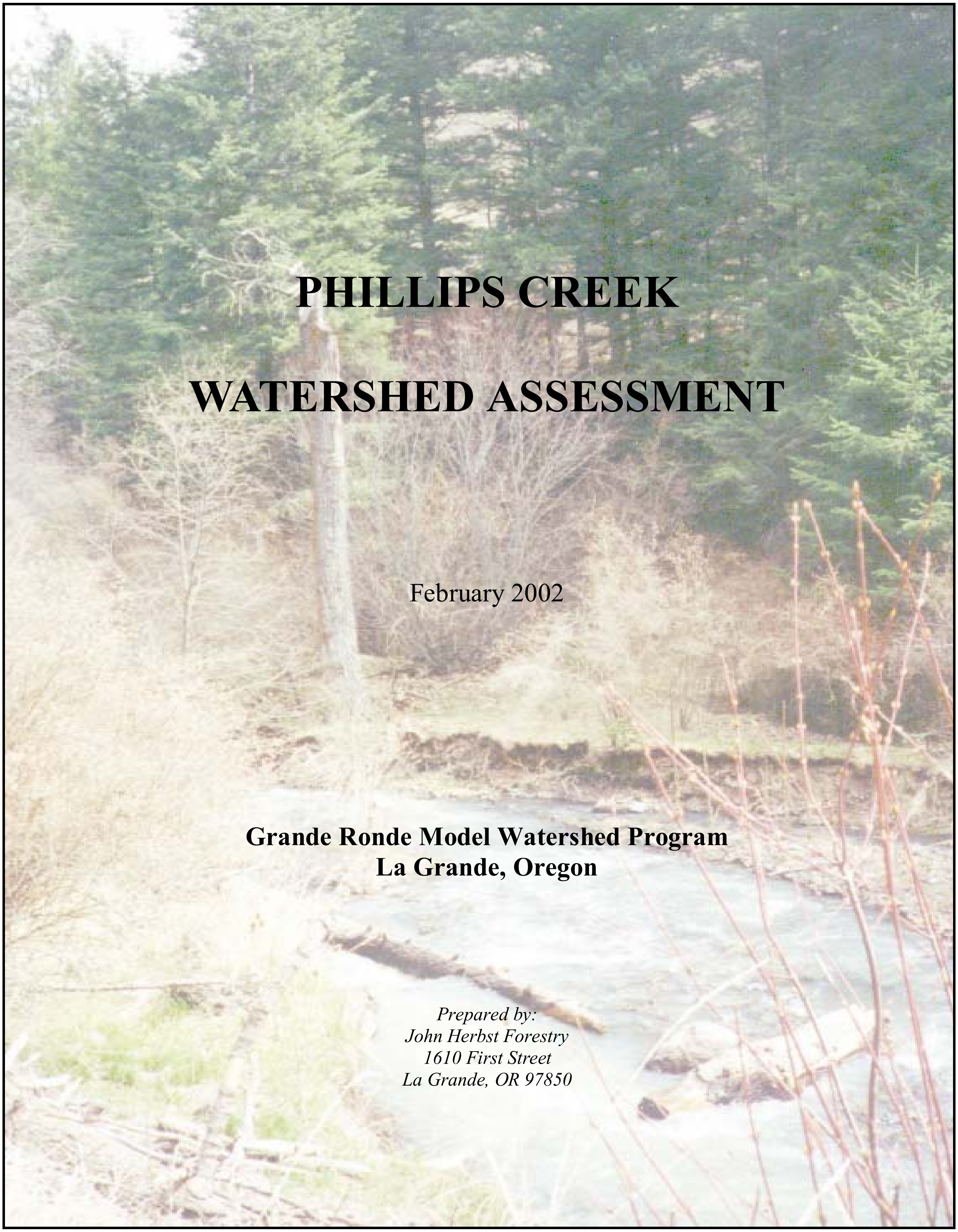

PHILLIPS CREEK

WATERSHED ASSESSMENT

February 2002

Grande Ronde Model Watershed Program
La Grande, Oregon

Prepared by:
John Herbst Forestry
1610 First Street
La Grande, OR 97850

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List of Abbreviations and Acronyms

BMP	Best Management Practice
CHT	Channel Habitat Type
cfs	Cubic Feet per Second
DEQ	Oregon Department of Environment Quality
ECA	Equivalent Clearcut Acres
EPA	Environmental Protection Agency
HUC	Hydrologic Unit Classification
NMFS	National Marine Fisheries Service
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
ODFW	Oregon Department of Fish and Wildlife
ODF	Oregon Department of Forestry
ODOT	Oregon Department of Transportation
OWEB	Oregon Watershed Enhancement Board
PGEA	Phillips - Gordon Ecosystem Analysis
SWCD	Soil and Watershed Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
WPN	Watershed Professionals Network

PHILLIPS CREEK WATERSHED ASSESSMENT

June 2002

INTRODUCTION

Watershed Assessments for the Grande Ronde River Subwatersheds are being prepared for the Grande Ronde Model Watershed Program. This Watershed Assessment addresses the Phillips Creek Watershed located near Elgin, Oregon. Phillips Creek is a relatively small watershed (4^{th} order HUC – Hydrologic Unit Classification) containing about 33 square miles or slightly over 24,000 acres. Phillips Creek empties into the Grande Ronde River in Elgin. It is an intermittent stream in some reaches, but water flows year around in other reaches. In this Assessment the main emphasis is on the nonfederal lands. The USDA Forest Service – Umatilla National Forest recently completed a watershed assessment on the National Forest area that includes Phillips, Cabin, Gordon and Dry Creeks. For more complete information on watershed condition on federal lands, please refer to the Umatilla National Forest's *Phillips-Gordon Ecosystem Analysis* (PGEA).

"A watershed assessment is a process for evaluating how well a watershed is working" [Oregon Watershed Assessment Manual (WPN)] A watershed assessment (assessment) is conducted to evaluate the condition of the watershed in regards to water quality and fisheries habitat. An assessment should describe how a stream is functioning in relation to potential fisheries habitat. The goals of an assessment are:

- "Identify features and processes important to fish habitat and water quality.
- Determine how natural processes are influencing those resources.
- Understand how human activities are affecting fish habitat and water quality.
- Evaluate the cumulative effects of land management practices over time."

This assessment will describe the Phillips Creek watershed and help to identify the stream processes and features that are working well, and those that are not. Information that is already available from state and federal agencies as well as from private sources (including people that live in the area) will be used. Several public meetings were held to obtain information and insights from people that live in the area. The assessment will identify human's positive and negative influences to the immediate stream environment. The assessment should provide enough information to develop project plans and monitoring plans that will help to protect and improve water quality and fish habitat in Phillips Creek and it's tributaries.

The entire watershed is broadly analyzed because the upland regions do affect the stream environment. However, most emphasis is placed on the immediate stream environment. The immediate stream environment includes the stream channel and the area wetted by the stream or having vegetation typical of riparian areas. Information provided by the assessment is used to identify the areas of the stream that provide high water quality and those areas with the most potential for native fish production. Users of the assessment will be able to identify:

- "Areas with the highest potential for improvement.
- High priority areas for restoration.
- The types of improvement actions that will be most effective"(WPN).

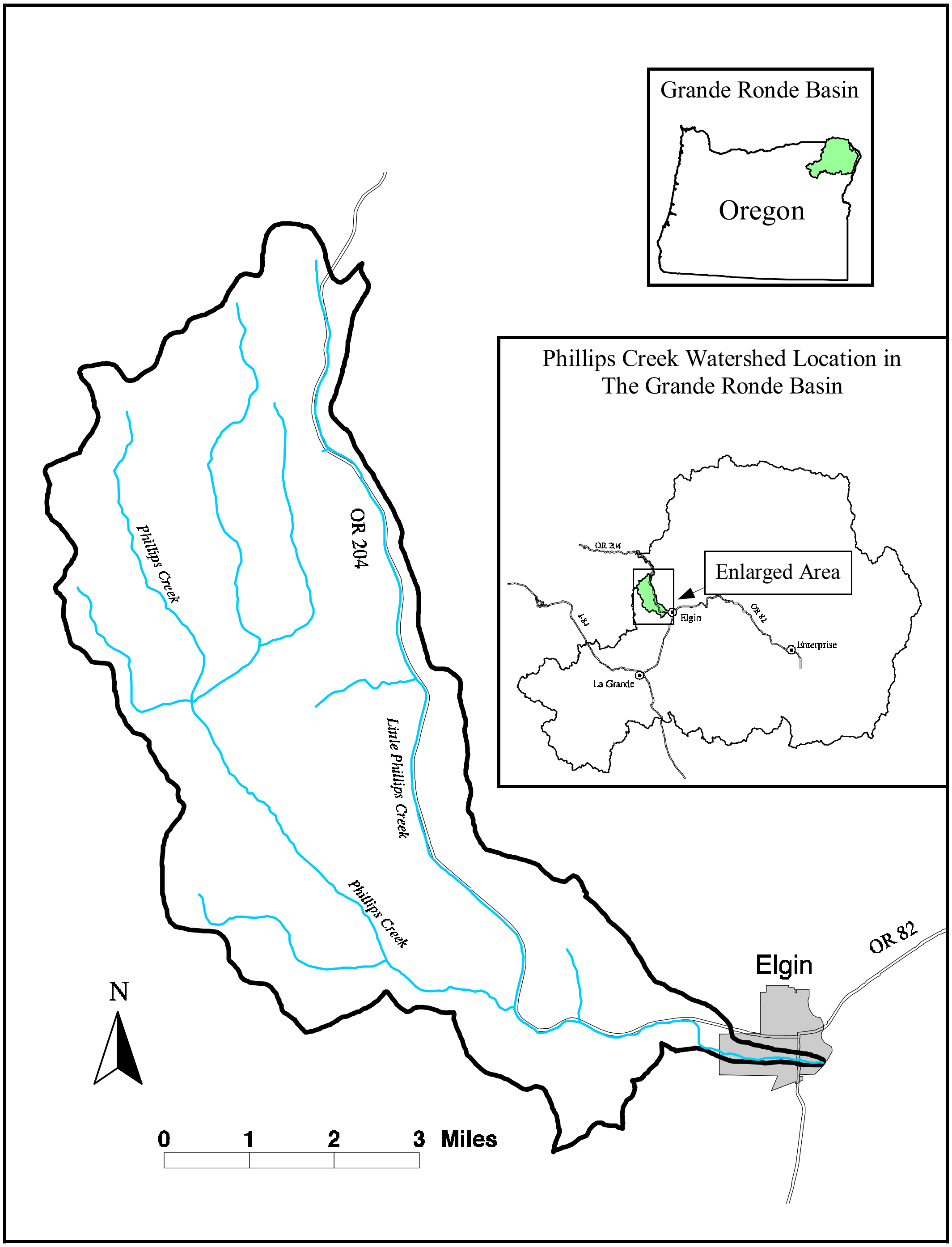
The benefits of having an assessment of a stream are many. Not only are activities influencing the stream identified, but also areas and methods for restoration, if needed, can more readily be identified. The assessment will provide information about the stream including historic use patterns. There are many sources of funding (grants, low interest loans) available to private entities and public agencies for stream habitat restoration. The assessment will help landowners to obtain financial and technical assistance to accomplish their desired restoration projects along the stream.

References

1 Umatilla National Forest. 2001. Draft Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

2 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

Phillips Creek Watershed—Vicinity Map



PHYSICAL DESCRIPTION OF PHILLIPS CREEK WATERSHED

The Phillips Creek Watershed drains an area of about 33 square miles northwest of Elgin. The main stems are Phillips Creek and Little Phillips Creek. The major tributaries are Bailey Creek, East Fork of Phillips Creek and Pedro Creek. There are numerous smaller unnamed tributaries. The elevation ranges from about 2,660 feet at its' mouth to 5,316 feet at Horseshoe Prairie. There are two major landforms in the watershed. There is an alluvial fan at the mouth on which Elgin, the only community in the drainage, is located. The mountainous uplands start where the stream valley is constricted just west of the Boise Cascade log yard in Elgin. The basic bedrock of the mountainous uplands is mainly basalt. The uplands are forest and open brushfields/ grasslands.

The watershed is further subdivided into subwatersheds. These have all been given numbers by the Oregon Water Resources Board. The Lower Phillips Creek drainage area up to the mouth of Little Phillips Creek is subwatershed 84A. Subwatershed 84B is the Little Phillips Creek drainage area. The Middle Phillips Creek drainage area up to East Phillips is 84C. Both East Phillips and Pedro Creek drainage's comprise subwatershed 84D. The Upper Phillips Creek drainage area is subwatershed 84E.

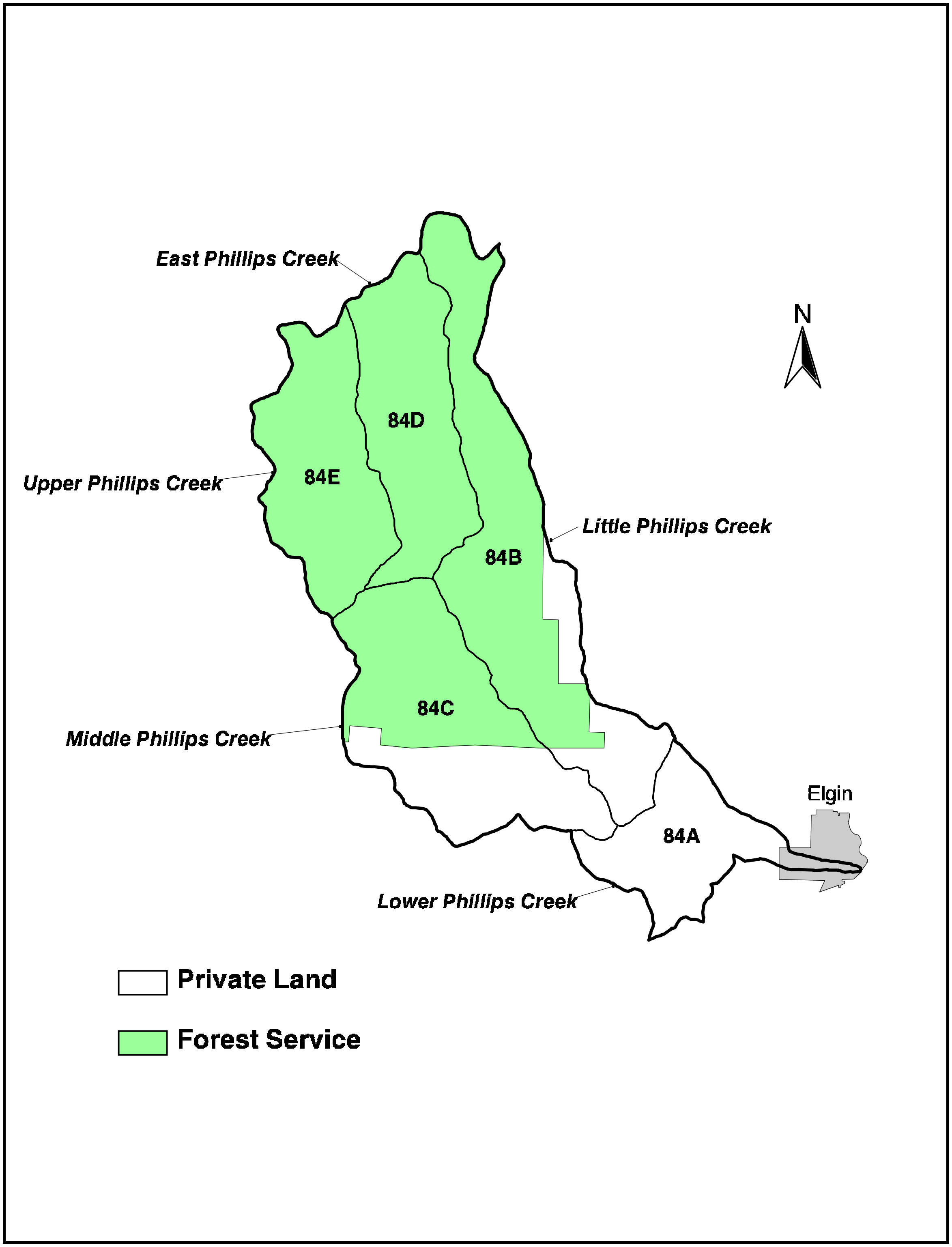
Table 1 shows how many acres are in different uses or vegetation status in the watershed. It shows that most of the watershed is in forest with very little of the watershed in developed area.

Table 1. Phillips Creek Vegetation Status by private or public ownership.

Vegetation Status	Acres of Private	% Private	Acres of Public	% Public	Total Acres	% Total
Developed Area	96	1%	0	0%	96	<1%
Agriculture	8	<1%	0	0%	8	<1%
Herbaceous/grass	2,836	38%	3,569	21%	6,405	26%
Dryland shrub	195	3%	2,333	13%	2,528	10%
Ponderosa pine forest	743	10%	347	2%	1,090	4%
Dry mix forest	2,226	30%	3,589	21%	5,815	23%
Douglas-fir forest	67	1%	0	0%	67	<1%
Wet mix forest	1,223	17%	7,244	42%	8,467	34%
True fir forest	0	0%	276	2%	276	1%
Riparian shrub	1	<1%	22	<1%	23	<1%
Rock, sparsely vegetated	16	<1%	0	0%	16	<1%
Water	1	<1%	0	0%	1	<1%
Total	**7,412**	**100%**	**17,380**	**100%**	**24,792**	**100%**

Oregon Department of Forestry

Phillips Creek Subwatersheds



The watershed lies on the eastern edge of a large basalt uplift block that drains southeasterly into the Grande Ronde River. Most of the watershed is in steeply dissected basalt plateau. Northerly slopes and deeper cool and moister soils in the drainage's are made up of an ash layer over soils derived from basalt bedrock. Southerly and convex slopes have shallower soils derived from basalt bedrock material.

The base rock is made up mostly of Columbia River Basalt. The ash in the soils comes mainly from volcanic eruptions to the west. There is evidence of local volcanic activity. One of the most evident of the local volcanoes is Jones Butte just north of Elgin outside the watershed. It is located south of Gordon Creek.

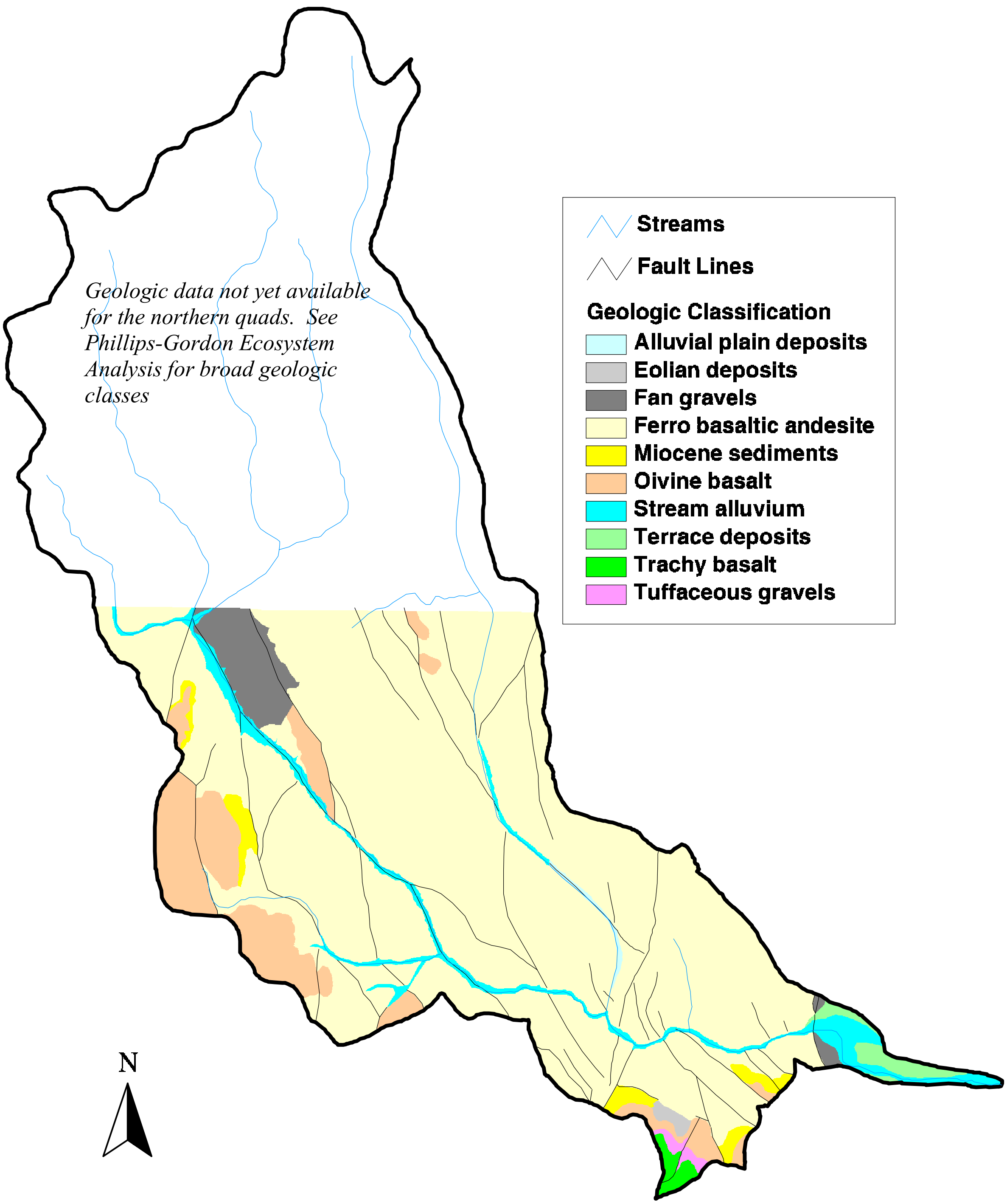
Pre-published geologic maps (Ferns) indicate that there probably are many faults in the lower part of Phillips Creek. At least one area where the creek subs and then starts flowing a again coincides with probable faults. Some faults in this area contain water bearing strata. Faults could affect the amount of water in the stream in different manners. Low water flows could be completely drawn off by the fault and/or the fault could deliver more water to the stream depending on the fault and the water bearing strata (personal communication - Ferns).

Most of this watershed has soils that are well suited to forest, range and recreational use. There is very little good agricultural ground. Some of that is due to the steep slopes and elevation. Soils will be described in general terms for this assessment. The following soils map is a general soils association map. More detailed information on site specific soils can be found in the *Soil Survey of Union County Area, Oregon* that can be obtained at the Natural Resource Conservation Service in Island City. These soil descriptions are for the private lands in the watershed, although some of the same associations can be found on public land. For more detailed information on federal lands in the upper part of the watershed see the Umatilla National Forest's *Phillips-Gordon Ecosystem Analysis.*

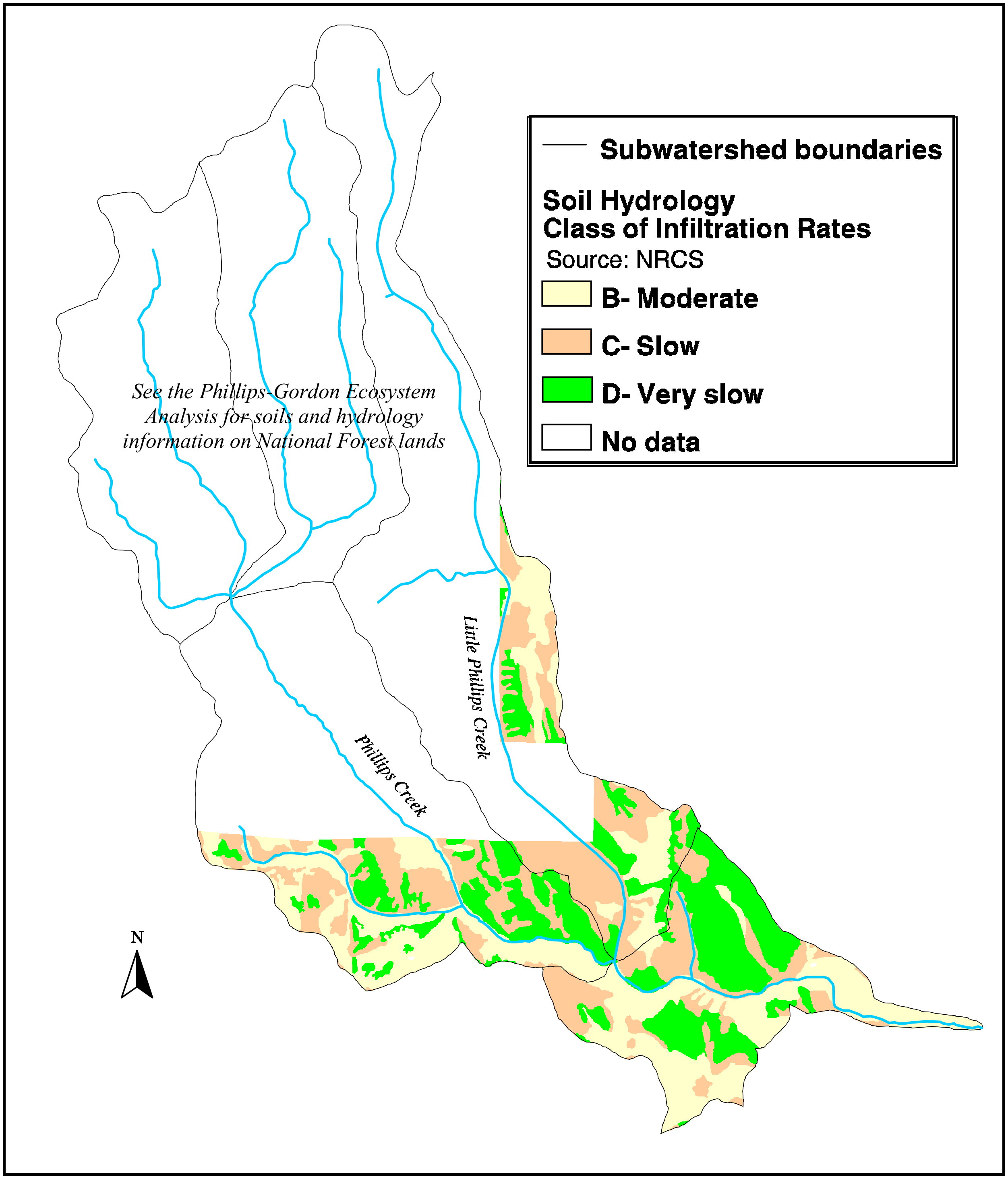
The lower part of the creek is in a Catherine-La Grande-Veazie association. These soils are deep well drained to poorly drained soils that formed in the alluvial or outwash fan. They are derived mainly from basalt from upstream. These soils are prone to flooding and can erode easily. The natural vegetation would be bunchgrass and forbs. These soils would be suited to growing hay and pasture. In this watershed most of the area is taken up with urban and industrial land uses.

The next band of soil types upstream are of the Lookingglass-Emily-Wolot association. These are deep well drained to moderately well drained soils formed in place or formed by sliding downhill and collecting on top residual soils. They are made up of volcanic ash and basalt. The natural vegetation would be coniferous forest with an understory of grasses, forbs and shrubs. There is often a clay subsoil, so any operations should be careful not to compact soils or the potential production is greatly reduced. The hazard from erosion when operated on is slight to moderate. Care should be taken to prevent erosion by keeping cover on the soil.

Phillips Creek Watershed Geology



Phillips Creek Watershed—Soils Hydrologic Classification on Private Land



From Oregon Department of Forestry

The next higher band of soil types are of the Tolo-Klicker-Cowsley association. These are moderately deep and deep well drained soils that formed in volcanic ash and wind blown soil and residual or native basalt. The native vegetation would be coniferous forest with an understory of grasses, forbs and shrubs. These soils are mainly used for production of forest resources. The hazard from erosion ranges from slight to high depending on steepness of slope and the amount of vegetative cover on the ground.

Data Gaps

- Complete geologic mapping

References

1 Ferns, M. and I. Madin. 1999. Geologic Maps of the Elgin and Sanderson Springs 7.5 Minute Quadrangles. Oregon Department of Geology and Mineral Industries.

2 Oregon Department of Forestry. 1999. Private land vegetation of Baker, Umatilla, Union and Wallowa Counties. Pacific Meridian Resources, Portland, OR.

3 USGS. Topographical Maps.

HISTORICAL CONDITIONS ASSESSMENT

Phillips Creek history has been gleaned from the scarce historical records of local conditions. Prior to the 1800s emigrants settling in the Grande Ronde valley, the native Indians had summer encampments at the mouth of Phillips Creek on the present Elgin townsite. The name of the camping area was Lochow Lochow and fish traps were set up annually on the Grande Ronde River just below the mouth of Phillips Creek to harvest salmon for the winter months (Hug). The Grande Ronde Valley was known as the "Valley of Peace" as members of diverse tribes used the area in the summer to gather food for the winter (Gildemeister). Tribes that regularly encamped in the general area included the Nez Perce, the Umatilla, the Cayuse and the Shoshone.

Because the encampments were for months at a time, the trails (roads) used to transport living quarters, household goods and the collected winter food in and out of the valley were probably fairly substantial. One of those trails approximates the Woodward Wagon Road between Elgin and Weston. The wagon road graded up the hill to the north of Little Phillips Creek just upstream from its confluence with Phillips Creek (Barklow). The present Oregon State Highway 204 between Elgin and Weston follows Phillips Creek upstream to Little Phillips Creek and then follows Little Phillips. The highway takes up a good share of the valley floor. Two tunnels were dug for the creek to flow through because the highway takes up so much room.

Before Forest Service Road 3738 was built up the bottom of Phillips Creek, access up Phillips Creek was via a primitive native surface road that crossed the creek many times. This road was mainly used for management activities and hunting. Before the 1950's, most roads in the Phillips Creek watershed were primitive "jeep" roads.

Vegetation manipulation during early times in the watershed was through the native's use of fire and their use of livestock grazing. Native Americans first obtained horses in the early 1700's (Gulick). There was a long history of grazing use before the emigrants arrived on the scene in the early to mid-1800s. Another major native manipulator of vegetation that directly affected the water quality of the stream was the beaver. Beaver dammed the creek in many places, and in the process cut down substantial amounts of riparian vegetation before moving on to better food sources. The harvested vegetation resprouted and grew prolifically when the beavers were not directly impacting it. The beaver dams probably did not block anadromous fish passage. The beaver dams likely stored substantial amounts of water in the soils adjacent to the stream in the upper reaches. That water would have contributed to late season flows and probably cooler water temperatures in the summer (Lowry in Bohle).

As far as is known, Phillips Creek is a traditional steelhead (*Oncorhynchus mykiss)* spawning and rearing stream. Use of Phillips Creek by spring Chinook salmon (*Oncorhynchus tshwytscha)* and coho salmon (*Oncorhynchus kisutch)* was probably incidental. There are no records of regular use of Phillips Creek by the latter two species (personal communication, Tim Walters, ODFW).

Use of the Phillips Creek drainage started changing with the advent of the 1800s American explorers and settlers. Trapping of beavers and other furbearers that dwelled in riparian areas started in the early 1800s. The populations of these animals were reduced to the degree that it was no longer lucrative to trap them by the mid-1800s (Gulick). Removal of these animals had impacts on the stream environment and hydrology. The beaver did recover after a beaver transplanting program in the 1940's, and by 1955 there were many beaver dams on Phillips Creek (personal communication, Paul Tate). After that the beaver populations again disappeared. During that time period, roads were being developed in the watershed, and the beaver may have been removed because they were a nuisance for road maintenance. Beaver have a habit of using culverts as a starting place for a dam. A dam built in a culvert often makes the road wash out. Beaver have recently been observed in Phillips Creek. There is only an incidental population at this time.

By the mid-1800s, large herds of cattle and bands of sheep started grazing the Blue Mountains. Skovlin reported that the Blue Mountains had been overgrazed by the 1880's. The numbers of animals grazing on the National Forest has declined dramatically from the early 1900's to the present day. Earlier grazing included large bands of sheep in the Phillips Creek watershed . The forage and terrain in this watershed is better suited to sheep than cattle (PGEA). In the early 1900's Elgin was a major railroad shipping point for bands of sheep and herds of cattle going to and from the summer grazing grounds in the mountains. The Elgin stockyards was a common stopping and resting-place for trainloads of sheep and cattle. An early law required that livestock in transit be rested, fed and watered on a regular basis and Elgin was well located for this (personal communication - Pete Trump).

Timber was harvested to some degree from private lands in the watershed since the late 1800s. Most of the early harvest was a selective harvest, mostly cutting the best material for the intended use. Good logs were readily available close to town. Transportation was difficult so logs were not hauled very far. There were several sawmills located in Elgin in the late 1800s. In the early 1950s there was a sawmill on one side of Phillips Creek owned by one individual that passed the lumber produced over the creek to a planer mill owned by a different individual (personal communication - Glenn Parsons). There was not a significant amount of timber harvested from the Umatilla National Forest in this watershed until the mid-1950s when larger sawmilling capacity was installed in Elgin. A spruce budworm outbreak in the 1950s followed in about 15 years by a tussock moth outbreak in the early 1970s prompted extensive salvage logging. A road to harvest timber from the Umatilla National Forest was constructed up main Phillips Creek in the 1960s.

Phillips Creek has not always been an intermittent stream. There have been times in recent history that the stream has run year around over most of its length. There was a period in the 1950s that the stream ran year around (personal communications – Ken Coe and Paul Tate). Phillips Creek was reported to have good beaver populations until they got trapped out before 1900. That would indicate that there was water in the stream year around, but it is not known whether there was water all the way to the mouth or just higher up in the drainage. In the past 20 years the stream has been dry in mid to late summer through Elgin in places, especially below the railroad bridge. The stream "subs" or goes underground in places and has surface water in other places. During the past 20 years, water has flowed continuously in some of its reaches and has been dry in other reaches.

There are water rights from Phillips Creek. Most water rights are for lawn and garden watering in Elgin. The irrigation demand is not high, probably because there is not much water in the lower stream in the summer when it is needed. Another factor is that there is not much good agricultural land within the watershed.

Historically there have been few dams placed on Phillips Creek. There have been at least two low ditch diversion dams near or within the Elgin City limits. One dam near Highway 82 actually protected the wooden main water line for the city for years. It has been reported by long time residents that the dams were good places to catch steelhead, but that steelhead could pass the dams and continue upstream for spawning and rearing. Water washed below the dams creating holding pools for fish.

References

1 Barklow, I. 1987. From Trails to Rails: The Post Offices, Stage Stops & Wagon Roads of Union County Oregon. Enchantments Publishing, Enterprise, OR. 299 pp.
2 Bohle, T. 1994. Stream Temperatures, Riparian Vegetation, and Channel Morphology in the Upper Grande Ronde River Watershed, Oregon. Oregon State University, Corvallis, Oregon.
3 Gildemeister, J. 1999. The Grande Ronde Watershed History Report Confederated Tribes of the Umatilla Reservation. Pendleton, Oregon.
4 Gulick, Bill. 1981. CHIEF JOSEPH COUNTRY: Land of the Nez Perce. The Caxton Printers, Ltd. Caldwell, Idaho.
5 Hug, Bernal. History of Union County, Oregon: edited and compiled for the Historical Society of Union County, Oregon. La Grande, OR: Eastern Oregon Review, 1961.
6 Skovlin, J.M. 1991. Fifty Years of Research Progress: a historical document on the Starkey Experimental Forest and Range. Gen. Tech. rep. PNW-GTR-266. Portland, OR: USDA Forest Service PNW Research Station. 58pp.
7 Umatilla National Forest. 2001. Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

CHANNEL HABITAT TYPE CLASSIFICATION

Background

The main purpose for conducting a watershed assessment is to evaluate the condition of the watershed in regards to water quality and fisheries habitat (WPN). A good way to get an understanding of a watershed is to describe the watershed in terms of channel habitat types (CHT). There are several popular methods of classifying streams being used by various agencies and educational institutions at this time. Channel Habitat Typing classification was chosen for the OWEB manual to use in assessments because it is a medium scale classification that can be used without extensive fieldwork. Office work plus some field verification can relatively quickly and inexpensively provide a useful tool for watershed planning. A more precise classification scheme such as Hankins and Reeves or Rosgen may be needed at the project planning level. More detailed descriptions of CHTs than is given here can be found in the OWEB Manual at the Grande Ronde Model Watershed.

A low gradient stream is usually slow flowing while a steep gradient stream flows faster. Stream gradient is measured over a distance of 1,000+ feet. This avoids having hundreds of stream classification changes due to small drops or pools in short distances. If a stream drops 100' in 1000' of distance the gradient is 10% (100'/1000'=10%). Streams tend to be steeper in the headwaters and gentler in the valleys. It is not uncommon in this area to have a stream with 20% gradient in the headwaters and <1% gradient in the plains before it enters the river. The purpose of a classification for the streams of Phillips Creek is to give a general description of the stream for planning of watershed work.

Stream confinement refers to the area over which a stream can flood, or the potential for a stream to move side to side given a large event (50+ year flood). It is measured in terms of distance the water will flood from the stream when it goes over its banks. That distance may or may not be the same as the 100 year floodplain. A confined stream does not have much opportunity to move within its valley (Little Phillips along the highway) while an unconfined stream has plenty of room to move (Catherine Creek in the Grande Ronde Valley).

Confinement Class	Floodplain Width
Unconfined	>4 x bankfull width
Moderately Confined	>2 but <4 x bankfull width
Confined	<2 x bankfull width

Methods

Initial channel habitat typing was done by first measuring the slope of the stream on a USGS topographic map.(vertical drop/horizontal distance). Then the confinement of the stream is estimated. Finally it is decided whether the stream is small, medium or large. The stream size

classification used by the Oregon Department of Forestry is used for this assessment. Small streams have base flows less than 2 cubic feet per second (cfs), medium streams have base flows from 2 to 10 cfs, and large streams have base flows greater than 10 cfs. Stream miles were measured using the ***Maptech©*** *Terrain Navigator* topographic mapping program.
Final channel habitat classifications were arrived at through collaboration with ODFW fisheries biologists. Table 2 provides the descriptions and codes for the channel habitat classifications used for the Phillips Creek watershed.

Table 2. Channel Habitat Types

Code	CHT Name	Gradient	Channel Confinement	Size
ES	Small Estuary	<1%	Unconfined to Moderately Confined	Small - Medium
EL	Large Estuary	<1%	Unconfined to Moderately Confined	Large
FP1	Low Gradient Large Floodplain	<1%	Unconfined	Large
FP2	Low Gradient Medium Floodplain	<2%	Unconfined	Medium to Large
FP3	Low Gradient Small Floodplain	<2%	Unconfined	Small to Medium
AF	Alluvial Fan	1-5%	Variable	Small to Medium
LM	Low Gradient Moderately Confined	<2%	Moderately Confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately Confined	Variable
MC	Moderate Gradient Confined	2-4%	Confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
MV	Moderately Steep Narrow Valley	3-10%	Confined	Small to Medium
BC	Bedrock Canyon	1->20%	Confined	Variable
SV	Steep Narrow Valley	8-16%	Confined	Small
VH	Very Steep Headwater	>16%	Confined	Small

Results

The map and Table 3 on the following pages show the results of the CHT typing of Phillips Creek and its main tributaries. While the main fork of Phillips Creek is about 15 miles long, the main tributaries make up another 22 miles of stream.

The CHT's found on private land are the FP3 found in Elgin and the LC between town and the junction with Little Phillips Creek. There are also LM, MC and MM types on private ground. All of these CHT's will respond to restoration efforts.

Following are more specific descriptions of the CHTs found in the Phillips Creek watershed. The OWEB Manual has more information on CHTs.

FP3 - Low gradient Small Floodplain

This channel habitat type is found from the mouth of the creek up to the Boise Cascade log yard. This CHT can be one of the most responsive to restoration. In the case of Phillips Creek, there are not as many options for restoration because the stream has been channeled to protect the town.

LM - Low gradient Moderately confined channel

This CHT is found along the main stem of Phillips Creek on both private and public lands. It is a low-gradient reach with variable confinement by hill slopes and/or roads. The channel is moderately sinuous. The stream gradient is <2% and the stream is medium in size.

LC – Low gradient, Confined channel

This CHT is found in Phillips Creek from the Boise Cascade log yard up to the junction with Little Phillips Creek. It is also found in that reach of Little Phillips Creek for about 1¼ miles above the Forest Service boundary. The stream gradient is less than 2% and the stream is medium in size.

MM – Moderate gradient, Moderately confined channel

This CHT is found in a few shorter reaches of Phillips Creek. It is located on the main stem from the junction with Little Phillips Creek upstream about a mile and from the junction with the East Fork of Phillips Creek upstream about 3 miles. It is also found on the lower ¾ of a mile of East Phillips Creek and the headwaters of Little Phillips Creek. It is unusual to find this CHT in the headwaters. The gradient is 2 – 4% and the stream is medium in size, except for the headwaters of Little Phillips that is a small stream.

Table 3. Miles of stream by CHT and stream name in the Phillips Creek watershed.

CHT	Phillips Cr.	Little Phillips Cr.	East Phillips Cr.	Pedro Cr.	Total Miles
FP3	0.8	-	-	-	**0.8**
LC	3.6	1.4	-	-	**5.0**
LM	4.8	-	-	-	**4.8**
MC	-	8.3	0.6	-	**8.9**
MM	4.3	0.6	0.6	-	**5.5**
MH	1.2	-	4.9	1.8	**7.9**
MV	-	-	-	1.8	**1.8**
SV	.5	-	-	-	**.5**
Total	**15.2**	**10.3**	**6.1**	**3.6**	**35.2**

MC – Moderate gradient, Confined channel

Most of Little Phillips Creek is classified as this CHT. About ½ mile of East Phillips is also in this classification. That portion classified as MC is from the junction with Pedro Creek downstream. The gradient is from 2 – 4%. The lower portions of Phillips Creek are classified as a medium stream, while the upper portions and that part of East Phillips is classified as a small stream.

MH – Moderate gradient, Headwater channel

This CHT is found in the headwaters of East Phillips and Pedro Creeks. It is also found just below the headwaters of the main stem. The gradients here are steeper, in the 4 – 6% range. These stream reaches are classified as small streams.

MV – Moderately steep gradient, Narrow valley channel

A MV CHT characterizes the reach of Pedro Creek from its mouth upstream for about 1½ miles. The gradient is from 4 – 8%, and the stream channel is confined by a steep slopes with a narrow bottom. This area has many cool springs. This is a small stream.

SV – Steep narrow valley channel

About ¼ mile of the headwaters of Phillips Creek are in this CHT. The stream gradient is from 8 to 16%. The stream is in a steep mountain valley with steep side slopes. There are boulders and large wood structures in this area. This part of the stream is a small stream.

Discussion

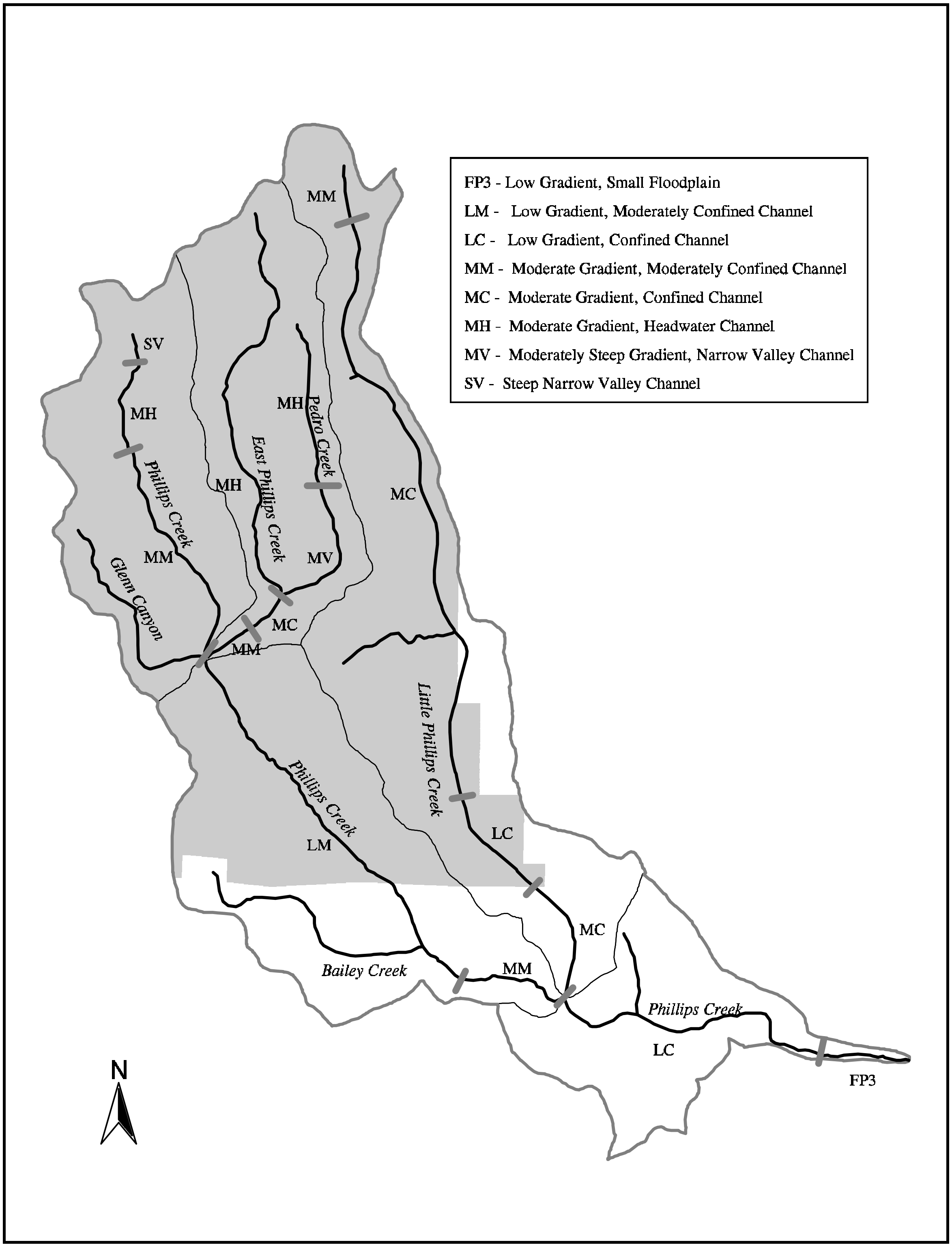
Channel habitat typing is a good tool to have. The responsiveness of stream to restoration can be quickly gauged by its channel habitat type. The type of restoration work that will be effective can be estimated so that limited dollars can work on higher priority projects first.

Generally speaking, some channel habitat types lend themselves better to stream habitat and water quality enhancement than do others. For example, a highly confined, steep stream offers little opportunity for enhancement other than increasing shade through vegetative manipulation or increasing habitat by placement of larger wood over the stream. Low to medium gradient streams that are not as confined offer increased opportunities for projects to enhance water quality and habitat. Additional treatments might include placement of wood or rock structures to increase the number of pools, allowing the channel space for lateral movement, and increasing wetlands along the stream.

FP3 - Phillips Creek delivers a lot of bedload, especially in high water years. As can be seen along much of this reach of the stream there is a high amount of deposition of fine and coarse sediments causing the stream bottom to build up and pools to fill. This reduces aquatic habitat complexity, and can cause the channel to overflow during extreme high water years.

The FP3 CHT offers a better chance of success of channel enhancement activities than larger floodplain channels. Localized activities to provide bank stability or habitat development can be successful. The tendency of this CHT to want to move around needs to be considered when planning restoration or protection projects.

Phillips Creek Watershed Channel Habitat Types



LM - This reach of the creek is probably the most responsive to restoration work in the watershed. There is a variety of aquatic habitat in the stream including pools, riffles and runs. Large wood is available along the stream, and over the past years several trees have fallen in and across the stream. In addition large wood has been added along the private stretch of the stream. There is a a lot of bedload movement through this channel, and without structure the stream tends to fill in pools and reduce pool structure. There are springs and small wetlands associated with this reach of stream.

This CHT can be highly responsive to enhancement projects. If a beaver population stays in the stream, it will probably have a beneficial effect on the creek environment. Beaver dams would provide some pools, and more water can be stored for later release in the year. Water flows year around in some reaches of this CHT, but not in others.

LC - These reaches are confined both by steep basalt based hills on either side, as well as by the highway. There is not a lot that can be done for restoration in these reaches other than plant shrubs where they are lacking. These reaches already have good shrub cover along them (aerial photo interpretation and personal observation). Water flows year around in some reaches of this CHT but not in others.

Because of the hard confinement of the stream, wood and gravel bedloads tend to move right on through. There is not a lot of opportunity for pools to be developed where they do not already occur.

MM - These reaches have gentle to steep slopes on either side, but the valley bottom is wide enough to allow the channel to move a little. These stream reaches are confined enough that they are not considered to have much sinuosity. The unique combination of a narrow floodplain, hill-slope confinement and steeper gradients sets the stage for a dynamic channel system. There are roughness elements present such as large wood, boulder and some bedrock that make for a variety of aquatic habitats within the channel (ODFW). These reaches would be some of the most responsive to restoration projects in the basin.

There is a fair amount of large wood in these reaches. Some has been the result of natural windthrow and logging. Wood has been placed in the stream for structure on some of the private land. The stream has been very responsive and the result has been the formation of pools and some readjustment of bedload carried by the stream. Some wood has fallen into the stream naturally, and the streamside vegetation is healthy. The stream is pretty well shaded in these reaches (ODFW).

MC - These stream reaches flow through a narrow valley, especially the portion on the East Fork. The lower portions of Little Phillips may have had some opportunity for terrace development had it not been for placement of the highway in the valley. There are some cascades and boulder runs in this stream, but for the most part the confinement makes it a high energy stream when it is flowing. That results in the ability to transport large amounts of sediment and bedload.

These reaches would not be very responsive to restoration efforts. Some increases in streamside vegetation might be accomplished, and some localized stabilization could be done along the highway. There are fish populations in all of these reaches, so the minimum amount of restoration possible would still have positive effects on fish habitat. Sanding gravel from the highway routinely is deposited in the stream during the winter because there is no other place to put it. The gravel is moved through the system rapidly, usually during spring runoff, and there is not much deposition in the streambeds.

MH - These channels are just above anadromous fish populations (PGEA). The channels tend to be too small for the larger fish to get into. They are the source of cool water, and in the case of Phillips Creek they are well shaded. They have low streamflow volumes and do not have a lot of stream power. There is a small upslope drainage area, and sediment sources are from upland surface erosion with some sediment from roads higher in the drainage area. All of these reaches are located on the National Forest.

Due to the low energy from the smaller streams, coarser sediments can fill pools and riffles. Road building and maintenance should be done with care to avoid getting sediments into the stream. Diverting sediment carrying water overland should filter out sediment. The streamsides do lend themselves to riparian plantings. Phillips Creek and its tributaries do not have water temperature problems in this CHT and the riparian vegetation tends to be in good shape (PGEA).

MV - This narrow stream near the headwaters develops enough energy to pass the finer sediments that are introduced. It has a good supply of large wood, and streamside vegetation is in good shape providing good shade (PGEA). The water is cool. This type of CHT responds to revegetation when that is needed.

SV - This CHT reach is in good condition in the Phillips Creek drainage. About the only type of restoration that would work here is planting shrubs or sedges along the stream.

Data Gaps

- New stream morphology surveys

References

1 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

2 Umatilla National Forest. 2001. Draft Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

HYDROLOGY AND WATER USE

<u>Climate</u>

Background

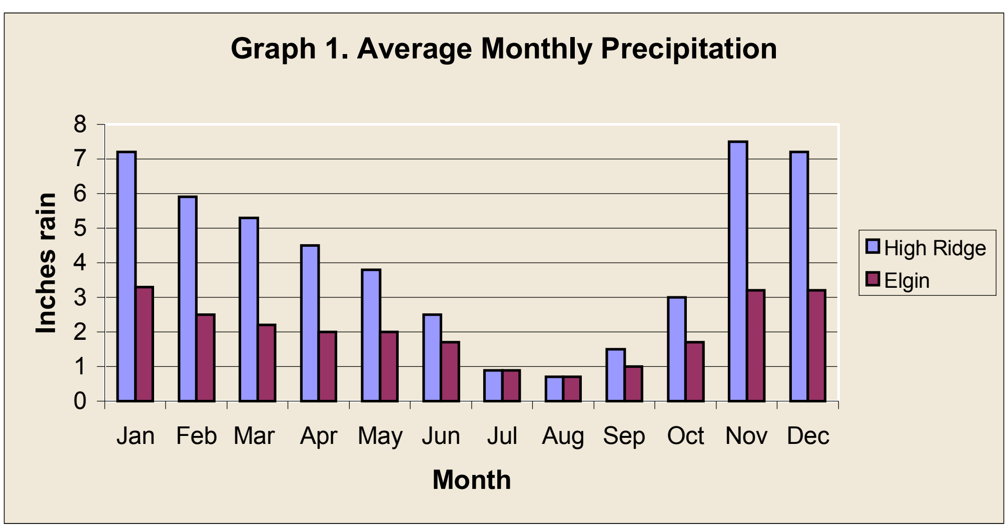
This part of the Blue Mountains receives most of its precipitation in the winter and spring months. The moist air from the ocean flows generally easterly across the Blue Mountains. As it rises up over the Blue Mountains it cools and drops moisture, much of it in the form of snow. This area from Phillips Creek north receives more moisture than most areas of the Blue Mountains with the exception of the Wallowa and Elkhorn Mountains (PGEA). Yearly precipitation ranges from about 20 inches at Elgin to over 45 inches at Horseshoe Prairie.

The temperatures are influenced by both maritime and continental climates. Temperatures have seasonal extremes, with cold moist winters and hot dry summers. Temperatures tend to be 5 to 10° F cooler high in the watershed than at Elgin. On the average, the high mountains are warmest in August and coldest in December. In Elgin July and August are the hottest months and January the coldest.

Methods

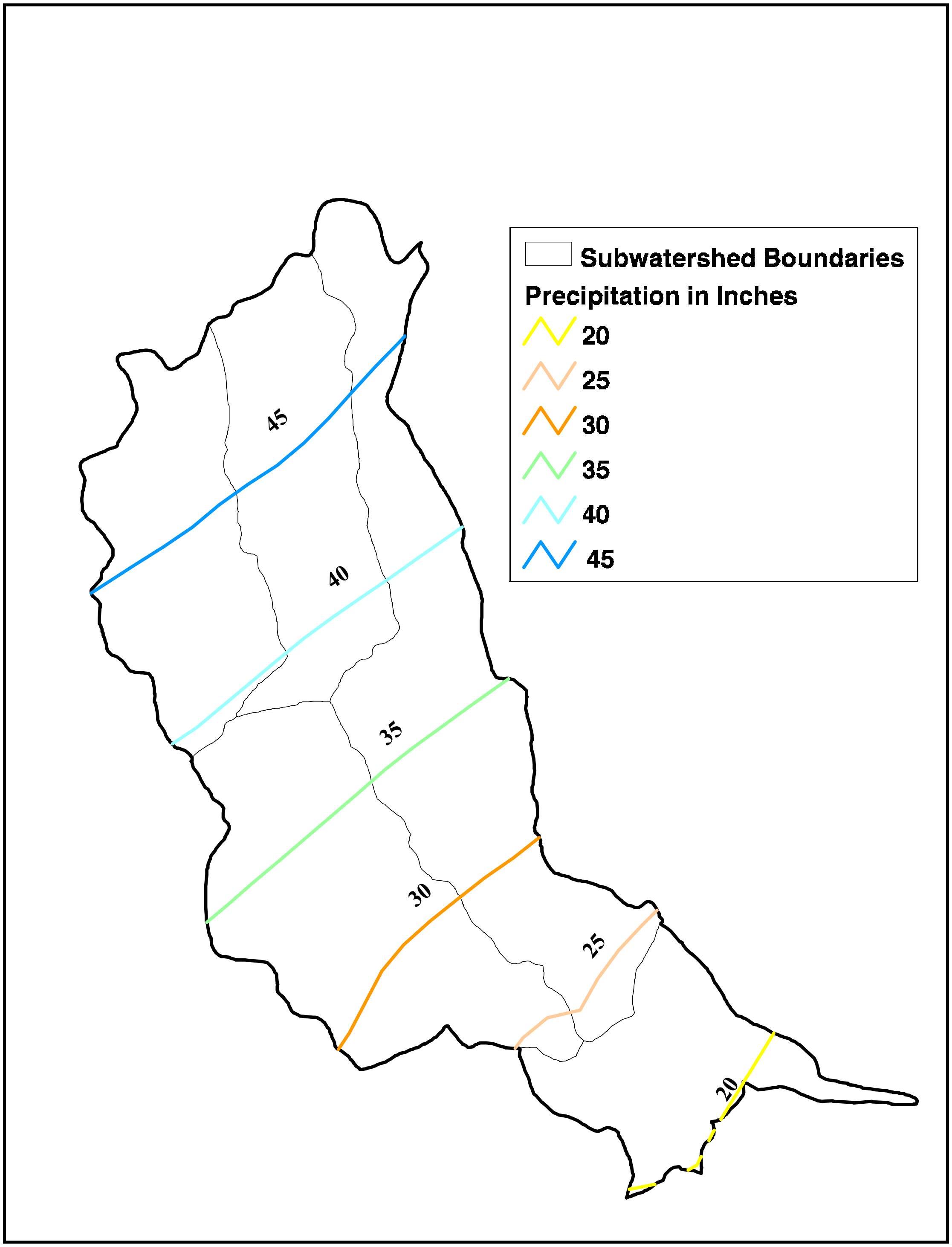
Temperature and precipitation data were collected on a regular basis in two locations. The Elgin location had yearly data from 1970 to the present. The data used to get the average temperature and precipitation were from 1970 to 1998. The High Ridge location is just out of the watershed, but near the headwaters. Average information for this station was collected from 1979 to 1999. The monthly averages were averaged over these time periods and presented in graph form.

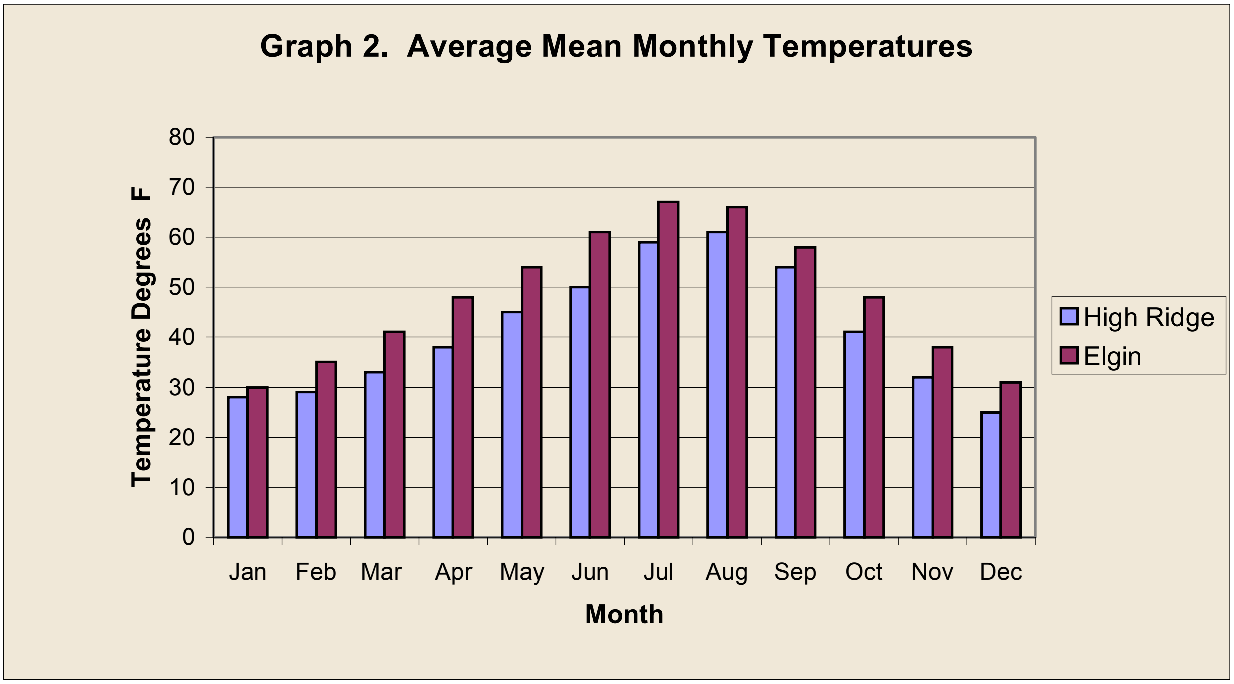
Results



From: Umatilla National Forest Phillips - Gordon Ecosystem Analysis
From Umatilla National Forest Phillips - Gordon Ecosystem Analysis

Phillips Creek Watershed—Precipitation





Hydrology

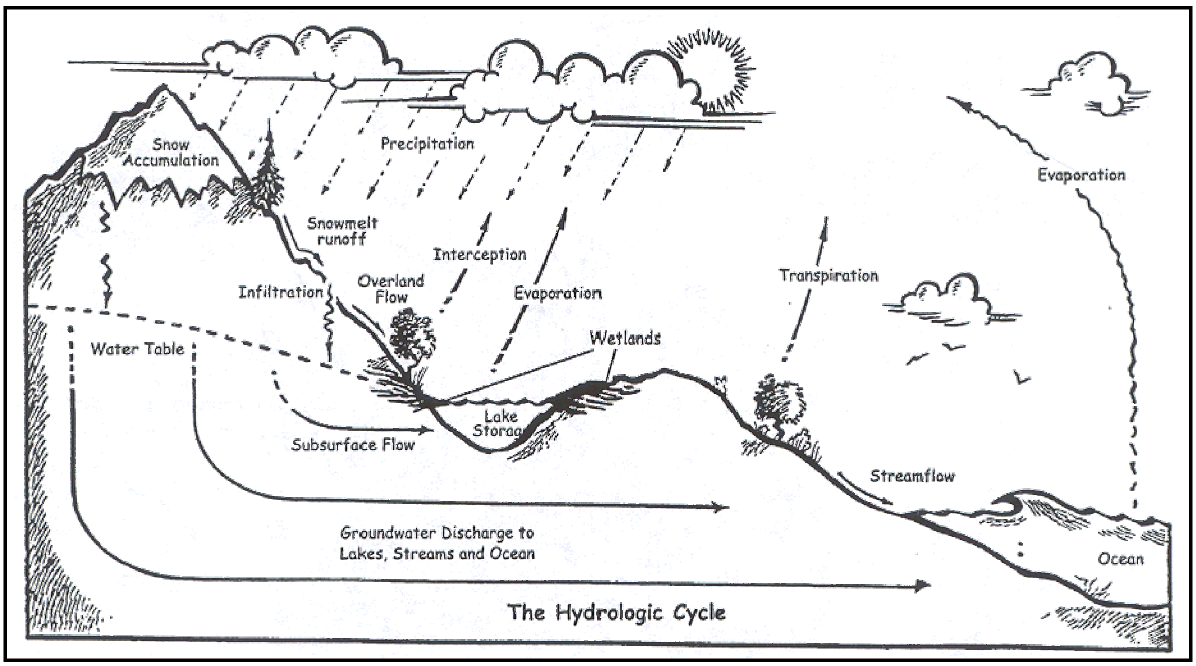
Background

Hydrology refers to the study of the way water cycles through our environment. Most of us are familiar with the hydrologic cycle. Simply stated, water is evaporated from the surface of the earth and ocean, condenses as clouds and falls back to earth as precipitation. The water then either sinks into the earth and eventually returns to the streams, lakes and oceans via groundwater or is intercepted by earth and plants and evaporates back to the atmosphere where the cycle begins all over. Hydrology is a study of the rates of infiltration and runoff in a watershed. Forest hydrology studies and measures the effects of changing vegetation patterns on the rate of infiltration and runoff. Urban hydrology studies the increased runoff caused by buildings and paving thus reducing infiltration rates and reducing the time for water to be returned to the streams.

The Phillips Creek Watershed drains approximately 33 square miles. It flows generally from northwest to southeast draining into the Grande Ronde River at Elgin. The elevation varies from about 2600 feet at Elgin to 5300 feet at Horseshoe Prairie. Precipitation varies from about 15 to 20 inches at Elgin to over 50 inches in Horseshoe Prairie. Most of the private land is located on the downstream portion of the watershed with Umatilla National Forest on the upstream portion.

The USDA Forest Service manages over 17,000 acres of the 24,000+ acre watershed. The primary use of the upper 71 % of the watershed is general forest use. The USDA Forest Service is no longer managing primarily for timber products (PGEA). Consequently significant impacts to the hydrology of the watershed caused by timber harvest from the National Forest is unlikely in the near future. However, large fire events and/or insect or disease epidemics could change the hydrograph significantly. For example a large scale fire such as those that have occurred in the Blue Mountains over the last several years could kill 50%+ of the watershed's trees. The same is true of insect or disease epidemics common to the Blue Mountains. Larger amounts of runoff over shorter time periods could be expected under that scenario.

Figure 1. The Hydrologic Cycle.



From: Oregon Watershed Assessment Manual

Over 7,000 acres in the lower portion of the watershed is in private ownership. Most (98%) of the private ownership is in forest or range use. Grasslands, brushfields and forests are used by cattle, deer and elk for browsing and grazing. Less than 50% of the 7,000 acres are currently grazed by cattle.

There are about 96 acres in the developed classification (Elgin) and only about 8 acres of agriculture in the watershed. The developed classification does not include roads outside of city limits. Roads account for less than 3% of the surface area of the watershed.

Land use activities can affect how fast water comes off a watershed. A heavily forested watershed usually increases the amount of time that water takes to get to the stream. Forests shade the snow so it melts more slowly. Forests have a highly permeable layer of soils for soaking up the water. The water then makes its way slowly through the soil to the stream. However, tree crowns intercept a good share of the snow that is then recycled to the atmosphere before ever reaching the ground and that reduces the amount of water reaching the streams. Areas that have had most of the vegetation cleared from them tend to collect more snow. The snow melts off open areas faster in the spring. Once soils get saturated, snowmelt becomes runoff and does not pass through the soil profiles. Overland flows then put the snowmelt water into the creeks quickly, causing higher creek levels earlier in the season. A watershed's hydrology can be temporarily changed if a large portion of it is in clearcuts.

Roads increase runoff speed in several ways. The most obvious is by the road surface collecting water and moving it over the road or ditch to the stream more quickly. This can also be a source of sedimentation. Roads can also cut off springs or ground water making its way slowly to the stream through the soil profile, sending the water more rapidly down ditches and channels into the streams not following original watercourses. Roads sometimes cut off natural drainages or springs and send the water down ditches to a culvert where flow is concentrated in another drainage, or spilled out overland to form new drainages.

The amount of precipitation received in a given year affects the hydrograph of the stream. A stream hydrograph shows the timing and amount of water from a watershed. The yearly precipitation for this watershed is highly variable. Precipitation can vary by more than 100% from year to year.

Methods

There is little direct hydrologic information (water temperature, flow levels, timing of runoff, high or low flow amounts, subterranean flows, rainfall, air temperatures, etc) available for Phillips Creek because this information has not been collected. There are few published streamflow records of Phillips Creek. The peak discharge of Phillips Creek was recorded as 495 cfs in 1956 and 646 cfs in 1958. These are the only years for which any streamflow data was collected.

Some nearby streams did have gages and limited records. These streams include the Grande Ronde River near Elgin, Lookingglass Creek and Indian Creek. From this data an approximated hydrograph of Phillips Creek can be constructed. Data from Lookingglass and Indian Creeks was used to develop the approximate hydrograph of Phillips Creek in collaboration with Caty Clifton, Umatilla National Forest Hydrologist.

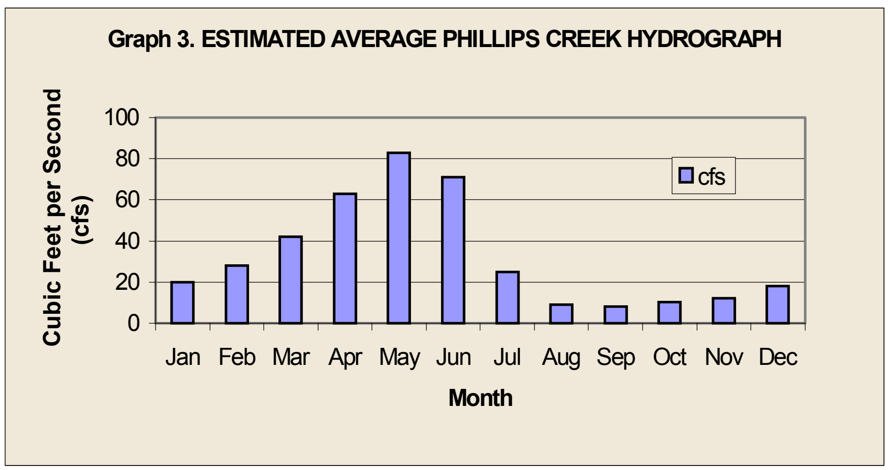
The likelihood of vegetation being manipulated having the ability to change the hydrograph was analyzed. This was estimated using the Risk Classes curve in the Oregon Watershed

Assessment Manual page IV-11 using data from the Oregon Department of Forestry. Known clearcut acres on private land were divided by total acres in the watershed to arrive at equivalent clearcut acres.

Roads can have an effect on the hydrology as well as the sedimentation of a watershed. The Umatilla National Forest is working with National Marine Fisheries (NMFS) "level of concern" guidelines of 2.0 miles of road per square mile. That guideline is more for wildlife than hydrology. The PGEA provided miles of forest service road in each subwatershed. Private road miles, including highways, were measured using the Maptech® measuring device on topographic maps using aerial photos for verification where possible. Private roads count all roads from two track logging roads to the highway.

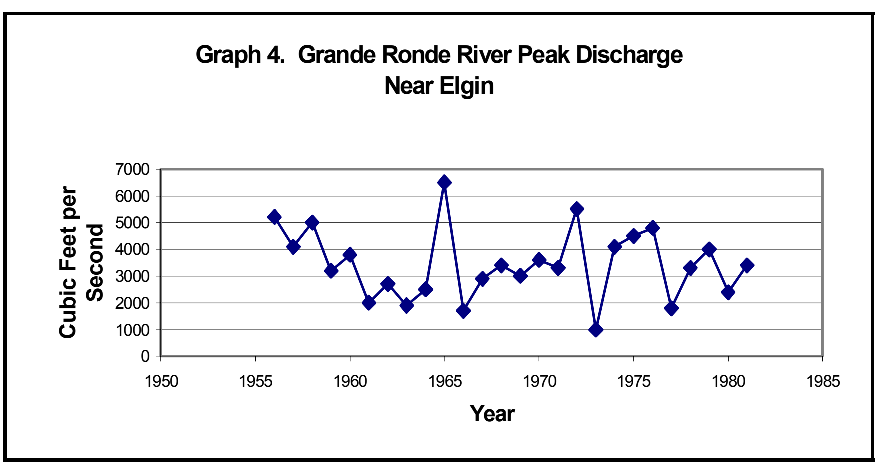
Results

Most of the Phillips Creek watershed lies between 3,000 and 5,000 feet in elevation. This means that for most years, the water comes off the watershed in a spring snowmelt scenario as most moisture comes in the fall and winter. Spring runoff usually starts in March and runs into July. The stream is relatively low for the remainder of the year.



In collaboration with Caty Clifton, Umatilla National Forest Hydrologist

Graph 3 shows the estimated hydrograph for the Phillips Creek watershed. Graph 4 shows the peak in the hydrograph of the Grande Ronde River near Elgin for the years 1956 to 1980. Note the large variability in the amount of water, or river height, year by year. On an average year,



Phillips Creek contributes about 2 to 3% of the peak flow to the Grande Ronde River at Elgin.

Analysis of hydrographs of other area streams indicate that one year in 4 or 5, the peak runoff may occur in late December or early January from rain on snow events. Years when there is a heavy early snowpack followed by heavy warm winter rains is when the stream causes most trouble for the human population. These are the times when the stream jumps its bank or tries to cut another channel, especially in Elgin. Rain on snow events are not predictable. There may be several years in a row that have this phenomena, or there may be 10+ years between events. Rain on snow usually occurs between elevations of 2,000 to 4,000 feet.

During at least the last four decades Phillips Creek has been known as an intermittent stream. Prior to that time there were periods when the stream flowed all year around.
Some parts of Phillips Creek and its tributaries flow year around. Recent fish surveys indicate that the headwaters have water through August, and probably all year. There is no historic data to support the presence or absence of water later in the year. There are many springs and seeps in the upper reaches of the creek (ODFW, PGEA). These provide relatively cool water to the stream. The sun's radiation and/or ambient air (heat transfer) heat the water in the stream. Many parts of the lower stream "go dry" or go underground (sub). There are known dry stretches in late July, August and September both on private ground and National Forest (PGEA). This phenomena is fairly common to other streams in northeast Oregon. The reasons for this are not well understood nor is there good documentation as to whether this is a relatively recent phenomena (last 150 years) or whether it is a longer term situation.

The Phillips Creek watershed has a very small percentage of area in clearcuts. The 15% percent of area with less than 30% crown closure is not large enough for present forestry activities to affect the hydrology of this watershed (WPN)
.

Table 4. Equivalent clearcut acres and road density by subwatersheds (SWS) for the Phillips Creek watershed.

SWS	Acres	SWS mi^2	%ECA	Road miles	Road Density mi./ mi^2
Lower Phillips Creek	2,928	4.6	2.1	35.9	7.8
Little Phillips Creek	7,294	11.4	2.8	35.0	3.1
Middle Phillips Creek	3,347	5.4	5.0	24.0	4.4
East Phillips Creek	4,219	6.6	9.9	25.5	3.9
Upper Phillips Creek	4,215	6.6	7.8	41.0	6.2

NMFS ECA level of concern is 15%+. NMFS road density level of concern is 2.0 mi./mi^2. Forest Service data in the table is from the Phillips-Gordon Ecosystem Analysis. Acres may not add up due to discrepancies in measuring private and public lands

Table 4 shows that the equivalent clearcut area in all of the subwatersheds is below the NMFS level of concern. However, road densities are well above the NMFS level of concern in spite of the road obliteration's that have been taking place on the Umatilla National Forest. This may not be as important for private lands where wildlife protection is not as high a priority. Current levels of timber harvest and roads are also indicators of watershed and stream conditions. High levels of harvest and roads or moderate levels in hydrologically responsive areas increase the likelihood of accelerated erosion, change in peak flows, channel adjustments, and adverse impacts to water quality and aquatic habitat. Roads alter surface hydrology through several mechanisms including interception of subsurface runoff, concentrating surface runoff, and extending channel networks which increase watershed efficiency. Roads also reduce infiltration, reduce vegetative cover in streamside areas, and accelerate erosion and sedimentation into streams (Megahan).

In the upper watershed the Forest Service has been obliterating roads and pulling culverts to reduce sedimentation. On private ground various improvements have been made. On Bailey Creek there have been two road relocations to reduce sediment, one tree placed to keep the road from washing out, and two fish barrier culverts have been replaced with a bridge providing access to ¾ of a mile of spawning habitat. Main Phillips Creek has had large wood placements in the 1½ miles between the junction with Little Phillips Creek and the Forest Service boundary on private land.

Discussion

The upland areas of the Phillips Creek watershed are in generally good condition. There is forest cover on most of the forest lands and less than 3% of the watershed area has been developed, including roads. About 20% of the forestland has less than 35% crown closure. That and the small amount of area above 5,000 feet elevation indicate there is a very low chance of lessening the rain on snow effects by increasing upland vegetation or changing the schedule or silvicultural method of managing timber from the past (WPN).

Future silvicultural activities should be evaluated against watershed effects. The effects of a large surge of water from rain on snow events cannot be reduced significantly by changing present forest management techniques in this watershed. However, the denuding effect of a large fire could significantly increase the amount of water entering the stream during a rain on snow event. Sedimentation would also increase significantly in that scenario.

There is a lot of speculation on the role that beavers may have played in the hydrology of these small streams. Some think that when the beaver populations were high and the stream had many beaver dams, the stream flowed year around. One study in Central Oregon suggests that bank storage of water alongside of beaver ponds may influence length of time that water is released and the temperatures at which it is released. Following is an excerpt from research by Todd Bohle in a Master’s thesis:

> *"At a smaller scale, natural beaver dams can also influence stream temperatures. On Bridge Creek in central Oregon, Lowry (1993) observed a three month lag time between stream temperatures in a beaver pond and groundwater temperatures below the dam. As a consequence, during warm summer months the relatively cooler groundwater associated with late-winter aquifer recharge near the pond may represent a localized "cool water" source to the stream below the dam"*

From this limited information one could infer that bank storage could lengthen the amount of time that water is released resulting in later flows as well as cooling the water.

Data Gaps

- Stream gauges with continuous measurements
- Road inventory on private lands

References

1 Bohle, T. 1994. Stream Temperatures, Riparian Vegetation, and Channel Morphology in the Upper Grande Ronde River Watershed, Oregon. Oregon State University, Corvallis, Oregon.

2 Holochek, J. 1970. Physical and Biological Stream Survey - Phillips Creek. Oregon State Game Commission, La Grande, Oregon.

3 Umatilla National Forest. 2001. Draft Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

4 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

RIPARIAN ASSESSMENT

Background

The plant associations along streams and rivers that are influenced by the stream and river environments are called riparian areas. Riparian vegetation plays an important role in protecting and enhancing water quality in the streams. Riparian vegetation shades the water and streambed preventing warming by solar radiation. It provides food (insects feeding and living in the vegetation) and cover for fish populations. Larger vegetation falling into or over the stream provides stream structure, hiding cover for fish and substrate for plants and insects. Smaller vegetation falling into the stream provides nutrients for aquatic insects. Riparian vegetation stabilizes streambanks and during high flows can dissipate the energy of the stream thereby slowing or preventing streambank and bed erosion (WPN). Slowing the flow of the stream may cause localized flooding. Localized flooding could recharge soils and/or cause damage to the fields along the streams. Riparian vegetation provides a buffer between the stream and streamside activities. It also provides habitat for many terrestrial animals.

It is much easier to keep water cool than it is to try to cool it down again. It is very important to shade streams higher in the watershed so that cooler water can be delivered downstream. Stream widening is a result of bank erosion. The majority of bank erosion in the last 120 years is due to vegetation changes. Most vegetation changes were not natural. The high water itself may not be natural due to a modified hydrograph (personal communication - Lyle Kuchenbecker). Shade as high and thick as can be grown on a site (site potential shade) may or may not be able to shade a stream. The amount of site potential shade available is dependent on many factors including soils, water availability and stream orientation. Small, narrow streams may be able to be shaded all day with tall grass or low shrubs. Wide streams or rivers may not be able to be shaded adequately because vegetation may not be tall or wide enough to provide complete shade. Streams that have been widened either naturally by flooding, ice or debris flows or by man’s activities are likely to have less total shade than before widening. Solar radiation is a large factor in increasing stream temperatures in wide shallow streams. Phillips Creek is small enough that site potential vegetation can do a high degree of shading of the stream throughout its length.

While there has not been a lot of research done on the effects of riparian areas on stream temperatures, this subject has been researched in Oregon including in eastern Oregon. Bohle summarized riparian research in *Stream Temperatures, Riparian Vegetation, and Channel Morphology in the Upper Grande Ronde River Watershed, Oregon.* Following are some excerpts from that study. Please refer to the study for more complete information on this subject.

"Cooling rates of headwater streams following heating in clearcuts were also evaluated by Andrus (1993). Results indicated that low gradient headwater streams cooled the quickest, an observation attributed to slower travel times and thus more time for heat transfer to occur between the water and air. However, even in these low gradient tributaries, streams needed to flow at least 300 m, distances greater than those within the clearcuts, through a downstream forested reach before the heat gained within the upstream clearcut was dissipated. Andrus also attributed groundwater dilution to be an important component in the cooling process. In semi-arid regions where low relative humidities are common, such as may exist in northeast Oregon, evaporative energy loss stemming from steep vapor pressure gradients may facilitate quicker cooling than within streams in more humid regions."

" . . . Andrus (1993) observed a 4.1°C decrease in maximum daily stream temperatures through a 245-m long clearcut on Phillips Creek, a small, headwater stream in northeast Oregon. Apparently the clearcut included a segment at which about 66% of the streamflow went subsurface. The impact of these cooler subsurface inflows on stream temperature regimes can be quite significant, particularly during the summer months when mean daily stream temperatures are greatest and base flows are at their lowest"

"The effect of various land use activities on stream temperatures is largely site-dependent and often difficult to assess."

"Land use activities which incur changes in soil temperature may also alter stream temperatures. . . . The affect of these activities on stream temperatures, therefore, is contingent on the hydrologic pathways which connect hillslopes to streams"

Bohles study indicates that much remains to be known about the hydrology of streams. His study seems to indicate that restoration efforts need to pay strict attention to site specific attributes of the stream. Using broad based assumptions from research in areas far away from the site to be restored may have unexpected results.

Because of the variable rates and intensities of natural disturbances, we likely never will see a time that even with man's best efforts entire stream reaches will have reached full site potential shade. Natural disturbances often re-occur over a shorter time period than it takes for shading vegetation to mature. However, any one natural disturbance usually does not change long continuous stream reaches so the amount over a stream is usually variable naturally. Man made disturbances also can reduce shade to streams. There are many fenced off stream reaches in the Grande Ronde watershed that attest to streams becoming revegetated if ongoing disturbances are removed.

Grazing by ungulates (cows, elk, deer, goats, etc.) can reduce the amount of riparian vegetation below the desirable threshold. Careful management of grazing of livestock can keep browse levels within acceptable levels. The impact of grazing on riparian vegetation is variable depending on season of use and the amount of grazing allowed before removing animals. Deer and elk may severely impact young plants trying to become established.along streams. Once shrubby vegetation is well established, it is not easily damaged as it has a rapid rebound rate. Overgrazing can result in shrubs barely existing to the point of not being identified as present, and yet able to rebound when grazing pressure is removed. Livestock grazing can coexist with healthy riparian vegetation when managed with that in mind.

Some roads are constructed close enough to streams to constrain the streams lateral movement. In some cases the roads cause the rerouting of the stream. An example of this is Highway 204 along Little Phillips Creek. Often the fill and protection of roads from erosion precludes much vegetation becoming established. Safety considerations often cause the removal of riparian vegetation. Protection of the infrastructure (roadbeds, bridges, etc.) can warrant the removal of riparian vegetation. Those responsible for road management have taken measures to take stream and riparian values into account when conducting construction or maintenance of the infrastructure. Best Management Guidelines have been adopted by both State and County Departments of Transportation (ODOT).

Methods

Riparian condition is estimated from aerial photos and reconnaissance of the streamside. This along with habitat descriptions from Oregon Department Fish and Wildlife stream surveys will provide an estimation of the health of the Phillips Creek riparian areas. Stream surveys were not done to obtain the information in this assessment. This method provides a broad descriptive analysis.

At this time there is no agreed upon standard methodology to measure shade over a stream. There are several consistent methods in use for different purposes. A spherical densiometer is an instrument that has been in use for many years. It measures the amount of sky or cover overhead at a specific point. The solar pathfinder is sometimes used to measure shade over streams. It takes into account the path of the sun and shade over time as the sun passes by during the day.

For this assessment the amount of shade over a stream reach was estimated as high, medium or low using guidelines from the Oregon Watershed Assessment Manual. Using 1997 aerial photographs and ground reconnaissance the stream is considered to have low shade if the stream surface and banks are entirely visible or visible at times. Low shade is less than 40% shade. If the stream is visible on aerial photos but the banks are not, the shade level is considered medium or 40 to 70% shade. If the stream surface is not visible or only visible at times it is considered to be a high shade level or greater than 70% shade.

Both the amount of shade and the potential for large wood recruitment can be estimated using the above method. Areas with large trees can be identified using aerial photos. Large wood (trees, root wads, logs, and in the case of smaller streams, large limbs) is important for stream structure and for fish habitat. Large wood also provides a substrate for habitat of both terrestrial and aquatic insects.

The effects of grazing on riparian vegetation was gleaned from stream survey notes. Some information was inferred from lack of comment on grazing damage in stream surveys. This was considered as a surrogate because in those reports where grazing was mentioned, it was mentioned as damage to vegetation. Personal observations by the author were made along selected segments of the streams to verify that information.

Roads located adjacent to streams were surveyed for presence and health of riparian vegetation through the use of aerial photographs where they were available. In other areas readily observed from roads some personal observations were made. Additional information was obtained from the *Phillips - Gordon Ecosystem Analysis.*

Results

This section describes the current condition of the riparian section of riparian areas of Phillips Creek. This can be compared to potential vegetation and that may identify restoration opportunities. Table 5 shows the estimated amount of shade along the various reaches of Phillips Creek. Estimates were made from aerial photographs and ground truthing. Table 5 along with the CHT gives an indication of which stream stretches may respond to shading restoration efforts.

Table 5. Estimated Shade Along Selected Reaches of Phillips Creek.

Stream Reach	Low	Medium	High
Mouth of Phillips Creek to canyon above log yard	15%	45%	40%
Canyon above log yard to Little Phillips	10%	10%	80%
Main stem from Little Phillips to National Forest Boundary	10%	80%	10%
Little Phillips from mouth to National Forest	-	40%	60%
Main stem National Forest Boundary to East Fork	?	?	?
Main stem above East Fork	?	?	?
East Fork of Phillips Creek	?	?	?
Pedro Creek	?	?	?
Little Phillips on National Forest	?	?	?

Phillips Creek flows through forestland from the town of Elgin upstream. The Oregon Forest Practices Act requires that landowners manage streamside vegetation to provide large woody debris for streams. That assures both large wood and tall shade for streams.

The Forest Service did not include shade estimates in their stream surveys. In general the shade on the National Forest would be medium to high using the same criteria. This was inferred from Forest Service stream surveys for the *Phillips – Gordon Ecosystem Analysis.* That inference was corroborated by personal observation on selected reaches and from aerial photographs.

The Umatilla National Forest manages stream areas under PACFISH guidelines. That provides for a 300' buffer along streams. One objective under PACFISH is to have more that 20 pieces of large wood per mile. Large wood is defined as greater than 12" in diameter and over 35 feet in length. Pedro Creek is the only stream that exceeds 20 pieces per mile and it only has about 22 pieces per mile. East Phillips is close behind with about 19 pieces per mile. Phillips Creek has two reaches with about 10 and 15 pieces per mile. The other reach of Phillips Creek and all of Little Phillips Creek have very little large wood.

Some of the potential large wood along Little Phillips Creek has been purposely removed for highway safety. The danger trees were felled for about 5.5 miles within ODOT right of way within the National Forest. Along these reaches the lower shrubs, willows and dogwood along with other species, have sprouted vigorously and presently provide critical summer shade to the stream. There are some cottonwood scattered along the stream.

The Umatilla National Forest completed stream surveys on the National Forest portion of the Phillips Creek watershed in 1994 (Lynch). Surveys were completed only on those portions of the streams that were fish bearing. Table 6 shows the number miles surveyed by stream.

Table 6. Number of miles of Phillips Creek and tributaries surveyed by the National Forest in 1994 and maximum/minimum temperatures measured during the survey in late July – early August 1994.

Stream	FS Miles	Private Miles	Total Stream Miles	Temperature Range (°F)
Phillips Cr.	6.1	2.5	15.1	50-76
East Phillips Cr.	6.2	0	6.3	43-75
Pedro Cr.	2.8	0	3.7	46-57
Little Phillips Cr.	8.1	1.4	9.8	50-71
Total	23.2	3.9	34.9	

There is little ungulate grazing along Phillips Creek at this time. Shrub and grass populations along the streams appear to be on an upward trend. During the 1994 stream surveys Lynch reports:

> *"Phillips creek grazing unit of the North End Livestock Allotment encompasses the Phillips creek drainage. This area has been stocked with sheep since the late 1800's, the Forest Service first began issuing grazing permits in 1920. One permittee has used the North End Allotment since 1972 with 4 to 5 bands of sheep. Sheep are normally on the allotment from June through August, but may be grazing as early as May and as late as October, depending on the weather conditions and elevation of the grazing units."*

He does not report damage to riparian vegetation by sheep grazing in his 1995 reports. The only grazing on private land within a riparian area is by less than 50 pairs of cattle on the last mile of Bailey Creek. These cows sometimes escape and are found on Phillips Creek. They are sent back as soon as they are found on Phillips Creek

Discussion

Not all areas of a stream can support high levels of shade. There are rock outcrops or soils not capable of producing vegetation capable of shading the stream. Some steep hills and rock outcrops shade the stream without vegetation. Natural disturbances such as high water or ice temporarily reduce the amount of shade on a stream by tearing or washing out streamside vegetation, usually in limited areas. These disturbed areas are prime places for cottonwoods to get started, or for other shrubs to resprout. That is why some streams have small cottonwood galleries and others have longer continuous cottonwood galleries. Because of this phenomenon, a lot of the reaches listed as low and medium in amounts of shade already have vegetation growing that will eventually provide high shade to the streams. Planting of shrubs and trees can speed up the process of providing shade to a stream.

Large wood in a stream is desirable because it provides habitat for a variety of organisms as well as shade and /or structure for the stream. Large wood is recruited to a stream naturally by large trees growing near the stream. Trees may die and fall into the stream. Trees may get heart rot and be weakened and eventually be blown over, hit by lightning or just be weakened enough that they break off and fall into the riparian area. Seemingly healthy trees may be blown over in strong winds or develop root rot and fall into the riparian area. Streams that are devoid of large wood can have large logs, root wads, or whole trees placed into the stream from upslope areas.

The definition of large wood can vary with stream size. The size of wood that would provide all of the above functions to a small stream may not provide any function to a large river. Large wood can be a safety hazard. A tree large enough to provide functional large wood to a large river may be a liability. When it is deposited in a river and high water floats it downstream seeking place to become stabilized it could damage bridges or other structures. The high water during the 100 year storm has tremendous power and ability to move large objects.

There are several legal mechanisms already in place that should prevent any future actions from depriving the stream of either shade or large wood within the forested areas. The limitations on National Forest have already been discussed. An exception to felling trees within 300' of any stream is if there is an issue with public safety, such as along Highway 204. On public lands there are legal limitations on doing any work near streams. Much of the public land in this watershed cannot have harvest of trees, or only limited harvest under compelling circumstances, within 300' of a stream. About 30.3 miles or 86% of the streams are in the National Forest.

On forested areas of private land the Oregon Forest Practices Act requires varying amounts of tree retention and total shrub and grass retention in riparian areas whenever a timber harvest takes place. The amount of trees retained depends on stream size and classification. The Forest Practices Act also requires retention of understory vegetation and no disturbance within certain distances of streams. Some exceptions can be made for temporary disturbances by preparing a written plan that needs to be reviewed and approved by the Forest Practices Forester. Provisions are available for road crossings. The Act also provides protection to wetlands both along streams and upslope. Only 4.9 miles or 14% of the streams flow through private lands.

Both state and county road departments are aware of their responsibilities in road maintenance along streams. Both ODOT and the Union County Road Department have adopted ODOT's *Water Quality and Habitat Guide Best Management Practices - July 1999.* That provides for routine road maintenance practices. In addition, whenever either road department is planning new construction near or over water, they need to prepare either an Environment Assessment or an Environmental Impact Statement depending on the scope of the project. The *Guide* provides for maintaining vegetation where it does not interfere with public safety. Both organizations restore vegetation when maintenance or new projects disturb vegetation. Even routine ditch cleaning may require a permit from the Army Corps of Engineers or the Oregon Division of State Lands and consultation with ODFW if the practice involves live streams or wetlands. ODOT has maps of the Highway 204 corridor showing ownership class, wetlands, riparian zones, wildlife and plant concerns, fish, and many other parameters. These maps alert planners and maintenance personnel to special concerns along the highways.

Senate Bill 1010 is a state law that requires Agricultural interests to protect water quality from their operations. It is a new law that provides the agricultural community a way to come up with plans for protecting water quality. Guidelines are being prepared on a county by county basis by local committees with oversight by the Oregon Department of Agriculture.

Data Gaps

- Recent riparian surveys

References

1 Bohle, T. 1994. Stream Temperatures, Riparian Vegetation, and Channel Morphology in the Upper Grande Ronde River Watershed, Oregon. Oregon State University, Corvallis, Oregon.

2 Lynch, G. 1995. East Phillips Creek Stream Survey Report. Umatilla National Forest, Pendleton, OR.

3 Oregon Department of Transportation. 1999. Water Quality and Habitat Guide Best Management Practices - July 1999. Salem, Oregon.

4 Umatilla National Forest. 2001. Draft Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

5 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. June 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

WETLANDS ASSESSMENT

Background

Wetlands are areas with saturated or hydric soils dominated by water tolerant plants (The Oregon Wetlands Conservation Guide). Wetlands include bogs, marshes and spring areas. Wetlands are defined by the Army Corps of Engineers in the Oregon Watershed Assessment Manual as "those areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions".

Large wetlands can reduce downstream flooding or reduce peaks in the hydrograph by storing water for slower release. Water stored in wetlands can improve water quality by settling out sediment and by plant uptake of minerals and nutrients. Wetlands can recharge aquifers and surrounding soils. They also provide specialized habitats for some species of plants and animals. In eastern Oregon, the duration of streamflow has been extended by restoring wet meadows in headwaters (WPN).

In 1974 the U.S. Fish and Wildlife Service conducted the National Wetland Inventory (NWI). NWI maps are based on aerial photography. The objective was to obtain an initial wetlands inventory of large areas. Because the scale of this inventory was large, many large wetlands may have been missed, much less the smaller wetlands. Most smaller wetlands were not included. There are no other wetland surveys for the entire Phillips Creek watershed.

Methods

A search for wetlands on NWI maps was conducted. Stream surveys were also searched for records of wetlands. Aerial photographs were also consulted. Wetlands were observed but not recorded on informal surveys of the creek.

Results

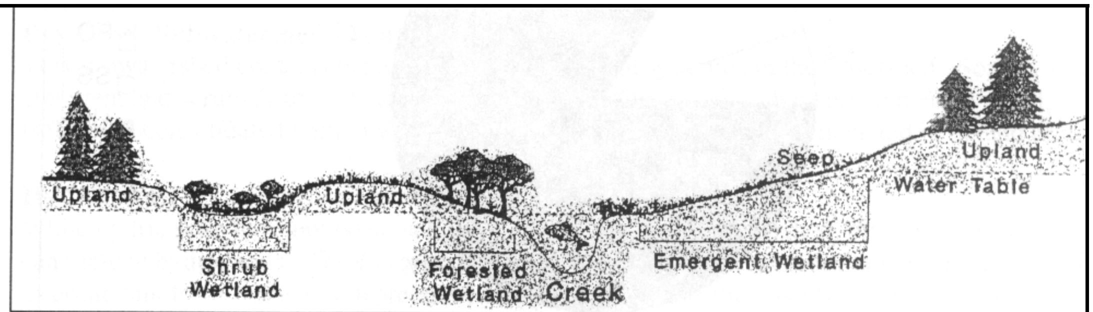
There are no records of wetlands in the Phillips Creek drainage in the NWI. That does not mean there are no wetlands in the Phillips Creek watershed. Small wetlands were observed during informal surveys. The wetlands in Phillips Creek are smaller than recorded in the NWI, but are important to the hydrologic function of the watershed.

There has not been a comprehensive formal wetlands survey on the National Forest . Both Forest Service and Oregon Department of Fish and Wildlife personnel noted seeps and springs during their surveys. The Forest Service has also noted developed springs (PGEA). There have not been any wetland surveys done on private property along Phillips Creek. The ODOT Operational Maps do not note any wetlands along Phillips or Little Phillips Creeks but they do record riparian zones within the highway right of way.

Discussion

Classes of wetlands found in the watershed are shown in the following illustration. Wetlands most likely to occur in this watershed are of only a few types. One type is Shrub Wetland. The shrub wetland will consist of willows or alders with dogwood included. It is located along streams and has a deep loamy soil over gravelly silt loam. Another type of wetland is the Seep. Seeps are springy areas either along streams or in the uplands that support sedges and mosses.

Figure 2. Wetland Classes



Source: Just the Facts #4

There are a few soils that have the potential to support or form wetlands in the Phillips Creek watershed. These include Lookingglass silt loam that have some poorly drained soils and/or seep areas on hillsides. Tolo silt loam also has the potential for marshy and wet spots forming in depressions.

Wetlands are now protected from many of man's activities. Activity in wetlands is regulated by the Department of State Lands under the state Removal-Fill Law and by the Corps of Engineers under the Clean Water Act. The Natural Resources Conservation Service regulates activities in wetlands under a provision in the Federal Food Securities Act. The Oregon Forest Practices Act regulates activities on forested wetlands. The National Forests operate under all of the laws listed above for wetland protection.

Data Gap

- Wetland inventory

References

1 Holochek, J. 1970. Physical and Biological Stream Survey - Phillips Creek. Oregon State Game Commission, La Grande, Oregon.
2 Umatilla National Forest. 2001. Draft Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.
3 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. June 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.
4 Wetlands Program. 1992. Just the Facts #4: How to Identify Wetlands. Oregon Division of State Lands, Salem, Oregon.

SEDIMENT SOURCES ASSESSMENT

Background

Erosion and sediment production are natural occurrences. Fish and other aquatic organisms have adapted to sediment entering their habitats. Erosion and sediment loads vary throughout the year, with most sediment moving during the short periods of high flows. In the Phillips Creek watershed most sediment enters the stream during periods of snowmelt in the spring.

Chronic natural sediment production occurs mostly from overland flow on shallow soils that are not well vegetated. These soils support the grasslands that had been overgrazed in the past and have not recovered. The soil type in the Phillips Creek watershed responsible for most of the natural sediment is the Gwinly complex. The Gwinly complex is a soil association that has a shallow clay layer. The clay results in a perched water table in the spring when runoff is usually occurring. During times of soil saturation with additional inputs of moisture slumps may occur on open hillsides and in the steeper headwall streams. Mud and debris flows that reach streams are not common in this area. A mud and debris flow did reach Phillips Creek 25 or 30 years ago about ¼ mile above Little Phillips Creek.

Natural sources of sediment are called background levels. They occur naturally and there are few restoration techniques that would change these levels of sedimentation. The intensity of natural sedimentation can range from very low with little visible sediment to extremely high with flows that turn the water brown and erode streambanks causing channel changes.

The *Phillips – Gordon Ecosystem Analysis* had this to say about natural erosion rates.

> *Natural erosion rates are highest on steep slopes with shallow soils. These are most often on south facing slopes and in areas where snow melt or rain runoff can be rapid. The highest rates of erosion are from rain on snow events, often called chinooks. During these times the ground may or may not be frozen, and there is a warm period along with heavy rains. The latest events like this occurred in the winter of 1995 – 96. The result was accelerated sheet and rill erosion on moderate non-forest slopes and slumps or shallow landslides in steep headwalls and steep open slopes. During this and past similar events there were debris flows in some of the small tributaries.*

Often the sediment entering a stream is eventually transported through the stream system. The rate of transport depends on sediment size, volume and speed of water, and steepness or gradient of the streambed. Transport of sediment through a stream is called bedload. Streams with relatively flat gradients tend to have large sediments deposited quickly and smaller sediments deposited more gradually. Conversely, steeper gradient streams with high flows and velocity may move large boulders amazing distances downstream and keep smaller sediments suspended and moving through the system.

There are two common ways that sediment can impact streams and the organisms that live in streams. Sediment can settle out in streams clogging the air pockets between rocks where anadromous fish lay their eggs. That can suffocate the eggs and/or fry that emerge from the eggs. This type of sediment can also reduce or eliminate habitat for other stream organisms. This situation is called embeddedness.

The second situation is suspended sediment. Suspended sediment is called turbidity. Turbidity passing through fish gills can literally wear out the gills, making it difficult for fish to breath and making them more susceptible to diseases.

Methods

Measurements of stream turbidity can be made. *"Very little water quality monitoring has taken place in the Phillips-Gordon analysis area. An automatic sampler was in place on East Fork Phillips Creek from 1986 to 1991, collecting late spring and summer daily composite sample. Water samples were analyzed for total suspended solids, turbidity, conductivity, and total dissolved solids. Sediment loads can only be estimated because streamflow was not measured"* (PGEA). In addition the Forest Service took measurements of water quality in Phillips Creek from May 17, 1994 to July 21, 1994 about ½ mile upstream from the mouth of East Phillips. These types of measurements have not been commonly made in these smaller streams. No measures of turbidity were conducted for this assessment.

Embeddedness can also be estimated. That is usually done during stream surveys. No embeddedness estimates were done for this assessment.

Results

The Forest Service measurements in May to July of 1994 were analyzed. Turbidity measured in Jackson candle units ranged from 0.60 on July 6 to 28.0 on June 5. There were only 3 days when turbidity was in double digits. On August 11, 1976 turbidity was measured at 2.5 Jackson candle units near the Highway 82 bridge (for more information on total measurements made on Phillips Creek log on to EPA's national data base *www.epa.gov/STORET*). The water quality measurements made from 1986 to 1991 in East Phillips are in STORET but have never been analyzed due to the large amount of data collected and lack of funding for analysis.

There is not a lot of erosion from forest harvest activities. The Forest Practices Act regulates timber harvest on private land to protect soils from eroding. The Forest Service has clauses in their contracts to prevent damage to soils and streams.

There have been several projects on private lands to reduce sedimentation from entering streams. These include a bridge replacing culverts, roads relocated, vegetation seeding, putting more and better drainage structures in roads, rocking roads, closing roads during times of year that could cause rutting or additional erosion and using structures to reduce bank cutting on Bailey Creek. The grazing of cattle has been eliminated to reduce damage done to streambanks along 2.5 miles of Phillips Creek and 2 miles of Bailey Creek. There were four road obliteration projects on the National Forest in the Phillips Creek drainage to reduce sedimentation to the stream.

There may have been additional projects in the basin not reported by individuals. A few private property owners armored the creek bank to protect their property from eroding.

Discussion

Most of the chronic levels of sedimentation in the Phillips Creek watershed come from several different activities of man. Sediment sources include: low-grade roads that are not properly designed or maintained; sanding gravel from Highway 207; and urban streets collecting dust and dirt that is washed into streams following storms.

Most of the erosion in the Phillips Creek watershed is surface erosion (both sheet and gully). In most years, erosion above the natural level is from poorly designed roads that are not maintained properly, from recently logged areas, heavily grazed areas, recreation sites and driving recreational vehicles on native surface roads or overland. Hunting season often brings accelerated erosion due to vehicular traffic (PGEA).

The Forest Service has specific clauses in their timber harvest and grazing contracts to prevent practices that harm soils and cause erosion. The Oregon Forest Practices Act regulates timber harvest on private lands and does not allow practices that harm soils or cause erosion. The agriculture community has developed the *Upper Grande Ronde River Subbasin Agricultural Water Quality Management Area Plan* that addresses reduction of soil erosion and stream sedimentation from agricultural practices.

During spring runoff Phillips Creek can transport a large amount of bedload. Throughout most of its length on private property the stream bottom consists of large cobbles and gravel. When the bedload arrives in the Elgin area it encounters the flatter gradient of the FP3 CHT. This is where the bedload settles out due to lower velocities. As the bedload settles out the channel starts filling in, and the stream tends to want to wander. That is why it is difficult to keep from flooding between the railroad and Highway 82 bridges during high water years.

"While timber harvest by itself generally has relatively minor effects on erosion rates (Helvey and Fowler 1979), associated roads often rapidly accelerate natural rates of erosion" (PGEA). It is difficult to measure exact amounts of sediment delivery from roads except by secondary methods. For instance, a washed rut in the road can be measured and the amount (tons) of sediment estimated. The sediment running off unimproved roads can be seen in filter strips but the amount entering the stream is not known. Sanding gravel from Highway 204 is getting into Little Phillips, but it is difficult to estimate how much. Most of this gravel is transported through the Phillips Creek system during spring runoff.

Most sediment is introduced to the stream both from upland sources and from roads during higher runoff periods. While this dilutes the sediment and helps to move it through the system, the sediment is going to settle out somewhere. Where it does settle it can fill in the spaces between the gravel and make the stream unsuitable for spawning.

Fish will seek refuge in side channels or around in-stream structures when sediment loads are high. Sediment loads can kill fish outright, but more often it reduces overall fish health by wear on the gills and delays in feeding or spawning. Redds may be suffocated if fish spawn before the sediment loads come downstream. Very high water levels can move enough bedload to destroy redds. Young fish may not be able to hide from predators if the gravel is filled with sediment.

Careful planning of projects including roads, timber harvest and farming minimizes the amount of new sediment to a stream. That needs to be followed with careful execution of the project and proper maintenance to keep additional sediment loads from entering the stream. .

The Oregon Department of Transportation adopted *Routine Road Maintenance - Water Quality and Habitat Guide and Best Management Practices – July 1999* as their guide to road maintenance to reduce sediment entering streams from highways. Road construction, alignment changes, bridges and other projects out of the ordinary require Environmental Assessments and permits from various state and federal regulatory agencies. The Oregon Department of Transportation has mapped all of the areas where the highway interfaces with the stream. The Union County Public Works Department has adopted the same guides for their routine maintenance work. They are in the process of training their personnel under these guidelines.

In general, native surface non-maintained roads produce more sediment than do paved roads. However, a well designed native surface road that is located away from streams will not produce as much sediment to the stream as a highway next to the stream, especially if sanding gravel is used. Public road departments are well aware of their responsibilities in maintaining and improving water quality. They are doing this through their maintenance programs and planned upgrading of roads.

The Oregon Forest Practices Act regulates timber harvesting associated practices that could cause sediment to enter streams. National Forest management practices are also working to reduce sediment from timber harvest and recreational activities. Some activities have been closing and/or obliterating roads. Drainage of other roads has been improved, and seeding to stabilize soils is done. Buffers around harvest units are much larger than they had been in the past to reduce sediment and other watershed values.

Data Gaps

- Recent sediment and turbidity measurements in critical fish habitat
- Inventory of sediment sources
- Stream surveys including embeddedness
- Analysis of water samples already taken

References

1 Oregon Department of Forestry. 2000. Oregon Forest Practice Rules and Statutes. Salem, OR.
2 Oregon Department of Agriculture. 2001. Upper Grande Ronde River Agricultural Water Quality Management Area Plan. Island City, Oregon.
3 Oregon Department of Transportation. 1999. Routine Road Maintenance - Water Quality and Habitat Guide and Best Management Practices - July 1999. Salem, Oregon.
4 Umatilla National Forest. 2001. Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

CHANNEL MODIFICATION ASSESSMENT

Background

The OWEB Manual states that "*In-channel modifications and activities such as damming and dredging or filling hinder fish migrations, alter the physical character of streams, and change the composition of stream biota. The degree of impact to habitat will depend on the type of channel and the type and magnitude of channel modification. Channels are dynamic systems that modify themselves in response to changes in physical watershed features regardless of human involvement.*" Channel modifications are usually done in response to a specific human need. In northeast Oregon irrigation diversions or dams are not uncommon. When a stream attempts to move laterally in response to high water or inputs of large objects within a town or near a structure, the human response usually is to "stabilize the stream" or "move the water through faster". That may involve dredging or straightening a channel, placing barbs to deflect the waters force, or rip-rapping stream banks.

Methods

Data for channel modifications was obtained through interviews. Agency personnel from Oregon Department of Fish and Wildlife, Oregon Department of Forestry, Oregon Department of Transportation, Union County Watermaster, Union County Department of Public Works, Union Soil and Water Conservation District and the USDA Natural Resource Conservation Service were interviewed to obtain information of channel modifications to Phillips Creek. The *Phillips – Gordon Ecosystem Analysis* was consulted to see if there were channel modifications on public lands. Private industry representatives and citizens were questioned during public meetings.

Results

In general, channel modifications have been done by both public and private entities. Channel modifications were completed to protect private property and public infrastructure.

There have been several channel modifications to the Phillips Creek Watershed over the years. Some took place right in the town of Elgin. During a public meeting for this assessment citizens of Elgin provided the following information.

> *The last really large flood was in 1964. That flood washed out the bridge on Highway 82. Prior to the highways being built, the creek came out of the canyon and "went anywhere it pleased" through the Elgin townsite. Prior to 1964, the creek was constrained to the south side of Highway 204 by the highway. Probably right after the flood, the Boise Cascade log yard was raised with rock fill and the creek was channeled around the log yard to the south. That put the creek in its present day position.*

As late as 1972 Boise Cascade obtained a Fill and Removal Permit for a channel change of Phillips Creek to better utilize their log yard and protect water quality in the creek.

In the early to mid 1900s there were two low dams on Phillips Creek. One was located near the railroad bridge. Its main purpose was to protect a wooden water line providing water to the town. A low irrigation diversion dam was located upstream from the log yard. It appeared that steelhead were able to negotiate this dam and continue upstream.

When the present day highway 204 was constructed up Little Phillips Creek, the highway severely constrained and channelized the creek.. In two places the highway crossed the creek, but in others it simply cut off a portion of the creek bed and provided another creek bed next to the road. Tunnels at river mile 2.5 and 4.8 over 100' in length have been cut through rock for the stream to flow through so the Highway could be straighter. Large wood in this stream would be likely to cause maintenance problems with the highway.

Downstream from the mouth of the canyon upstream to Little Phillips Creek the stream is constrained to some degree by the highway. Landowners between the highway and the stream have tried quite successfully to keep the stream "in its banks". They have removed large wood that caused the stream to start moving laterally and armored banks where it started cutting. There has been about a 200 yard realignment of the stream to accommodate the Summerville bridge.

In the early 1960's, the Forest Service constructed a high-grade road up Phillips Creek. In most places the road was placed far enough to the side and on the hill slope that the road did not affect the stream. The road does constrain the creek somewhat within a couple of miles of the highway but not after that except where it crosses the creek in the headwaters.

The City of Elgin with cooperation of the Union Soil and Water Conservation District did some minor channel reconstruction within the Elgin City limits. The creek had flooded and was threatening private property. Several barbs were placed to deflect water to keep banks from eroding and the channel was placed back to where it was previous to the flood.

There have been modifications to the Phillips Creek channel that changed fish habitat. From the mouth of the canyon through the town of Elgin the stream has been channelized and/or constrained. The stream gradient is gentler from the High School downstream than from the mouth of the canyon past the log yard. The gradient is least from the railroad crossing downstream. Consequently there have yearly been large bedload depositions in this area. This in turn has caused the stream to widen and become shallower.

Discussion

There have been many modifications to the channels of Phillips Creek and Little Phillips Creek. The modifications have been done mainly to protect private property and public infrastructure. The largest modification was to the channel of Little Phillips Creek when Highway 204 was constructed up the bottom of the valley. This is a narrow valley so the stream was moved or meanders cut off as needed to build a high speed road highway.

Other major modifications took place in the town of Elgin. Phillips Creek was moved and constrained to its present position following the 1964 flood. This had the effect of protecting both the highway and the town. The channel was moved further to the south to keep the stream out of the log yard. This both protected the log yard from washing and greatly reduced the amount of pollution reaching the creek.

The modifications made to the channels of the creeks is not likely to be changed in the near future. There are not many alternate routes for the highway and the town will probably remain protected for many years. Relocating highways and towns is not an inexpensive process. Some minor channel modifications may be made in the future that would reverse the constraining process. An example is the Forest Service removing a bridge crossing that constrained the channel for a short ways. Other culvert removals may take place in the future, and they would be replaced with structures that would not constrain the creek.

Data gaps

- Channel modification inventory and mapping

References

1 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

WATER QUALITY ASSESSMENT

Background

Phillips Creek is not on the Oregon Department of Environmental Quality's 303d list. The 303d list is for water quality limited streams. Phillips Creek may exceed the state standard for temperature and sediment, but monitoring data is not available that could cause the stream to be listed. The Grande Ronde Water Quality Plan lists Phillips Creek as a high priority for restoration.

There are several water quality parameters that could be measured to determine whether it should be on the 303d list. These include temperature, pH, conductivity, total suspended solids, total dissolved solids and turbidity. The section on sediment discussed turbidity and it will not be discussed here.

Methods

The Umatilla National Forest Monitored daily stream temperatures on East Phillips Creek in 1986 and 1988. Oregon Department of Forestry monitored stream temperatures on several portions of Phillips Creek and its tributaries in 1993. The Umatilla National Forest did some other limited water quality monitoring. The following is from the Phillips-Gordon Ecosystem Analysis.

> *An automated sampler collecting daily water samples for analysis of sediment parameters (total suspended solids (TSS), turbidity, total dissolved solids, and conductivity) was operated on East Phillips Creek from 1986 to 1991. These data are stored in STORET, the EPA national water quality database.*

As noted in the sediment section, the Forest Service took water quality measurements from May 17 to July 24, 1976 from Phillips Creek about ½ mile upstream from the mouth of East Phillips. There were also a few measurements of water quality made by Oregon Department of Environmental Quality. These were in response to cleaning up point sources of pollution in the 1960s and 1970s.

Results

All of the streams monitored by the Forest Service in 1986 and 1988 showed a 7-day maximum lower than the state standard for steelhead of 64°F. The streams that were measured were located high in the watershed and were relatively cool.

The Oregon Department of Forestry water quality samples in 1993 also showed 7-day maximum temperatures that were lower than the state standard. These measurements were also taken higher in the watershed. The following tables shows the temperatures that were measured by these two agencies. Keeping the temperature as cool as possible as it flows downstream would be desirable as that could increase the amount of habitat available for rearing steelhead.

Table 7. Number of miles of Phillips Creek and tributaries surveyed by the National Forest in 1994 and maximum/minimum temperatures measured during the survey in late July – early August 1994.

Stream	FS Miles	Private Miles	Total Stream Miles	Temperature Range (°F)
Phillips Cr.	6.1	2.5	15.1	50-76
East Phillips Cr.	6.2	0	6.3	43-75
Pedro Cr.	2.8	0	3.7	46-57
Little Phillips Cr.	8.1	1.4	9.8	50-71
Total	23.2	3.9	34.9	

Table 8. Annual 7-day Moving Average of the Daily Maximum Stream Temperatures.

Stream	Agency	7-Day Maximum (°F)		
		1986	1988	1993
East Phillips at Mouth	USFS	56	63	-
Est Phillips Above Pedro	ODF	-	-	57
Upper East Phillips	ODF	-	-	54
Pedro at Mouth	ODF	-	-	56
Upper Phillips	ODF	-	-	55
Phillips	ODF	-	-	55

There are a few anecdotal measurements of water temperature being taken on Phillips Creek in the last couple of years. A one-time measurement taken near the Summerville cutoff bridge in August showed a water temperature in the mid-50 degree range. In 2001 a couple of one-time measurements of water temperature further upstream on private land produced the following results. On July 31, just after noon on a cool cloudy day temperature was measured on an open stretch of the stream. The water temperature was 56°F with ambient temperatures about 63°F. A week later the water temperature was taken in the same place at about the same time of day. That day was sunny and clear. The water temperature was 75°F and the ambient air temperature was 88°F.

The 1986 sediment load was almost 3 times higher than any of the other years that had measurements. The Forest Service has not done a complete analysis of the data gathered from the 1986 to 1991 measurements. However, the Forest Service reports:

> "*The sampler was mostly running during the end of snowmelt through summer/ fall low flows. . . . Estimated yearly loads range from 5.6 tons/square mile/year in 1986 to 16.6 tons/square mile/year in 1989.*"

Discussion

From the 1940's into the 1970's the watershed was altered by loss of riparian vegetation including conifers and loss of riparian habitat by removal of large wood from the streams. In addition many miles of logging roads were constructed and much timber was harvested. These practices have since changed, but they are still having a prolonged impact on watershed characteristics such as timing of runoff. There is no data that indicates specific impacts to water quality from timber harvest in the Phillips Creek drainage..

Water quality research in the United States started providing data that was useful in the field in the 1950's.. Information was gained about the effect of pollutants on fish and water quality but with emphasis on drinking water. At that time point source pollution started getting attention. Regulating agencies were formed and point source pollutants started to get cleaned up. In 1964 the runoff from the Boise mill pond was identified as a source of pollution. Boise took steps to prevent the pollution by piping water from artesian wells in the log yard around the mill pond. Shortly after that they quit using mill ponds and filled and raised the log yard. The records show that over the years as soon as water quality problems came to light, Boise remedied them.

Boise has been aggressively working on water quality from its log yard. They have invested heavily in sprinkler systems to minimize the amount of water needed to keep log quality high in the summer months. Their process and storm water is piped across the creek to a large lagoon. Water from the lagoon is used to irrigate farmland south of the drainage. Discharges from a single tile drain dewaters groundwater from the log yard year around. Stormwater discharged from the facility from November 1 through May 15 each year provides water for a constructed wetland installed in 2001. The wetland is located south of Phillips Creek and the high school. The water is piped across Phillips Creek to the wetland. Boise's goal has been to have 0 discharge to the creek (personal communication with Bart Barlow, Boise Environmental Engineer). In 1998 the log yard was moved 50' away from the creek and a berm installed between the log yard and the creek. The berm has been planted to shrubs and trees to improve habitat and to buffer the creek from the log yard.

Last year was an extremely low water year in Northeast Oregon. In August, subsurface seepage of brackish groundwater water from the log yard was discovered entering the Phillips Creek channel. Boise notified the Oregon Department of Environmental Quality in writing about the seepage, and proposed new BMP's (Best Management Practices) to be initiated immediately to address the problem. ODEQ agreed to the implementation of the BMP's as a solution to the problem.

The City of Elgin has a sewer system to address water quality in the city. The sewage lagoons are downstream from town adjacent to the Grande Ronde River.

Data Gaps

- Analysis of water quality data
- Recent water quality measurements
- Stream surveys that identify cold water refugia
- Stream surveys that inventory shade
- Water temperature measurements throughout the system

References

1 Oregon Department of Environmental Quality. 2000. Upper Grande Ronde River Subbasin Water Quality Management Plan. Grande Ronde Water Quality Committee, La Grande, Oregon.

2 Umatilla National Forest. 2001. Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

WATER RIGHTS ASSESSMENT

Background

Water rights for irrigation are important to the people in the area. Phillips Creek is an intermittent stream. Water is available for early season irrigation but by the middle of July there is very little water available. Under Oregon law, a water right must be obtained if you are going to remove water or use water from a stream. If a water right is not available or even if it is not available at the desired point of diversion water may not be used for any purpose. That includes establishing riparian vegetation for restoration purposes.

Water rights can provide a maximum of 3-acre feet per year under Oregon law. An acre-foot of water is enough water to cover an acre of land to a depth of 1 foot. Water rights applicants automatically file for the maximum. Water rights and water use is regulated by the county watermaster. His office has complete records of water rights including date of certificate, point of diversion, area to be watered and amount and timing of water allowed.

In most of the semi-arid west water becomes scarce in late July, August and September. The senior (oldest) water right has first right to any water in the stream, even if it is furthest downstream. The Oregon Department of Fish and Wildlife was granted an instream water right from East Phillips Creek to the mouth in 1991. In most years they will not get to exercise their water right after mid-July because theirs is the most junior right and the creek is almost dry by that time.

Methods

Water right information was obtained from the office of the County Watermaster. Another source of information is the Oregon Water Resources website – www.wrd.state.or.us/water rights.

Results

Because of the lack of water, and the minor amount of farm ground available in Phillips Creek, there are not many water rights on the creek. There are about 41 water rights granted in this watershed. The oldest is from 1877, the newest is 1991. Most of the water rights are small, less than 5 acres. They are probably for gardens, lawns and horse or cow pasture. The largest is about 40 acres. Little of the 40 acres is in the Phillips Creek drainage. Water taken from a stream is not necessarily used in the streams drainage area. Phillips Creek is referred to as Dry Creek on some of the older water rights.

Discussion

At this time it is not easy to sort out exactly where water diversion points are located. The database is not that accurate. For instance, not all of the water rights listed in the Phillips Creek area are from Phillips Creek. Some that are listed in the Phillips Creek watershed are from Spring Creek, a very small drainage to the north of Phillips Creek. Some water rights are for stock watering ponds or springs in the uplands. There are about 16 water rights filed on the National Forest for watering stock. Additional stock watering water rights are on private lands. There are also some ponds for water for fire control.

The important thing to note is that the water from Phillips Creek is over-appropriated.
At the point of diversion there is seldom any water available from mid-July through September due to the creek drying up naturally.

The in-stream water right filed by ODFW is meaningful only because most of the area filed for is above the points of diversion for older rights and instream use is not consumptive. According to the measurements discussed in the Water Quality section there is cool water available in the headwater streams for fish rearing.

Data Gaps

- Stream gauges to measure timing and amount of water available
- Computerized database linked to GIS
- Mapped points of diversion and areas of water use
- Measurements of actual use by water right

References

1 County Watermaster records
2 Oregon Water Resources Department database

FISH AND FISH HABITAT ASSESSMENT

Background

Fish surveys by ODFW and the Umatilla National Forest show that the Phillips Creek system supports several species of fish. The most notable is the steelhead trout. Other species in the system include redband trout, suckers, pike-minnow, shiners, sculpins and dace. Although not recorded, there is a good chance that Chinook smolts use the lower reaches during some times of year (personal communication – Tim Walters, ODFW).

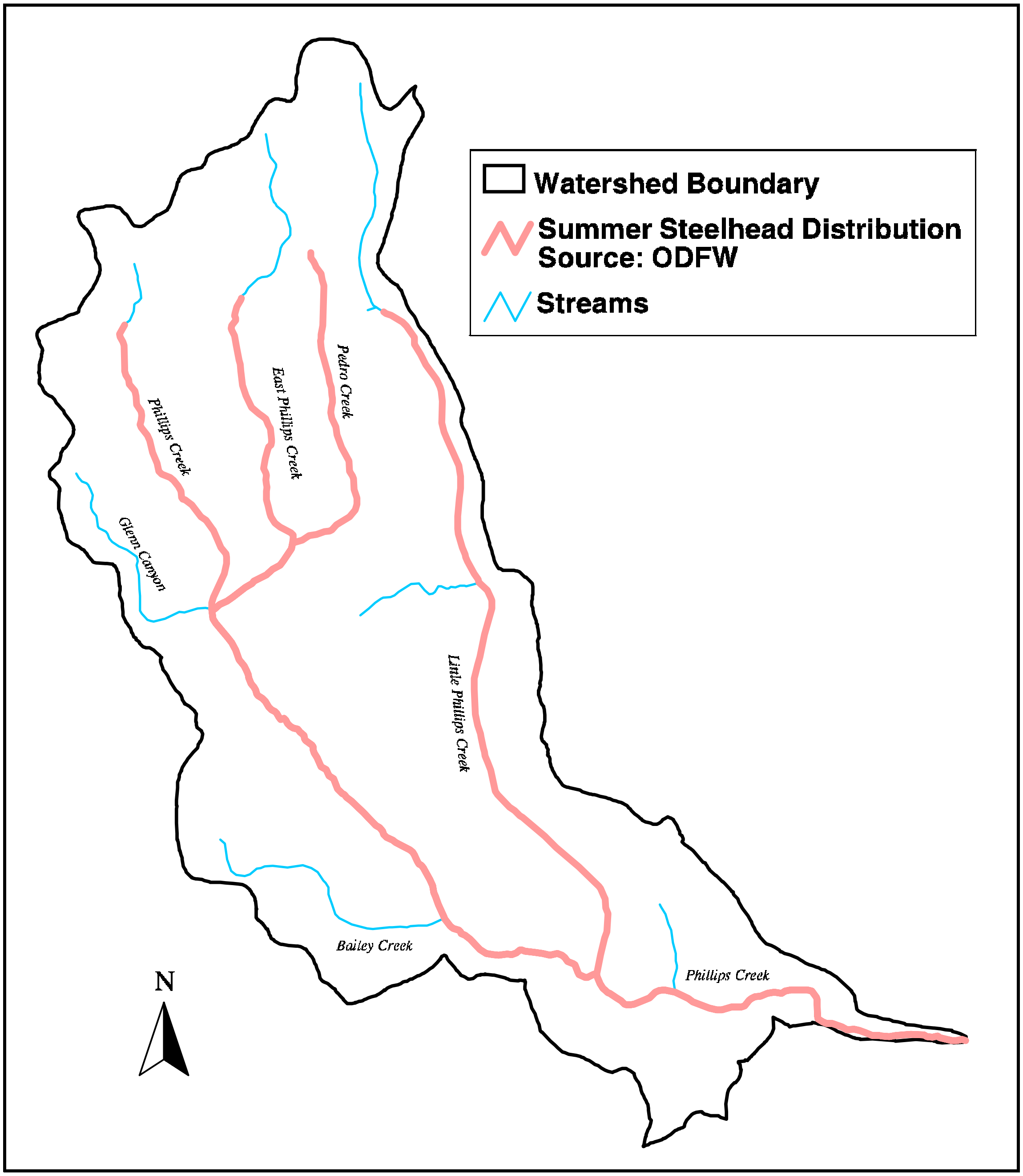
Phillips Creek is a Snake River Steelhead spawning and rearing stream. Salmonids such as the steelhead are among the most widespread group of fish in the state of Oregon and are well recognized as indicators of watershed health (WPN). Protecting and restoring steelhead habitat should improve watershed health in the long run. The Snake River Steelhead was listed as threatened by the National Marine Fisheries Service in 1998. The major in-basin causes of salmonid population declines are in-channel and riparian habitat degradation, as well as high summer and low winter water temperature (James 1984; ODFW 1987 and NPPC 1990, ref. in McIntosh).

Steelhead juveniles migrate to the sea in the spring and undergo a physiological transformation known as smolting to adapt to salt water. Phillips Creek steelhead are “A-run” steelhead that typically spend only one year in the ocean before returning to spawn (ODFW). This run of steelhead is also known as summer run because they return to freshwater from early fall to spring (October to May). They primarily spawn from March to May.

The steelhead dig redds (nests for laying eggs) in the gravel. The eggs hatch out 35 to 50 days later depending on temperature. In Phillips Creek they are laying eggs before and during high water. The alevins (young fish surviving off their yolk sac) hold for 2 to 3 weeks in the gravel or until their yolk sacs are absorbed. The young fry begin to feed during the period when the water level in the stream is going down and in time to find refuge during low water periods. The juveniles rear in fresh water from 1 to 4 years. They smolt when they are 6 to 8 inches long as they head for the ocean. They migrate singly meaning that not all fish born in one place migrate at the same time. They remain in the ocean as little as a few months or as long as two years and then return to fresh water to spawn.

Loss of habitat complexity is a cause of population declines. Habitat complexity includes the mix of pools, riffles, gravel, stream width to depth ratio, large wood and riparian vegetation. All of these interact with one another. Care needs to be taken so that restoration efforts do not do more harm than good. For example, in the 1950’s it became known that dissolved oxygen in the water was important to fish survival. It also became known that the decay of logging slash in water requires large amounts of oxygen. In a classic case of over-reaction, not only was logging slash removed from streams, but large wood that had been in the water for decades was also removed. The result was unintended changes in habitat complexity.

Phillips Creek Watershed—Summer Steelhead Distribution



From PGEA

Other management actions that reduced stream complexity includes roads constraining channels, channelization of the stream, overharvest of riparian trees, and sediment and/or bedload filling of pools where large wood was removed. Following these activities there were a variety of reactions by the streams. There were large changes in pool to riffle ratios. Increased water velocity resulted in bank erosion and in many cases down cutting of the streambed. The deposition pattern of bedload was changed and some streams widened and became shallower. The wider distances between riparian vegetation could have the effect of allowing more solar radiation directly on the shallower water and that would cause more rapid warming.

Methods

There have been stream surveys, fish presence surveys and redd (fish nest) surveys on Phillips Creek and its tributaries. The first survey to be mentioned is the 1959 *Environmental Survey Report Pertaining to Salmon and Steelhead in Certain Rivers of Eastern Oregon and the Willamette River and its Tributaries* completed by the Fish Commission of Oregon Research Division. ODFW completed the "*Physical and Biological Stream Survey of Phillips Creek"* in 1970. Redd surveys have been conducted by ODFW with records from 1966 to 2000. There is limited creel census data available for Phillips Creek. The Umatilla National Forest completed a more recent stream survey on the National Forest and 2.5 miles of private land for the *Phillips-Gordon Ecosystem Analysis.*

Data was retrieved and condensed from the various surveys completed by ODFW and the Umatilla National Forest. Fisheries biologists involved in the surveys were also interviewed. Information was also obtained from the Grande Ronde Model Watershed.

Results

The 1959 report indicated that Phillips Creek was an intermittent stream. A 1957 report indicated there was enough water above the dry area to sustain fish life. The 1959 report noted that from the mouth of Little Phillips upstream Phillips Creek was rather well shaded by trees along the banks except in the lower mile where a logging road is along the creek. Three log and debris jams were noted as possible obstructions to upstream migrating steelhead. Also noted was the dam about 1 mile above Elgin that was a possible obstruction to steelhead in moderate to low flows.

During the stream survey in 1970, Holochek reported on logging practices that were having influences on the stream. Following area some quotes from his report that apply to river mile 6.0 to 7.5:

- *"Much debris in the form of wood is present along the streamside, and stream is muddy from logging operation."*
- *"Channel has been altered in parts of this stream."*
- *"The whole stream of Big Phillips has been logged recently, and right now it is currently in bad shape."*
- *"Currently the stream is extremely muddy due to heavy logging along stream. Stream banks are being badly torn up by bulldozers and trucks."*

The large wood was subsequently removed from the stream. The stream in the reach just mentioned is in the process of healing. There is good shade and the banks have healed. There was another logging operation in 1999 in this reach during which shade was protected, trees were left for large wood recruitment, and large wood in the form of rootwads and large logs were placed in the stream for habitat improvement.

The 1970 ODFW report made observations by ¼ mile stream segments. In general it noted fair to good shrub cover along the stream except along roads. Observations were made during July and August. Cool spring areas were noted as well as presence/absence of fish. Timber harvest was taking place, and several areas of logging debris were noted, as well as one active operation in which tractors were dragging logs across the stream. Fish were observed as high as the mouth of Pedro Creek in the main system. Fish were noted as high as the highest highway culvert on Little Phillips, although there were long reaches in which no fish were observed.

The most recent stream survey was by the Umatilla National Forest in 1994 during low flow periods. They surveyed all reaches from Little Phillips upstream. Following are some excerpts from that survey:

> *Phillips Creek . . . has an estimated 14.1 miles of Snake River steelhead spawning and rearing habitat. Little Phillips Creek . . . has an estimated 7.8 miles of Snake River steelhead trout spawning and rearing habitat and . . . East Phillips and Pedro Creeks has an estimated 5.6 miles of Snake River steelhead trout spawning and rearing habitat. Stream inventory began at the confluence with Little Phillips Creek and continued upstream to the Forest boundary for 2.5 miles and is in private ownership. Dry channel during low flow conditions is one of the most limiting factors for fish production. From its headwaters to the junction with East Phillips, the 4.1-mile reach of Phillips Creek is 61% dry channel during summer low flow. The 3.9 mile reach between East Phillips Creek and the Forest boundary is 31% dry channel. Dry channel is rare below the Forest boundary. Marginal steelhead trout habitat is found in Phillips Creek in current condition. Fish habitat improvement opportunity would be long-term floodplain and upland vegetation recovery to improve summer low flow fish habitat.*
>
> *East Phillips Creek is very important fish habitat under current conditions. Rainbow/steelhead trout are found throughout the entire 6.2-mile length of this small spring fed tributary. The East Phillips floodplain does not have a road and we find an abundance of pool habitat and large woody debris creating high quality fish habitat. East Phillips Creek also provides over half the flow of Phillips Creek at their confluence.*
>
> *Pedro Creek is a tributary of East Phillips Creek providing an estimated 10% of East Phillips Creek flow at their confluence. Rainbow/steelhead were found throughout the 2.7-mile survey. Average steam channel gradient was 8.8%. That is steep for fish habitat. The steep channel gradient and abundant large wood have worked together to create many small pools providing valuable fish habitat. Pedro Creek, though small in size is an important fisheries resource.*

Little Phillips Creek runs parallel to Oregon Highway 204. The highway occupies most of the floodplain forcing the creek to the toe of either slope at the edges of the narrow "V" shaped valley floor. . . . Little Phillips has a low abundance of pool habitat and large woody debris. The creek is occupied by rainbow/steelhead trout throughout its entire length at low density due to poor habitat quality. There is little opportunity for aquatic habitat restoration on Little Phillips Creek since the floodplain has been dedicated to Oregon Highway 204.

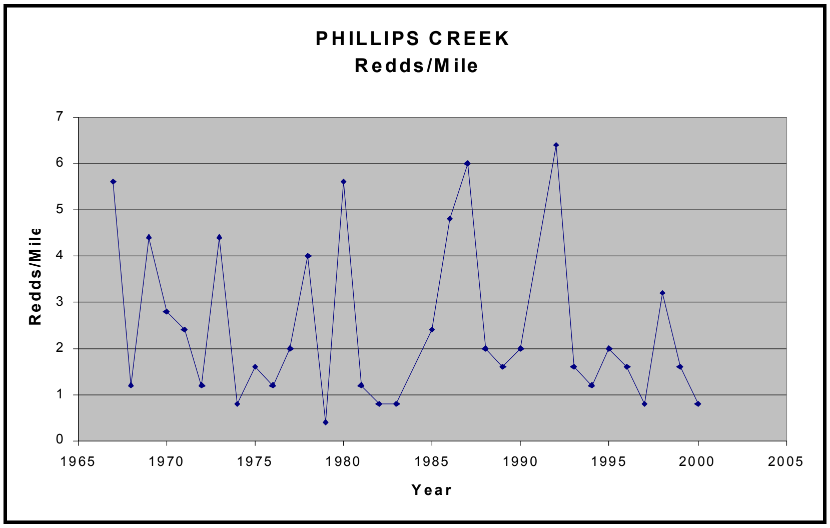
A thorough habitat survey has not been done on the lower section of the creek below the National Forest Boundary.

PACFISH recommends pool frequency in the amount of 84 to 96 pools per mile. That is about a pool every 60 feet. The survey found that only East Phillips and Pedro Creeks attained that level. The 1994 Forest Service report stated: '*These two streams have the most intact and least developed floodplains with occupied fish habitat on the National Forest."* The rest of the reaches generally had fewer than 25 pools per mile. The Forest Service placed several pool-forming structures in Phillips Creek to provide summer survival habitat for juvenile steelhead trout and resident redband trout. Pool forming structures were also placed in Phillips Creek below the Forest Boundary down to Highway 204. Culverts that blocked fish passage on Bailey Creek were replaced with a bridge. The Forest Service reported that most of Phillips Creek has had a reduction in pool to riffle ratios since the 1950s.

The older surveys of the stream reported that the three mile area above Little Phillips the bottom materials consisted mostly of medium to small sized rubble and some boulders and bedrock. It did not mention embeddedness as being a problem. The 1994 Forest Service Survey had this to say about channel roughness.

Embeddedness and dominate substrate are measures of stream channel roughness that can be useful in characterizing the current condition of juvenile fish hiding cover and stream channel conditions for aquatic insect production. Average cobble embeddedness is a measure of proportion of rock buried in the stream bottom. A high amount of fine sediment in transport will typically bury cobble. The cobble embeddedness measured in the analysis area ranged from 18% embedded to 39% embedded. This is typical of streams that are not dominated by fine sediment transport. Small fish and insects can easily find hiding places between the cobble of the streambed. Cobble and gravel was reported as the dominant and subdominant substrate type for all but one surveyed stream reach. Reach one of Little Phillips Creek had sand reported as the subdominant substrate type probably due to sand used on Highway 204 for tire traction during the winter. The current condition for streams in the analysis areas is a low amount of sediment in transport with the exception of highway sand entering Little Phillips Creek.

Records of steelhead redds are available from ODFW for the period from 1967 to 2000. Most of the surveys are on the 2.5 miles of Phillips Creek above Little Phillips Creek. The surveys obviously do not count all of the redds in the system, but they are useful to compare year to year spawning differences. There have been large differences in the numbers of redds between years without good explanations for the swings in numbers



Culverts, dams and logjams all have the potential to be barriers to fish passage. Some good fish habitat can be under-utilized if the fish cannot get to it. In recent years partial surveys of fish barriers have been made. In 1998 the ODFW did the *Inventory and Assessment of Road Culverts on State-Owned Roads: Grande Ronde and Imnaha River Basins* for the Oregon Department of Transportation. They found two culverts that were fish passage barriers in the Phillips Creek drainage. They are the upper culverts on Highway 204. The lower culvert was rated as a moderate priority as it blocked passage to potential fish habitat. The upper culvert was given a low priority due to lack of substantial fish habitat above the culvert. No known surveys were done on private lands.

The Forest Service surveyed 24 culvert sites on the National Forest suspected to be fish passage barriers. The highest priority for fish passage improvement was on Pedro Creek Road 3734-060 and one in the headwaters of Phillips Creek on the 3738. The culvert on Pedro Creek Road 3734-070 was rated as moderate priority because of the low amount of fish habitat above it. The culvert at Phillips Creek and road 3738-060 has a moderate priority for fish passage improvement. It already has log step pools installed, but passage would be improved with a structure that does not restrict bankfull flows.

Discussion

Fish populations and fish habitat have gotten some attention in Phillips Creek. The annual redd survey by ODFW has been one of the most consistent measurements made on this stream. The wide swing in numbers of redds year by year is hard to explain. A few points to keep in mind are that steelhead spawn during the high water periods, making it difficult to see the redds in some years. In some years spawning takes place before high water, and some redds may get covered or washed out.

Steelhead spawn and rear in Phillips Creek. Even though some reaches of the creek dry out, fish are often able to find a refuge for the drier months. The headwaters of the streams are sources of water that are cool enough for steelhead. There are cool water refugia located between dry reaches of the stream. Cool water may come from springs, seeps, and from water "subbing" or going underground for substantial distances. The geology study indicates that cool water may be introduced through the numerous faults in the area.

In the warmer water reaches there are species of fish that are tolerant of the warmer temperatures. These include suckers, pike-minnow, shiners, sculpins and dace.

Sediment and embeddedness does not seem to be causing a problem with fish habitat at this time. There still is a lack of pools, and the pool to riffle ratio could use improvement except in East Phillips and Pedro Creeks. The stream has widened in many places, making it more susceptible to warming. More shade would be helpful in some reaches to improve temperatures. Addition of more structure would be beneficial to fish habitat. The most beneficial addition would simply be more water later in the season.

Restoration efforts should be made carefully. All cause and effects are not yet known, but we do have a lot more knowledge about how to restore and manage riparian areas and streams than we had 40 and 50 years ago. Fortunately we still have steelhead runs and native fish that will respond to habitat restoration. Stream and riparian habitats are in constant change. That is why it is important to have both trend and recent information about habitat conditions.

In the upper watershed the Forest Service has been obliterating roads and pulling culverts to reduce sedimentation to improve fish habitat. On private ground various improvements have been made. On Bailey Creek there have been two road relocations to reduce sediment, one tree placed to keep the road from washing out, and two fish barrier culverts have been replaced with a bridge providing access to ¾ of a mile of spawning habitat. Main Phillips Creek has had large wood placements in about one and three eighths miles between the junction with Little Phillips Creek and the Forest Service boundary.

The Umatilla National Forest completed two fisheries habitat projects including placing large woody debris and riparian plantings. One project included removing a bridge and closing the road served by the bridge.

Data gaps

- Inventory of riparian conditions
- Detailed stream surveys, especially in the lower reaches.
- Fish surveys that are recent
- Monitoring of water quality, especially temperatures
- Mapping of cool water refugia

References

1 Holochek, J. 1970. Physical and Biological Stream Survey - Phillips Creek. Oregon State Game Commission, La Grande, Oregon.

2 McIntosh, B.A. 1992. Historical Changes in Anadromous Fish Habitat in the Upper Grande Ronde River, Oregon, 1941-1990. Master's Thesis, Oregon State University, Corvallis, OR.

3 PACFISH. 1995. Interim strategies for managing anadromous fish-producing watershed on Federal lands in eastern Oregon and Washington, Idaho, and portions of California. Umatilla National Forest Land and Resource Management Plan, Amendment No. 10.

4 Umatilla National Forest. 2001. Draft Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

5 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. June 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

UPLAND CONDITION ASSESSMENT

Forest

Background

The condition of the upland vegetation in a watershed is an indicator of watershed health. The Phillips Creek watershed has two major classes of upland vegetation types – forest and shrub/ grassland. Other major cover types include farmland and developed land. A watershed functions "normally" when there is adequate vegetation on the land to prevent overland flow and the accompanying erosion. The vegetation should also keep the soil loose so that most of the water falling on the land travels through the soil profile to reach the stream rather than flowing overland. This will be a brief report on the general condition of the upland areas of the watershed.

Crown closure information is important because once crown closures have reached 35%, additional shading has little effect on the timing of runoff. Crown closure less than 35% can cause runoff to be earlier and more rapid. Denser crown closures intercept more snow and rain and return more moisture directly to the atmosphere without letting it into the ground. That will reduce the total amount of runoff. If a "natural hydrograph" were desired, a balance of acres in the various crown closures would need to be attained within the watershed.

Knowing the type and mix of vegetation in a watershed is helpful for planning restoration efforts in a watershed, or helping to prioritize where to put restoration efforts. In some cases, such as a large hot fire, not much can be done for short-term restoration other than stabilizing the soil and getting vegetation restarted.

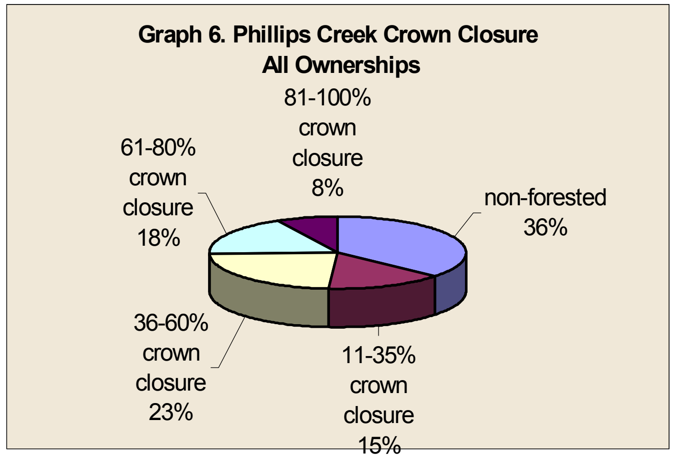
Methods

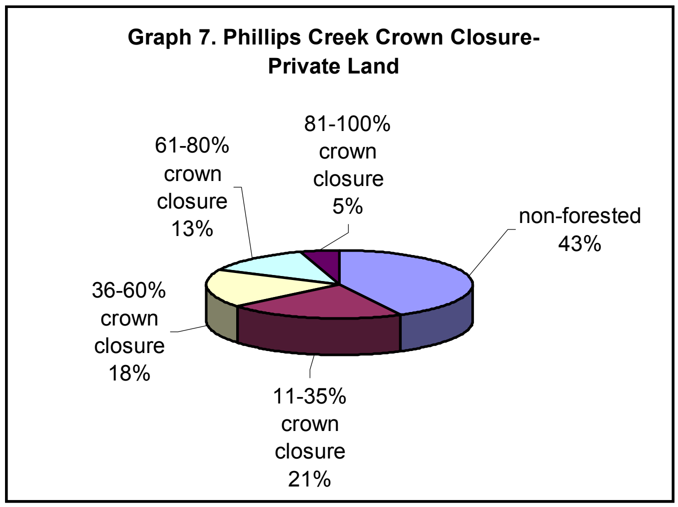
The vegetation data was obtained from the Oregon Department of Forestry *Private land vegetation of Baker, Union and Wallowa counties* analysis of 1997 aerial photographs. That was combined with ground truthing to assure the analysis was reasonable. Much of the private land is in a couple of large ownerships, and people with first hand knowledge of the vegetative status could check the analysis. The *Phillips – Gordon Ecosystem Analysis* covers the vegetation status on the national forest. Fire models are available on the National Forest, but not on private ground.

Results

The vegetation in the Phillips Creek Watershed is in good condition from a watershed management or hydrologic perspective. About 15% of the forestland have less than 35% crown closure classification. That land has all been replanted and will eventually provide more than 35% crown closure. There is a diverse mix of species, vegetation types and size classes. The present mix of vegetation will have very little effect on the "natural" hydrograph.

Some of the desired upland vegetation watershed restoration efforts would include thinning (both commercial and precommercial) to keep stands healthy, thinning to reduce fuel ladders and fuel loads and breaking up or removing existing down and dead fuel loads to provide green fire breaks.





Clearcut harvests of timber are generally not being used in the forests at this time. The Umatilla National Forest did use clearcuts in the past but has changed silvicultural techniques in the present. They are now doing more thinnings, including thinning from below. Those clearcuts have been regenerated. There are about 60 clearcut acres in the Bailey Creek drainage on private land. These acres have also been replanted. The accompanying graphs show crown closure by vegetation type, size classes and associations on all ownerships (Oregon Department of Forestry).

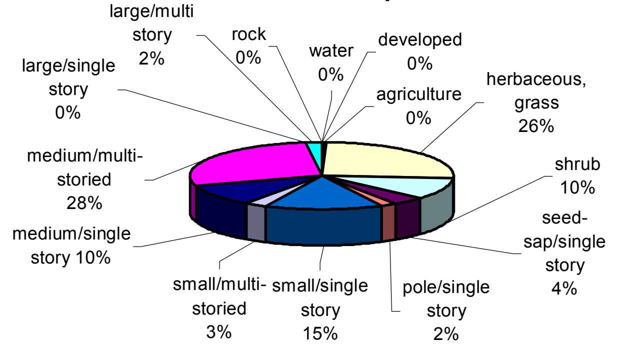
Discussion

The balance of acres in a watershed in different size classes and structures is interesting from a hydrologic viewpoint. That information gives a "snapshot" of what the watershed looks like now, and an indication of what it will look like in the future as some stands continue to grow and some stands decline. It can provide information on the likelihood of a large scale and catastrophic fire destroying a large number of trees in the watershed. Other pieces of information that would be helpful from a fire viewpoint would be the way that the size classes and structures are situated on the landscape. This can be seen on the accompanying maps. Smaller blocks may indicate a smaller risk of a fire getting a good run and killing large areas of trees. The amount of fuel on the ground and in the crowns is important. If a watershed is in need of restoration for a specific watershed objective the above information is very helpful.

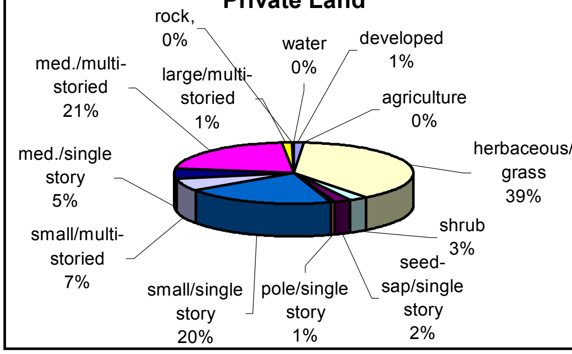
The Oregon Forest Practices Act assures that all private forestland is stocked with trees. If a clearcut harvest is used, the stand must be stocked and "free to grow" within six years. Partial harvests must leave trees that are healthy and are likely to grow. Skid

trails and roads need to be water barred and seeded to erosion controlling grasses if soil has been disturbed. Basic production of forest land is protected. Before land can be taken out of forest production it must be approved by the State Forester. There are specific requirements to protect water quality. At this time buffer requirements along

Graph 8. Phillips Creek Size Classes All Ownerships

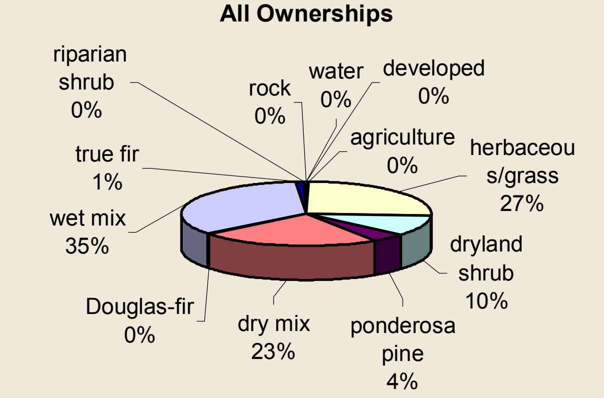


Graph 9. Phillips Creek Vegetation Size Classes Private Land

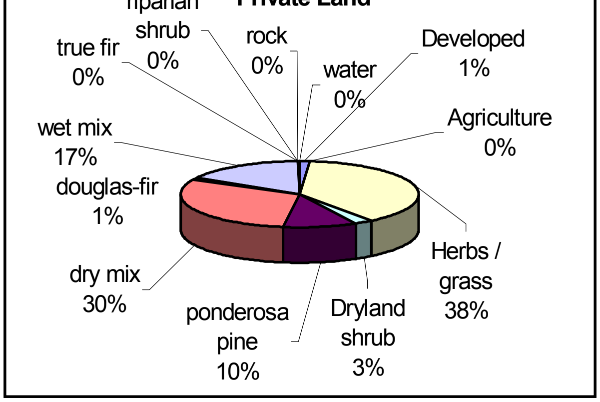


streams vary by stream size and class. Provisions are made to protect riparian vegetation from harvest damage. Provisions are made to provide large woody debris to streams in the future. The Act specifically provides for stream restoration activities with State Forester approved written plans. An attempt has been made to protect society's values while taking into account private property rights. Streamside rules are in the process of being reviewed by a committee with diverse backgrounds to see if changes will be recommended. The committee is using field trips as well as office sessions to see if changes to the Forest Practices Act is needed in light of a statewide study completed by a Forest Practices Advisory Committee appointed by the Board of Forestry.

Graph 10. Phillips Creek Vegetation Associations All Ownerships



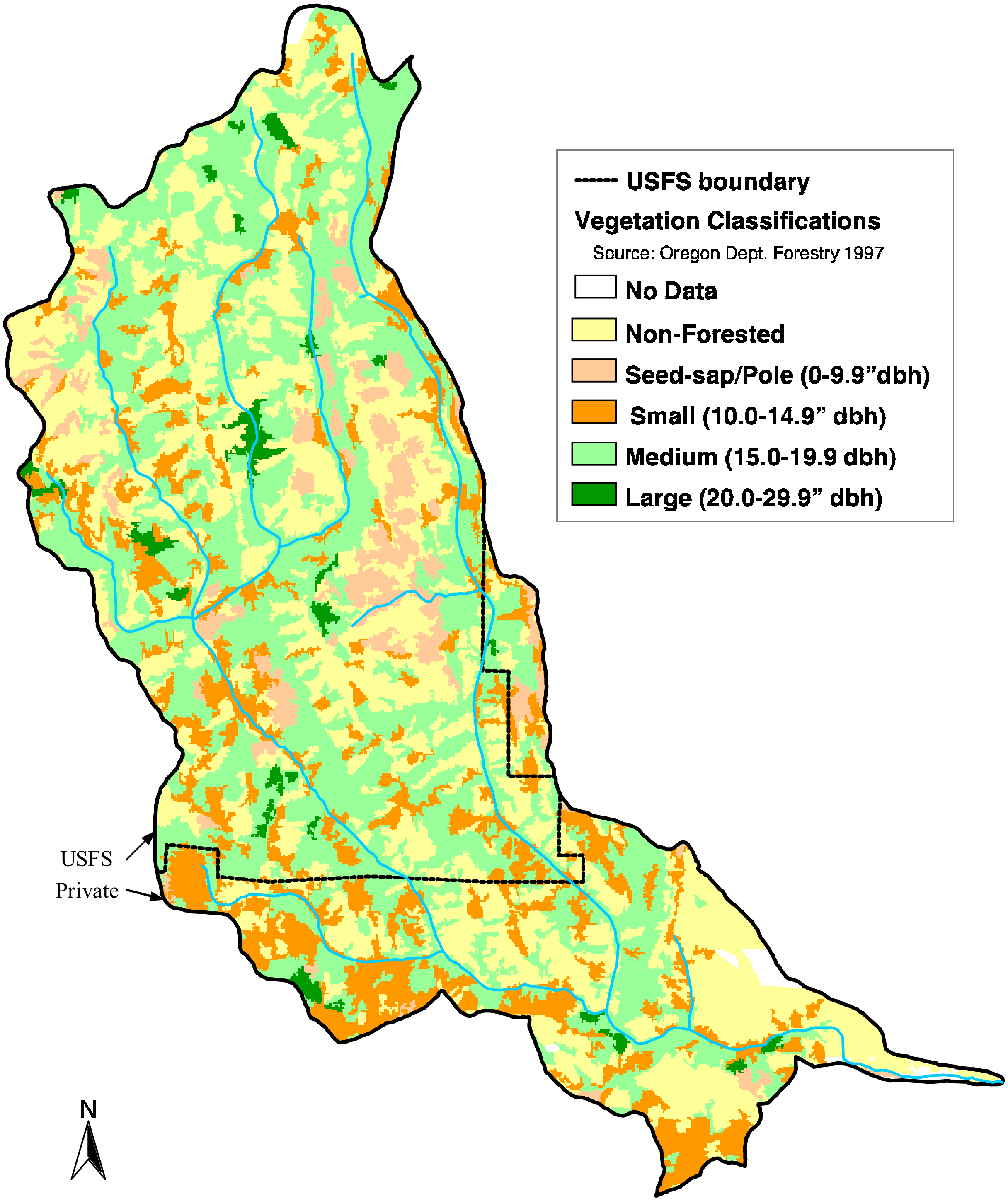
Graph 11. Phillips Creek Vegetation Associations Private Land



The National Forest forest resource practices must meet the Forest Practices Act requirements. National Forest harvesting policies generally exceed Forest Practices requirements.

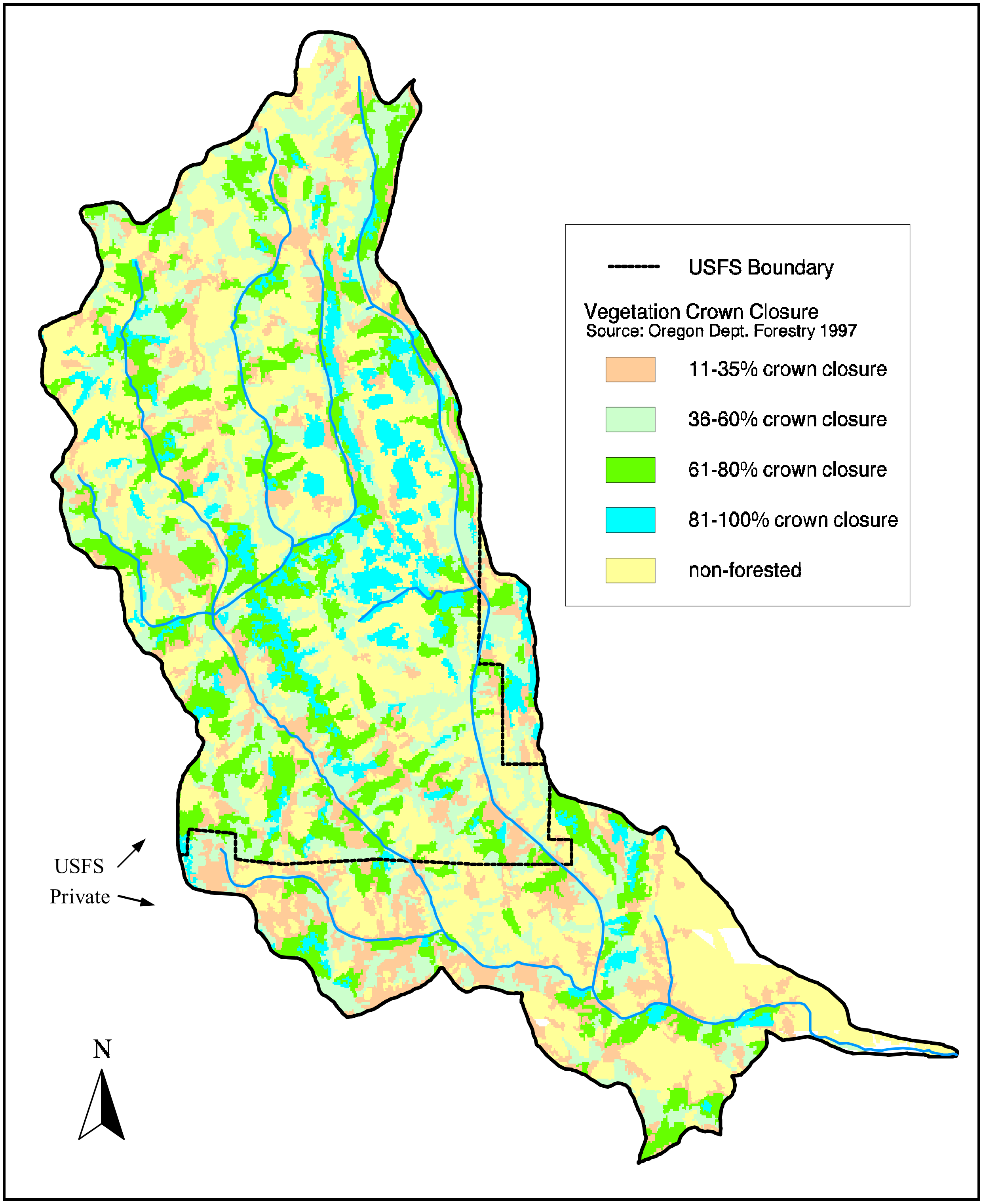
Research has shown that forest stands can be manipulated to change the timing and amount of water delivered by a stream. A forest opening will collect more snow, and release it more quickly in the spring, than a closed canopy. A closed canopy will intercept some precipitation, either rain or snow, and return it directly to the atmosphere. Less precipitation reaches the

Phillips Creek Watershed Vegetation Classification



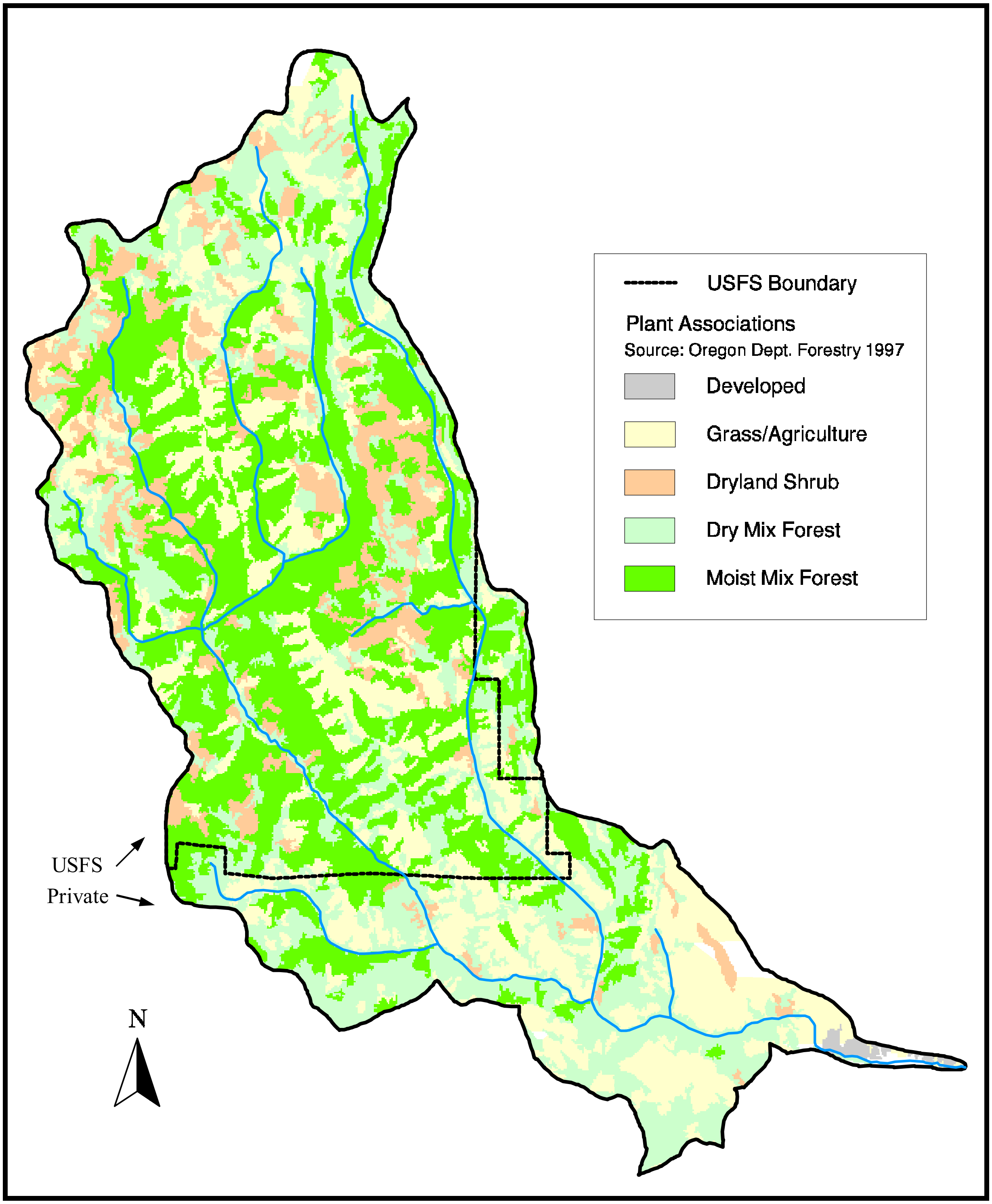
From Oregon Department of Forestry

Phillips Creek Watershed Vegetation Crown Closure



From Oregon Department of Forestry

Phillips Creek Watershed Plant Associations



From Oregon Department of Forestry

ground under this scenario. The water that does reach the ground tends to infiltrate the soils more thoroughly. Even though a closed canopy would deliver less water, it would deliver it later in the season when it may be more critical. Manipulating the forest canopy between these two extremes can change times and amounts of water delivered downstream.

Data Gaps

- None

References

1 Oregon Board of Forestry. 2000. Report of the Forestry Practices Advisory Committee on Salmon and Watersheds. Salem, OR.
2 Oregon Department of Forestry. 2000. Forest Practice Rules and Statutes. Salem, OR.
3 Oregon Department of Forestry. 1999. Private Land Vegetation of Baker, Union and Wallowa Counties, OR. Pacific Meridian Resources. Portland, OR.

Range

Background

A familiarity with range use in the watershed allows managers to see how grazing may be impacting the water resource. Overgrazing, both past and present can have harmful effects on streams, riparian areas and even in upland areas. Overgrazing in the uplands can cause erosion from overland flow. Severely grazed riparian areas can remove virtually all vegetation down to less than 1" tall. That heavy of grazing usually also causes compaction and breaking down of stream banks making them unstable. That makes restoration more difficult and takes more time. Grazing need not be harmful to streams or habitat. Research at the Eastern Oregon Agricultural Experiment Station in Union has shown that carefully managed grazing and healthy streams can be compatible. Carefully managed grazing may even increase the amount of forage available while maintaining riparian function.

Methods

People with knowledge of grazing on private lands were interviewed about livestock use. The Umatilla National Forest was contacted about grazing on public land. Observations were made along major roads and streams for grazing use.

Results

Cattle graze on a small portion of the 7,400 acres of private land. The total livestock grazing on private land in the watershed is less than 50 pairs from about May to October. The pasture includes a large area in the Dry Creek drainage. There are no cattle grazing in riparian areas along Highway 204. That is probably due to the constricted nature of the stream and the steep valley with little forage. The only place that cattle have access to the stream on private ground is on less than the first mile of the headwaters of Bailey Creek. Other private lands are not being grazed close to the creeks except for the occasional strays that trespass. Bailey Creek dries out by mid-July most years, and there is not much feed near the creek so that there is little cattle use even in the headwaters. There are no active sheep allotments on private ground.

The North End Allotment administered by the North Fork John Day Ranger District is a sheep allotment. Part of the Phillips Creek watershed is in that allotment. The area has been grazed since the late 1800's and the Forest Service has issued permits since 1920. The allotment allows 4,000 ewes plus lambs from June 1 to October 10 over a much larger area than the Phillips Creek watershed. The allotment covers 63,162 acres. There are no cattle allotments on the National Forest in the watershed.

Discussion

Under the present management of the watershed, there does not appear to be any severe problems caused by grazing of livestock. Most of the grazing is on National Forest land where it is monitored closely to prevent undue damage to the resources.

Data Gaps

- Rangeland inventory including trend analysis

References

1 Umatilla National Forest. 2001. Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

DEVELOPED AREA ASSESSMENT

Background

Elgin is the only town in the watershed. There are several industrial areas associated with Elgin. Only 96 acres are classified as developed is this watershed, or less than ½% of the area of the watershed. All of the developed area is clustered around the mouth of the stream.

Methods

Interviews of Elgin officials and industrial representatives provided most of the information for this section. The OWEB Manual was also consulted.

Results

The area of developed land is not enough to impact the hydrograph significantly. There is enough "hardened" area to increase overland flow but the area is not large enough to make a noticeable difference in the hydrograph. Through the town of Elgin the Phillips Creek drainage is seldom over two blocks wide on either side. There are no known pollutants being discharged to Phillips Creek from either municipal or industrial entities at this time.

Discussion

The developed area could impact water quality through polluted runoff. The City of Elgin is taking steps to minimize pollution. They have sewage lagoons to control and treat wastes. There are no street sweeping programs and no storm sewers at this time.

The industrial representatives are also aware of the potential for pollution and have taken steps to avoid polluting the stream and groundwater. These steps include a wastewater lagoon that is used to irrigate trees and pasture on an area that is outside of the watershed and a man-made wetland near the high school to purify water before it returns to the creek. A berm has been constructed around the log yard to prevent the stream from picking up pollutants during high flows. This berm has been planted to vegetation to further screen the creek from the log yard.

Flooding can be a problem in the Elgin area. As Phillips Creek enters the developed area it changes from a Low Gradient Confined Channel to a Low Gradient Small Flood Plain Channel. A characteristic of FP3 channels is that they are deposition areas for bedload being carried by the creek. As the channels fill the creeks tend to want to move about and form new channels.

FP3 characteristics are evident in the channel through town alongside the new industrial park. The gradient of the stream flattens out between the railroad track and the Highway. Barbs have been put into place to discourage the channel from moving. Gravel is filling in the channel, and will continue to do so as a natural process. Action will need to be taken from time to time to keep the channel in place, or it will move. Another problem area for the city is at the mouth of the creek. During very high flows as occurred in 1996, Phillips Creek dropped a large bedload where the creek met the Grande Ronde River and backed the bedload up about one-eighth of a mile towards town. The water then spread out across a wide area threatening to flood homes. These are not areas that will be fixed with a one-time entry. They will continue to need maintenance to address the problems to homes, building and infrastructure from time to time. In the past, the city reopened the filled channel every 3 or 4 years. A similar program may need to be reinstituted.

Data Gaps

- Water quality measurements
- City water quality plan

References

1 Watershed Professionals Network. 1999. Oregon Watershed Assessment Manual. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon.

NOXIOUS WEED ASSESSMENT

Background

Non-native plants have invaded northeast Oregon for many years. Much time and effort has gone into trying to control the invaders. The invaders are called noxious weeds. The Oregon State Weed Board has defined a noxious weed as “exotic, non-indigenous species that are injurious to public health, agriculture, recreation, wildlife or any public or property”.

Noxious weeds can drastically alter the composition of native plant communities. Often they out-compete native perennial grasses, changing the plant community from a strongly rooted erosion resistant self-sustaining perennial plant community to a weak-rooted erosion prone annual or biennial plant community. Too many times noxious weeds have gotten their start by the native plant community being too weak from mismanagement to compete effectively with the invaders.

Noxious weeds get introduced in a variety of ways. They arrive in or on crop seeds, animal feed, ornamental plants and animals coming into the area. Reseeding, vehicle transport, animal transport, animal feed, and recreationists spread them. Weeds starting in the uplands are often spread to downstream areas by streamflow. The most common corridors for spreading weeds are the public roads in the watershed.

Methods

Noxious weed information was collected from a variety of sources. The main sources were the Union County Weed Board and the Tri-County Weed Management Area. The *Phillips – Gordon Ecosystem Analysis* also contained noxious weed information. The Umatilla National Forest has mapped noxious weed sites for the National Forest. Because weeds spread so readily mapping is an ongoing process. Noxious weeds were observed while traveling throughout the watershed.

Results

The National Forest has a weed control program that is underfunded and understaffed for the size of the problem. The National Forest is unable to keep up with their weed problems. Many new sites have been discovered since the Forest’s 1995 Environmental Assessment for the Control of Noxious Weeds. Methods of control on the National Forest are often limited to hand control. Some chemical control has been used, especially for diffuse knapweed. Chemical control on the National Forest has mostly been done through county weed control district contracts. A coordinated effort is needed to keep weeds from spreading from the National Forest to private lands and vice versa. Table 9 from the *Phillips-Gordon Ecosystem Analysis* provides information on noxious weeds on the forest. These noxious weeds are also present on private lands to varying degrees.

Table 10 lists the noxious weeds that the Union County Weed Board knows is in the county. Class A weeds are non-native species that have limited distribution that pose a serious threat to the state. Class B weeds are non-native species with a limited distribution or are unrecorded in particular regions within the state and pose a serious threat to the regions. Class C weeds are generally more abundant than Class A and B weeds. Class A and B weeds have top priority to try to eradicate before they become widespread and harder to control.

Information about and methods of identification of these weeds can be obtained from the Union County Weed Board or the Tri-County Weed Management Area. Other sources of information on weeds and weed control are the Extension Office, the Soil and Water Conservation District and the Natural Resource conservation Service in Island City. Weed control usually costs about $20 to $30 per acre (personal communication, Dave Clemens, Tri-County Weed Management Area), but costs can vary. Get specific information for your situation. There are several cost share programs available. The Oregon Weed Board may provide a grant to eradicate weeds or restore pastureland. OWEB may provide cost shares. Assistance can be obtained from the NRCS, Extension Service, SWCD, Weed Board, ODA and the Grande Ronde Model Watershed.

Discussion

Perhaps the most abundant and pervasive weed in the Phillips Creek watershed is the diffuse knapweed. It has a weak root system that does not hold soil as well as native grasses. Where it is prevalent there is increased surface erosion and a higher level of sediment is delivered to the creek than with healthy native vegetation. This weed, as with most weeds, reduces the amount of forage available for ungulates and that can lead to increased grazing pressure on riparian areas. It can be controlled by chemical, mechanical and biological means. Hand pulling can be done in sensitive areas. Gloves and other protective measures should be taken if handling the weed as it does have a toxic effect on some people. Aggressive seeding of desirable vegetation can be effective in controlling knapweed. Knapweed control will take several years. It is a biennial plant and the seeds can be persistent for several years.

The knapweed problem is most severe along roadways. These include Forest road 3738 along Phillips Creek, Highway 204 and other private access roads. There still is knapweed in Elgin in spite of a concerted effort that greatly reduced the amount of knapweed in town over the past 10 years.

Other weeds are problems within the watershed. Tansy ragwort, a weed toxic to livestock, is becoming established. This is a top priority weed for the Forest Service to control and eradicate if possible. Klamathweed can also be a problem. A biological control in the form of a beetle that feeds only on Klamathweed seems to be keeping this weed in check. When the weed population gets larger, it has been followed in a year or two with an increase in the beetle population that can again control this weed.

In the forested area, some weeds have been around for so many years that they are common and easily found. These include Canada thistle, scotch thistle, bedstraw, morningglory and houndstongue. Many of these are widespread without real concentrations, making them difficult to control. If they are not controlled high in the watershed they continue to spread downstream re-infecting the downstream areas.

Weed control is a high priority for public officials. A coordinated effort between public and private landowners is needed to keep weeds in check.

Table 9. Status and treatment priority for noxious weeds species occurring in the Phillips-Gordon analysis area (on the Umatilla National Forest).

Common Name	Scientific Name	Management Status	Spread Potential	Treatment Priority
Diffuse knapweed	*Centaurea diffusa*	New Invader/ established	Very high	Very high
Spotted knapweed	*Centaurea maculosa*	New Invader	Very high	Very high
Canada thistle	*Cirsium arvense*	Established	Moderate	Low
Bull thistle	*Cirsium vulgare*	Established	High	Low
Houndstongue	*Cynoglossum officinale*	Established	High	High
Klamathweed	*Hypericum perforatum*	Established	Very high	Low
Tansy ragwort	*Senecio jacobaea*	New Invader	Very high	Very high
Flannel Mullein	*Verbescum thapsus*	Established	Low	Low

Table 10. Union County 1996 Noxious Weed List

Class A	Class B	Class C
Velvetleaf	Hoary Cress (whitetop) south of Catherine Cr.	Quackgrass
Hoary Cress (whitetop) north of Catherine Cr.	Yellow star thistle	Wild oat
Muck thistle	Dalmation toadflax	Water hemlock
Spotted knapweed	Puncturevine	Poison hemlock
Russian knapweed	Jointed goatgrass	Morning glory
Scotch broom	Canada thistle	Horsetail rush
Leafy spurge	Catch weed bedstraw	Kochia
Dyer's woad	Diffuse knapweed south of Willow Creek	Scotch thistle
Tansy ragwort		Russian thistle
Buffalo burr		Cereal rye
		Diffuse knapweed north of Willow Creek

Data Gaps

- Mapping of weed sites needs to be completed, both public and private.
- Maps of areas in which weeds have been controlled.

References

1 Tri-County Weed Board. Dave Clemens. Personal Communication

2 Umatilla National Forest. 2001. Draft Phillips-Gordon Ecosystem Analysis. USDA Forest Service, Pendleton, Oregon.

WATERSHED CONDITION EVALUATION

There has not been adequate information collected on Phillips Creek to make a judgement on its present condition. Neither Phillips Creek nor its tributaries are 303d listed streams, but that is probably because there has not been adequate monitoring to date. There is not a lot of data available for Phillips Creek itself. It is known as an intermittent stream. There are no stream gauges on Phillips Creek and there is no concerted monitoring effort. Still, there is a lot of information available to guide restoration efforts.

There is good forest cover from a hydrologic viewpoint. Roads constrain the creek in many places but changing road locations is not feasible at this time. Many agencies already regulate uses along the streams and the trend of vegetative condition appears to be upward.

Following is the additional desirable information needed for stream management purposes. These are often called data gaps.

- Refined mapping of areas in need of restoration. Maps should include the type of restoration that would be desirable.
- Additional temperature and streamflow data. The estimated hydrograph and a good estimate of the range of flows are adequate for most planning.
- An inventory of roads producing sediment
- An inventory of other sediment producing areas.
- A riparian habitat survey on private lands
- A fish habitat survey on private lands.
- A survey to identify and map cold water refugia.
- A restoration action plan
- A property protection plan
- Noxious weed inventory and mapping
- A monitoring plan

The CHT typing indicates on a broad basis the types of restoration that would be successful. In addition to stream restoration planning, a plan to protect public and private property should be developed. Bridges, roads, homes; buildings and fields may be at risk. Each CHT description included information on the types of restoration that would be successful. The CHT typing in this Assessment is broad, and any anticipated project should take into account the characteristics of the individual site. Planning of specific restoration projects should be based on micro-site planning.

Following are some of the most needed restoration efforts on Phillips Creek. These are not given in order of highest priority. An Action Plan should be developed that could prioritize these and any additional restoration efforts.

- Elgin Bedload Buildup. The barbs that were installed seem to be working. Each year is bringing more bedload to settle out between the railroad and highway bridge. The barbs are starting to get covered. Bedload has also built up upstream from the high water mark of the Grande Ronde River. Consider removing some of this bedload build-up before the next extra high stream flow to protect residences and the industrial park. An ongoing maintenance plan is needed.

- Increase vegetation where there is site potential to do so. There are places that could use more shade and riparian habitat.
- Low-grade roads that contribute sediment to the stream system should be upgraded, maintained, relocated or put to bed.
- There is a general lack of large wood habitat in the stream. Wood additions should be large enough that the wood cannot migrate far downstream. Large wood can provide structure to the stream, forming pools for fish. It also provides shade, protection from predation and a substrate for insects that are food for fish.
- Make restoration and protection of cold water refuges a priority for fish habitat.
- Continue to reduce point sources of pollution through BMP's or other means

Some restoration practices work better in some CHTs than others. Following are some suggestions to keep in mind when planning restoration projects.

FP3 – addition of streamside vegetation works well. This channel habitat type has a low gradient and is a place of bedload settling. Consequently the channel has a tendency to fill and then start to wander over a large area. Efforts to restrain the channel should be carefully planned with this in mind. On-going maintenance will be necessary for physical structures and high water may render structures such as barbs ineffective because of being filled with bedloads.
LM – CHT with some of the best potential for restoration. Addition of streamside vegetation is a good option. Physical constraints work well. Addition of large wood or rock for structure has good potential for improving structure. Pool frequency and depth may increase, and side channel development may result.
LC – addition of streamside vegetation is the best option. Addition of large wood and rock for structure has some potential if planned carefully. Channel enhancement may not have desired results. Plans must be made carefully.
MM – among the most responsive of channel types. Good candidate for channel enhancement. Habitat diversity can be improved by adding large wood or boulders. May increase pool frequency and depth as well as side channel development.
MC – Not highly responsive to channel enhancement. Riparian vegetation establishment often successful.
MH – Moderately responsive to channel enhancement efforts. Riparian vegetation additions highly successful.
MV – Not very responsive to channel enhancement. Riparian vegetation additions are often highly successful.

SV – Not highly responsive to in channel enhancement. Does well with riparian vegetation additions. If larger trees can be grown they may serve as recruitment areas for large wood.

A lot of the Phillips Creek drainage streambeds have been altered in the past. It appears that the channel has probably widened and become shallower over the years in many places. That was probably in response to the removal of large wood of the stream. After the structure was removed, the stream was able to have more energy and that tended to allow bedload to fill in the pools and cut out side channels.

In general it could be stated that the pool to riffle ratio in Phillips Creek is much lower than would be desirable. While it is true that Phillips Creek is an intermittent stream, it also appears that even in low water years there is some water flowing in some reaches of the stream. There are pools in which fish hold over the summer or until predators get them. Because the water appears in some places and not others, it means that water is flowing subsurface in some places. That would tend to cool the water, and may hold potential for increased cold water fish populations. If the stream had more structure, protected pools may serve as a refuge for salmonids during the warm temperature and low water months.

Because the stream channel tends to be wide and shallow, solar radiation can heat the small amounts of water flowing on the surface in the July to September period. Large changes in stream water temperature are expected between night and day or cloudy days and sunny days. A one time and place sample of temperatures a week apart in July and August during a cool cloudy day and a hot sunny day seems to indicate that may be the case. At the same time of day there was approximately 20°F difference in water temperature. This was due to a combination of solar radiation and ambient temperature.

Some reaches of Phillips Creek have a high potential for restoration efforts. Channel complexity could be increased by additions of large wood. In some places the channel could be allowed to move. In some places the planting of riparian vegetation, including conifers, could increase shade on the water when it is on the surface. That would keep the water cooler. If refuge pools were formed and fish protected from predators the population of salmonids could increase substantially. These enhancements could take place on both public and private lands.

The Phillips Creek channel does not appear to be degrading at this time. It is relatively stable, but does not appear to be improving substantially. Vegetation is becoming denser in the riparian areas but there is room for more rapid improvement through planting. Credit should be given to the individuals, corporations and agencies that have been restoring, improving and protecting the Phillips Creek habitat over the years.

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