Appendix 6.1: Potential Wetland Plant Communities in the Thirtymile Creek Watershed (from NRCS Site Descriptions)

Wet Meadow

- Occurs on low floodplains of perennial streams and rivers
- Soils of this site are recent, very deep and poorly drained. The potential for erosion is moderate. The optimum growth period for native plants is from April through August. The soils are in hydrologic group D. The soils of this site have runoff potential. The soils in this site have excellent water holding capacities providing late season water for plant growth and slow water releases to streams.
- The potential native plant community is strongly dominated by sedges. Rushes and tufted hairgrass are common.

Meadow

- Occurs on low floodplains of perennial streams and rivers
- Soils of this site are recent, very deep and poorly drained. The potential for erosion is moderate. The optimum growth period for native plants is from April through August. The soils are in hydrologic group D. The soils of this site have runoff potential. The soils in this site have excellent water holding capacities providing late season water for plant growth and slow water releases to streams.
- The potential native plant community is dominated by tufted hairgrass. Sedges and rushes are common. Tufted Hairgrass production is dependant on the extent and duration of subsurface water flows.

Loamy Bottom

- Occurs mainly on the floodplains of perennial streams and rivers. It is near channels occupying secondary terraces.
- Soils are recent, very deep and well drained. The soils in this site have excellent water holding capacities providing late season water for plant growth and slow water release to streams. The soils are in hydrologic group B. The soils of this site have moderately low runoff potential.
- The potential native plant community is dominated by Basin Wildrye.

Sodic Bottom

- Occurs on low to mid-elevation floodplains of perennial streams and rivers.
- The soils of this site are recent, very deep and somewhat poorly drained. The soils are in hydrologic group D. The soils of this site have high runoff potential. The soils in this site have good water holding capacities providing late season water for plant growth and slow water releases to streams.
- The potential native plant community is dominated by Basin Wildrye.

Willow Riparian

- Occurs on depositional floodplains along perennial streams and rivers. Floodplains are well connected.
- Soils are silt loam over gravelly silt loam and are deep.
- The potential native plant community is dominated by willow with an unknown understory. Current plant community is willow and non-native reed canarygrass. As willows decrease reed canarygrass becomes strongly dominant.

Gravelly Braided Bottom

- Occurs on floodplains of perennial streams and rivers.
- The soils on this site are very deep, gravelly and well to excessively well drained. The soils are in hydrologic group B. The soils of this site have moderately low runoff potential. The soils of this site typically reflect hydric soil characteristics.
- The potential native plant community is dominated by black cottonwood and tall willows, alder, hawthorn, rose and basin wildrye are present.

Chapter 7: Water Quality

Introduction
In this chapter, water quality data collected in the Thirtymile Creek watershed is presented and summarized.

Background
Water quality is influenced by both natural and human activities. Human caused point and non-point source pollution, land use activities in riparian zones, in-stream disturbances, and water withdrawals or diversions all affect water quality. Natural conditions of streams, such as low summer flows and low stream gradient, can result in streams being more susceptible to water quality changes and less able to handle pollution levels.

Under the Clean Water Act, the U.S. Congress required the Environmental Protection Agency (EPA) to "protect and maintain the chemical, physical and biological integrity of the nations waters." The EPA has, for the state of Oregon, put the Oregon Department of Environmental Quality (DEQ) in charge of setting the state's standards for quality and to enforce them. Water quality affected by agriculture is regulated by the Oregon Department of Agriculture.

Water quality in Oregon is evaluated by comparing existing conditions to criteria contained in water quality standards set by the DEQ. These criteria were set as a way to determine whether the quality is sufficient to support beneficial uses of each basin. In the case of multiple beneficial uses in a body of water, federal law requires DEQ to protect the most sensitive of those beneficial uses. This premise assumes that by protecting the most sensitive beneficial use, all will be protected. Beneficial uses vary from basin to basin to account for land use patterns and existing aquatic life. The Oregon Water Resources Department has listed 14 beneficial uses for all waters in the Lower John Day Basin:

- Public water supply
- Domestic water supply
- Industrial water supply
- Irrigation
- Livestock watering
- Anadromous fish passage
- Salmonid fish rearing
- Salmonid fish spawning
- Resident fish and aquatic life
- Wildlife and hunting
- Fishing
- Boating
- Water contact recreation
- Aesthetic quality

Stream reaches that do not meet one or more of the Oregon Water Quality Standards are considered impaired or threatened and placed on the **303(d) list.** For all reaches on the 303(d) list and any waterbody designated is water quality impaired. DEQ is required to establish a **Total Maximum Daily Load (TMDL)**. When TMDLs were set for the Lower John Day Sub-basin, DEQ identified criteria, including temperature, dissolved oxygen (DO), pH, nutrients, bacteria, turbidity, habitat and flow modification, and aquatic weeds or algae.

DEQ has signed Memorandums of Agreement (MOA) with Oregon Department of Agriculture (ODA) and Oregon Department of Forestry (ODF). The MOA with ODA assigns ODA with the task of implementing TMDLs on state and private agricultural lands. According to **Senate Bill 1010,** ODA will implement TMDLs through water quality management plans for each sub-basin in the state of Oregon. ODF is assigned to implement TMDLs on state and private forested lands. This will be done through **Best Management Practices** and revisements of the **Forest Practices Act** in order to meet water quality standards.

Temperature

Cool water temperatures are a basic requirement for many aquatic species, including summer steelhead, that have evolved in the Thirtymile Creek basin. Reproduction and development are adversely affected when water temperatures are outside the ranges these species have historically lived in.

Temperature is also closely linked with other water quality parameters, like dissolved oxygen and pH. Dissolved oxygen levels and pH are inversely related to temperature.

Solar radiation is one of the primary sources of heating water in streams. The amount of surface area versus volume affects stream temperature. A stream that is widening but not increasing its net flow will have a greater exposed surface area for the volume of water it holds. This can result in increased temperatures. Shade from riparian vegetation and topography decreases the amount of solar radiation hitting a stream, thereby slowing the rate of stream temperature increases due to heat radiation. At night, stream temperatures decrease.

DEQ's temperature standard states that "where salmonid fish rearing is a designated beneficial use, no increase in temperature should be caused by human activities when temperatures exceed 64°F. Thus, when temperatures exceed 64°F, only the portion of heating that results from human activity is considered to be pollution. The 64°F criterion refers to the seven-day moving average of maximum daily temperature. This method of reporting temperature decreases the effect of a single peak temperature in data interpretation.

Dissolved Oxygen

The amount of dissolved oxygen in water is vital to fish and other aquatic animal respiration. In the Pacific Northwest, these species have evolved in the high dissolved oxygen levels characteristic of the regions waters. Developing steelhead and trout eggs and fry are especially sensitive to low DO levels. Nearly saturated levels are necessary for salmonids to maintain normal metabolic function. Lower levels inhibit salmonids' ability to find food and shelter.

Oxygen is usually dissolved in running water in equilibrium with the atmosphere. Water temperature and atmospheric pressure determine oxygen saturation. Dissolved oxygen levels fluctuate throughout the day, because of stream temperature and the presence of **photosynthesis** and **respiration** of plant and algae species. During the day, when photosynthesis is occurring, plants convert carbon dioxide into energy, expelling oxygen as a waste product. This causes dissolved oxygen levels to rise. Plants and algae respire continuously, consuming oxygen and producing carbon dioxide. During the night, when algae and plants do not photosynthesize but do respire, dissolved oxygen levels fall. Because of this daily fluctuation, dissolved oxygen is best measured over a 24 hour period for the results to be useful. Samples taken in the early morning and late afternoon can also capture this daily fluctuation (pers. Comm.., Mitch Wolgamott, DEQ).

For the Thirtymile Creek watershed, the DEQ 30-day average standard for Dissolved Oxygen is 8.0mg/L. The TMDL target for DO in the Lower John Day River has not been set as of this date but should be completed in 2006.

pH
pH is a measurement of the activity or basicity of a body of water. The pH scale is 1-14, with 1 being most acidic, 7 being neutral, and 14 being the most basic. The scale is logarithmic, meaning that the difference between a pH of 1 and 2 is not 1 but a factor of 10. Therefore, a pH of 9 is 10 times more basic than a pH of 8.

The pH of natural waters varies according to an area's level of precipitation and geologic composition. In arid northeast Oregon, higher average pH levels are to be expected. But geology and precipitation cannot explain the large daily fluctuations in pH. pH varies throughout the day because of aquatic plant and algae photosynthesis and respiration, making it difficult to measure the maximum daily pH without sampling an entire 24 hour period. If other watersheds in eastern Oregon are used as an example the DEQ will more than likely set the pH standard to between **6.5 and 9.0.**

Nutrients
Phosphorus and nitrogen are the primary growth limiting macronutrients in water and, therefore, are the two nutrients most often measured when monitoring water quality. In moderation, these nutrients promote a healthy stream system, increased levels of dissolved oxygen, and food for macroinvertebrates by plant growth. High nutrient levels in streams can be unhealthy for fish and other aquatic organism because they lead to excessive algae growth which causes problematic changes in Do and pH levels. Algae blooms also inhibit recreation and the aesthetic value of the water.

Nitrogen is present in streams as nitrates, nitrites, ammonia, and organic forms. The forms readily available for plant uptakes are nitrates, nitrites, and ammonia (or Dissolved Inorganic Nitrogen). The lower John Day Sub-basin has not determined a TMD Level for Dissolved Inorganic Nitrogen but the assumption is that it will be at **33µg/L.**

Phosphorus is also present in streams in organic and inorganic forms. The form of phosphorus readily available for plant use is called orthophosphate. It is assumed that the TMD Level will be in the vicinity of **7µg/L.**

Bacteria

Coliform bacteria are used as indicators for testing the sanitary quality of water for drinking, swimming, and shellfish culture. Oregon Water Quality Standards for bacteria are: no single sample shall exceed 406 E. coli organisms per 100ml of water and no 30 day log mean shall exceed 126 E. coli organism per 100ml of water. For the purposes of this assessment, the single sample standard shall be used, due to limited data. However, this method shows only a moment in time, not trends of bacterial contamination.

Turbidity and Suspended Sediment

Turbidity measures the clarity of water. Turbidity can be caused by suspended sediments, algae, or other suspended materials. Turbidity is measured by passing a light beam through a sample. The more suspended material, the less the light that passes through the sample, resulting in a higher turbidity value. Turbidity is measured in NTUs (Nephelometric Turbidity Unit).

Suspended sediment is all the sediment suspended in the water column. It is measured by drying a water sample and then weighing the residual sediment. Concentrations are usually reported in mg/L, the equivalent of parts per million (ppm). To calculate sediment load, discharge data is needed.

Turbidity and suspended sediment will vary naturally with soil types. Silts and clays will stay suspended for long period and cause turbidity, while larger particles, like sand, will settle to the bottom. Turbidity will also increase during storm and runoff events.

DEQ specifies a criterion that compares an activity's turbidity level relative to a background level measured upstream. An increase in turbidity greater than 10% exceeds the turbidity standard.

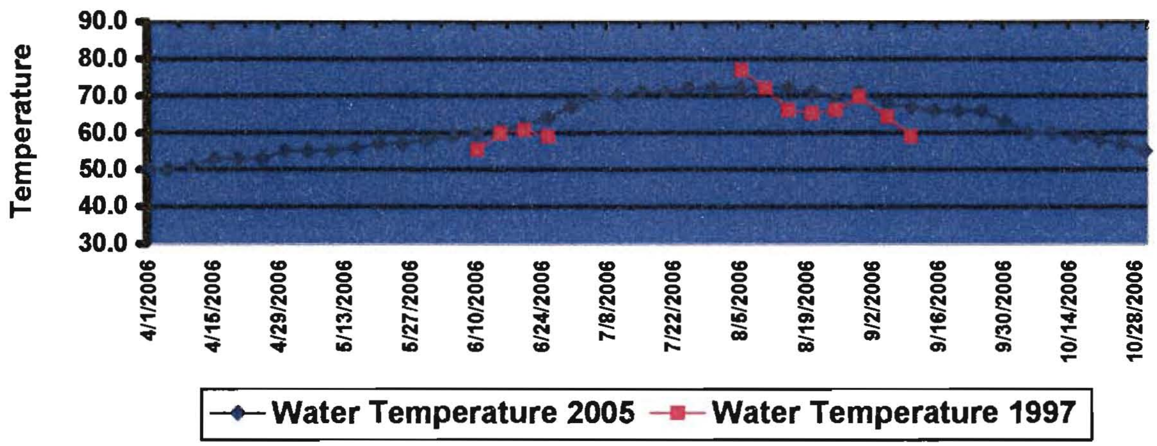
Methods

Data presented in this component was gathered from the Gilliam-East John Day Watershed Council monitoring completed in the year 2005. Very little data was available in the Thirtymile Creek watershed prior to this date, so most of the information available in preparing this report is a one year picture in time. Though, some information was made available from the EPA that was used but again it is only information that was collected during a one year time period. The TMDL for the Lower John Day River Sub-basin is scheduled to be completed during 2006 so TMDL information is assumed from other eastern Oregon watersheds.

Results

Water Quality Data was collected by the Gilliam-East John Day Watershed Council. Three sites have been sampled for water quality in the Thirtymile Creek watershed by the Gilliam-East John Day Watershed Council. **Map 7.1** shows their locations. Temperature data was sampled every hour from April to October using a data logger. Chemistry data was collected weekly with grab samples. There is also some partial data collect by the EPA in 1997 that will be assumed as accurate and used in this report.

Figure 7.1 Thirtymile Creek Near Highway



64° F is the DEQ Temperature Criterion (Temperatures on Graph is the Daily Average)

Discussion

Water quality is a difficult topic to adequately address with minimal data. The existing data shows Thirtymile Creek's impact on the water quality of the John Day River, but is too limited to show what portions are natural and human caused. To summarize the data, temperature exceeds the seven day moving average maximum temperature of 64°F a good portion of the summer months on all three sites that were tested the summer of 2005. Nutrient levels in Thirtymile Creek did not exceed the **assumed** TMDL standards of 33µg/L (Dissolved Inorganic Nitrogen) or 7µg/L (orthophosphates) for the John Day River. pH levels are recorded at slightly below 9.0 (8.7 to 8.9) and dissolved oxygen has not dropped below the standard of 8.0 mg/L but some grab samples have been right at that level throughout the length of the stream. Although there is very limited flow data (EPA 1997 and 2000), Thirtymile Creek is a high priority for flow in the John Day River Watershed Sub-basin Revised Draft Plan. Fine sediments, another form of pollution, is also present at levels affecting fish reproduction (see Chapter 8: Sediment).

What does all this mean? How is water quality affecting salmonid fish in the Thirtymile Creek watershed? High nutrient levels, low flow, exposure to direct sun, and high water temperatures promote algae growth. Algal growth increases the magnitude of daily fluctuations in dissolved oxygen and pH. When dissolved oxygen, temperature, and pH fall outside the range which salmonids are adapted to, mortality and reduced reproduction occur. Extreme fluctuations place additional stress on the fish. **As salmonid fish rearing is the most sensitive beneficial use in the Thirtymile Creek watershed, current water quality conditions are not adequate to support this beneficial use.** Algal growth, with its effects on fish habitat requirements, is a large factor in this. By minimizing algal growth and minimizing human caused increases in temperature, fish habitat parameters can be improved and Thirtymile Creek's most sensitive beneficial use protected.

Minimizing algal growth requires limiting exposure to sunlight, lowering water temperatures and reducing nutrient levels in streams. Limited data is showing that nutrient levels are not outside of the parameters set by DEQ. **The main emphasis should be placed on restoring a good condition riparian area with adequate woody species to shade the stream from solar radiation which will have an effect on both flow and temperature.**

Additional monitoring in the future will provide a stronger basis with which to assess and improve water quality in the Thirtymile Creek watershed. By monitoring in the headwaters of the watershed, information on how much pollution is natural and how much is human-induced can be gathered, providing further insight on how to improve water quality in the watershed.

Data Gaps

- Lack of water quality data
- Flow data
- Monitoring that measures daily Do and pH fluctuations
- Amount of natural versus human-caused pollution

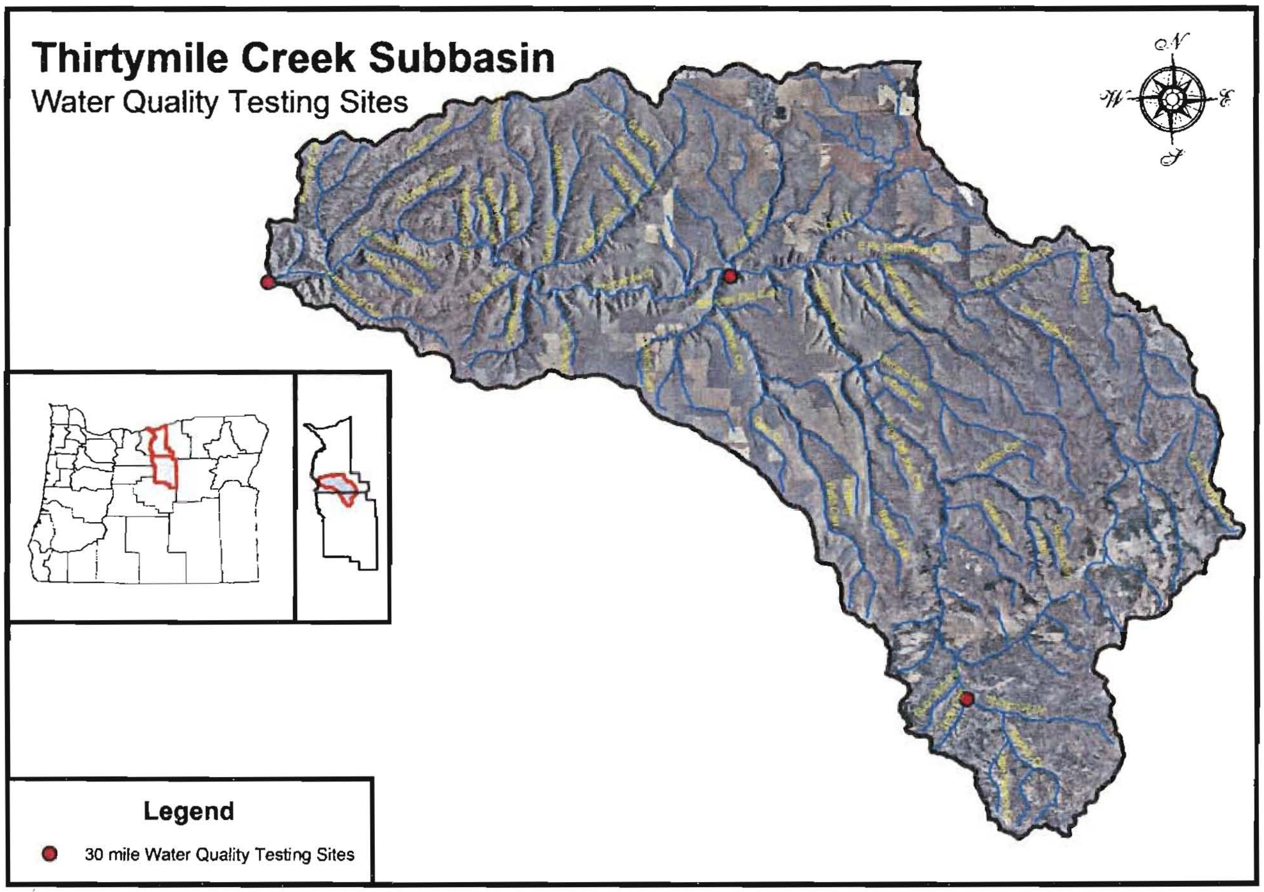
References

Monitoring Guidelines to Evaluate Effects of Forestry Activities on Stream in the Pacific Northwest and Alaska. Environmental protection Agency. May 1991

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

John Day Subbasin Revised Draft Plan. Prepared by Columbia-Blue Mountain Resource Conservation and Development Area, March 15, 2005.

Map 7.1: Water Quality Data Collection Sites in the Thirtymile Creek Watershed



Chapter 8: Sediment

Introduction
In this chapter potential sediment sources are identified and discussed. As high levels of sediment can negatively affect salmonid reproduction and cause undesired changes in channel form, understanding sediment's current role in the watershed is needed.

Background
Erosion is a natural occurrence. Fish and other aquatic organisms have adapted to a range of sediment amounts entering streams in their habitat. Erosion and sediment load in streams vary throughout the year, with most sediment moving during the short time periods with the highest flows. In the Thirtymile Creek watershed, this usually occurs during spring snowmelt.

Humans can also induce erosion in a watershed. Separating human-induced erosion from natural erosion can be difficult because of the highly variable nature of natural erosion patterns. Generally, the greater a stream's sediment load deviates from natural conditions, the greater the chance that fish will be affected.

Sediment in streams can also negatively affect humans. High sediment level can increase the costs of treating drinking water, can be aesthetically displeasing, and can decrease angling opportunites.

Sediment Transport Process
Sediment moves in a system and eventually is deposited. Sediment processes are often discussed in terms of collection, transport, and deposition. Rock is eroded through runoff into high gradient streams, from where it is transported through the stream system until the gradient lowers and the confinement eases. As the gradient levels out, the stream's energy is dissipated, through increased **sinuosity** and slower flows. This causes the stream to deposit its sediment load into **alluvial** and **floodplain** channels of the stream system. Generally, the larger the particle of sediment, the less distance it will travel. Thus, boulders will only move a few feet, while sand may move miles. Sediment input into streams can come from two sources: hillslope or channel sources.

Hillslope Sources
Sediment moves downslope by surface erosion and mass wasting. Landslides are a form of mass wasting. They can occur when soil cohesiveness is exceeded by high soil moisture content or when slope steepness causes soils to detach and move downslope rapidly.

Surface erosion can occur when precipitation exceeds the ability of the soil to absorb water or where soil surface have been exposed or compacted (ex. Road surfaces, heavily grazed areas, areas compacted by heavy machinery). Surface erosion includes many types of erosion: **sheet erosion, raindrop splash erosion, rill and gully erosion,** and **raveling** (see glossary).

Sediment transport to a stream is dependent on soil type, slope, proximity to the stream, and the duration and intensity of rainfall. Vegetative cover can affect the likelihood of sediment impacting streams. Erosion potential can also be affected by the degree of soil compaction, road drainage systems, and land management activities.

Channel Sources

Channel sources are associated with debris flows and bank sloughing. Debris flows occur when a landslide reaches a steep stream channel and incorporates logs, boulders, soil and water. It grows in size as it heads downstream and stops when the slope lessens. Most streams that have experienced debris flows will probably have more in the future. Bank sloughing occurs when stream channels migrate laterally. It is often increased by a lack of riparian vegetation and is more prevalent in unconstrained channels.

Methods

Information was collected from the Gilliam County Public Works, Oregon Department of Geology, Umatilla National Forest, Oregon Department of Fish and Wildlife, and the Natural Resources Conservation Service. USGS topographic maps, Geographical Information System data, aerial photos, and Department of Geology maps were also used.

Results

Sediment Sources in the Thirtymile Creek Watershed

The following were assessed as potential sediment sources: roads, channel erosion, slope instability, erosion from land uses, and erosion from burned lands.

Roads

Roads account for .16% of the entire area of the Thirtymile Creek watershed (see Chapter 4). There is minimal information about private roads within the watershed.

Culverts

Culvert assessments have not been conducted on the culverts in the Thirtymile Creek watershed to determine whether they pass ordinary high water flows, flood flows, whether they pose velocity barriers for fish passage or completely block fish passage up or down stream.

Road Conditions

Roads can contribute to sediment in streams, especially if not properly maintained.

Streams and Roads

Roads that are within 200 feet of streams can affect a stream's morphology by artificially constraining the channel and can be direct contributors of sediment to streams, **Table 8.1** shows the miles of roads that are within 200 feet of streams in each sub-watershed.

Table 8.1: Road Miles Within 200 Feet of Streams

Subwatershed	Miles of Stream within 200 Feet of Stream	Total Road Miles	% of Road Within 200 feet of Stream
Upper	8.3 Miles	16 Miles	50%
Lower	1.2 Miles	8 Miles	15%

Channel and Near Channel Erosion

The Oregon Department of Fish and Wildlife conducted an extensive survey for summer steelhead habitat in Thirtymile Creek and fish producing tributaries. Though bank erosion in itself was not measured other measurements that can give us a good idea of the condition of the bank are available. In almost all of the survey points spawning gravels were marginal because of fine sediments, streamside cover was herbaceous with no woody vegetation, and stream area shaded was marked at either 0 or 10%. The assumption that can be made from this survey is that riparian vegetation is not adequate on most of Thirtymile Creek. The lack of riparian area, almost always, suggests that bank erosion is occurring.

Bank erosion greater than 20% is considered unnatural and undesirable (per. comm., Tim Unterwegner). Streams that are **dynamic** will often have eroding banks as one bank erodes to move laterally. Channel habitat types in the Thirtymile Creek watershed that move laterally include medium floodplain (FP2) and small floodplain (FP3). In confined CHTs, natural bank erosion may result from fallen trees, landslides, and or debris flows (EPA 1991). For more information about channel habitat types in the Thirtymile Creek watershed, see Chapter 3: Channel Habitat Types.

Fine sediments in riffles are an indication of the ability of a stream to manage its sediment load. In ideal conditions, slow moving pools are where most deposition occurs. However, if the sediment load is high for the stream or there are not enough pools, then the stream will deposit sediment in other sections of the stream, such as riffles. Because riffles are where spawning gravel is most likely to be found, this can result in a net loss of spawning gravel, or impede the successful reproduction of cold water fish. The ODFW undesirable benchmark for fine sediments in riffles in eastern Oregon has been set at 20% and the desirable benchmark at 8%.

Slope Instability Not Related to Roads

Historically the upper watershed has had slope instability due to landslides and debris avalanches. In draft geology quad maps the Oregon Department of Geology has recently created, there are a number of landslides that have occurred in the Holocene period (the last 11,000 years). **Map 4.2** in Chapter 4: Hydrology and Water Use shows these landslides. The majority are on the steeper higher elevation areas in the watershed.

The Department of Geology considers landslides a geologic hazard of the watershed and has stated that a landslide could occur at any given time (Mark Ferns). Land use practices such as harvesting trees and road building on steep slopes can increase the risk of landslides.

Debris Flows are known to occur in the watershed. In the 1964 and 1996 rain-on-snow events, debris flows that began in the upper watershed brought debris and sediment downhill. (Pers. Comm., Jordan Maley)Debris flows can be a significant source of sediment in streams when they do occur. However, it should be noted that the salmonids using this and other river systems evolved under natural conditions of debris flows and mass-wasting (landslides). It is the ability of the watershed to recover from these events that has been altered which influences the impacts on salmonids.

Erosion from Agriculture and Range Lands
The Natural Resources Conservation Service (NRCS) has divided soils in the Gilliam County Soil Survey into two categories: non-highly erodible and highly erodable. Soils can be highly erodible from wind and/or water. 66 percent of agricultural soils in the Thirtymile Creek watershed are highly erodible by water (NRCS, digital Gilliam County soil survey data). 82 percent of potential range soils on private land are highly erodible by water. Some soils types are highly erodible by wind. For more information about soils, see the Gilliam County Soil Survey. **Appendix 8.3** lists the soil types present in the private lands of the watershed.

Soil types are not the only factor in erosion from crop and rangelands. Cover type, conservation measures, precipitation, and slope also determine whether an area is likely to be contributing sediment to streams. A detailed assessment of agriculture's sediment contribution to streams needs to be conducted.

Erosion from Ditches
There are uncounted miles of ditches in the Thirtymile Creek watershed, used for road drainage, irrigation, and land drainage. Unstable ditches can contribute sediment directly into the stream system. Annual cleaning of ditches can increase sediment contributions to streams from ditches.

Erosion from Burned Land
There are no recent fires within the Thirtymile Creek watershed. The fuel loads of many forest stands are large enough to have increased fire risks and significantly higher consequences. For more information, see Chapter 12: Forest Health.

Discussion
Too much sediment in spawning gravels can adversely affect salmonid spawning. Fine sediment in riffles ranged from 7 to 68% (estimated by author) in surveyed reaches in the Thirtymile Creek watershed. As the ODFW benchmarks are set for fish needs, the excessive fines in riffles or the surveyed reaches indicates that fish reproduction and development may be impaired in those reaches. This also mean sediment deposition amounts are too large for quality fish habitat in those reaches. Most deposition occurs in pools, where there is less velocity. It is possible that the sediment loads of Thirtymile Creek are more than the stream can handle and therefore you have deposition in riffles. It is also possible that the lack of large woody debris (LWD) and the low number of pools per mile (See Chapter 10: Fish and Fish Habitat discussion) have changed the distribution of sediment in the stream. To determine whether sediment loading, streams structure, or both are the causes of excessive fines in riffles, more sediment data needs to be collected.

The Thirtymile Creek watershed was listed as a high priority area for sediment in the John Day River Sub-basin plan. If the sediment loads are too large for the stream to handle, what can be done? Sediment sources need to be identified and minimized. Possible sediment sources in the Thirtymile Creek watershed include: roads, crop and range lands, stream bank erosion, ditch erosion, and landslides.

Roads can be one of the major contributors of sediment to streams, especially when there are high road densities. In the Thirtymile Creek watershed, the entire watershed and each sub-watershed all have relatively low road densities. But a large majority of the roads in the watershed are unpaved, and thus are contributing larger amounts of sediment to streams. Native surface roads contribute more sediment to streams than rocked or paved roads.

The geology and topography of the upland sections of the watershed show landslides as a potential occurrence. While the geology and topography cannot be changed, they can be recognized and land uses adjusted to minimize landslides and debris flows.

Most of the crop and range lands are highly erodible and some of those lands are on moderate slopes. These lands are probably contributing sediment to streams. **Conservation practices and riparian buffers can minimize the amount of sediment that reaches streams and also conserve soil on crop and range lands.**

The ODFW habitat survey shows the potential for high levels of bank erosion throughout all sections of the watershed. Therefore, stream bank erosion is a source of sediment to streams in the watershed. The erosion can be a result of stream bank instability or from peak flows reshaping the channel form. Flows passing through channelized reaches may have more energy than when in original channels, with the added energy resulting in stream bank and stream bed erosion. Stream bank instability can be the result of lack of riparian vegetation. As the results in Chapter 5: Riparian Areas show limited woody and brush vegetation in riparian areas, this is likely the case with bank erosion. Erosion from ditches is also a source of sediment to streams in the Thirtymile Creek watershed. How, how often and when ditches are cleaned can help control ditch erosion.

Understanding the geology, topography, climate, and soils of the watershed, along with how human activities can contribute sediment to streams and alter how streams manage their sediment loads is a good beginning for improving sediment conditions and fish habitat. Implementing actions to control sediment and improve stream structure will be the next step.

Data Gaps

- Miles of private unpaved roads
- Assessment of all culverts
- Identification and mapping of all landslides in watershed
- Miles of ditches in the watershed

References

Tim Unterwegner, Physical and Biological Stream Survey Forms, Oregon Department of Fish and Wildlife, August 1971.

John Day Subbasin Revised Draft Plan. Prepared by Columbia-Blue Mountain Resource Conservation and Development Area, March 15, 2005.

Monitoring Guidelines to Evaluate Effects of Forestry Activities on Stream in the Pacific Northwest and Alaska. Environmental protection Agency. May 1991

Watershed Professionals Network. <u>Oregon Watershed Assessment Manual</u>, Salem, Oregon: prepared for the Governor's Watershed Enhancement Board, 1999

Chapter 9: Channel Modification

Introduction
The purpose of the channel modification component is to identify current and historical channel modifications in the Thirtymile Creek watershed. By knowing the types and amount of channel modifications, current watershed functions can be better understood and restoration opportunities identified.

Background
Channel modifications occur when humans alter stream channels. These modifications can change channel geomorphology and biotic function in the altered reach and in reaches and streams downstream and upstream of the modification. Modification types include: dams, roads, bridges, riprap, ditches, channelization, culverts, in-stream mining, dredging, levee building, and other bank stabilization efforts. These activities typically result in more uniform channel cross sections, steeper stream gradients, and reduced average pool depth.

By changing stream gradients and straightening channel paths, channel modifications cause increases in the energy of stream flows. This energy, no longer dissipated over length and meandering channels, instead can cut into the stream bed and banks, causing instability and increased erosion. This causes an increase in the sediment load on the stream. An undisturbed stream's sediment load is in equilibrium, as the stream is able to handle the sediment eroded and transported and then deposited. Channel instability occurs when the scouring process leads to **degradation**, or excessive sediment deposition results in **aggradation.**

Channel modifications have significantly altered salmonid habitat in the Pacific Northwest. Dams along the Columbia, Snake, and other rivers have created fish passage barriers for sea-migrating species such as summer steelhead. Changes in salmonid spawning and rearing habitat have also affected salmonid population numbers.

Methods
Topographic maps, aerial photographs, and other records were gathered and used in identifying channel modifications in the Thirtymile Creek watershed. Stream lengths were estimated using a measurement meter on the computer generated maps.

Results
Channelization
Aerial photos were used to estimate the amount of channelization on Sniption, Badger, Searcy, Little Searcy, East Fork Thirtymile, and Trail Fork Creeks. During the floods of 1964 the lower end of Thirtymile Creek had a large area where the channel jumped out of the original channel and carved a new channel through some agricultural land. An effort was made to move the channel back into the vicinity of the original channel. This new channel was straighter than the original channel and sections of it did not stay where it was located but moved back into the newly carved channel that was formed during the flooding event. Finally the irrigated agricultural land was abandoned. The rest of the lower watershed looks to be in the natural channel.

In the upper watershed Thirtymile Creek has been moved to allow for the road to be installed which has straightened and removed the meander for several miles. Other roads along the tributaries have moved the channel and straightened the meander in small sections. **The total amount of manipulation to the channels within the Thirtymile Creek watershed has been low.**

Ditches/Irrigation Canals

Since most of the irrigated land is high in the watershed and there are only small amounts of irrigated ground, ditches are not a severe problem but do add to the cumulative effects of channel modifications.

Roads

Roads that parallel streams affect stream structure by actinically constraining the stream in a narrow area. They also contribute sediment to streams and decrease infiltration rates, depending upon their surfaces. Chapter 4: Hydrology and Water Use includes information on the hydrological effects of roads in the Thirtymile Creek watershed. Chapter 8: Sediment provides more information on sediment contributions of roads, the mileage of streams affected by nearby roads and culvert information.

Discussion

Several types of channel modifications were identified while researching this chapter. Ditches and diversions are not that prevalent, due to the agricultural nature of the watershed but roads and road ditches are prevalent in the watershed. As mentioned in the background section of this chapter, these modifications have changed the hydrology of the watershed, causing less infiltration of water into the soil and causing water to enter the stream system more rapidly.

Stream channelization is not that common in the agricultural areas of the watershed, but agricultural lands on both sides of streams and roads that parallel streams have artificially confined stream channels. This can result in effects similar to those of channelization, namely disconnection with the stream's floodplain, loss of habitat complexity, and unstable stream banks.

Many of the channel modifications in the Thirtymile Creek watershed are necessary to infrastructure and agriculture. Irrigation and road ditches are necessary for crop production and road stability. Diversion dams are necessary for irrigation purposes. However, the effects that these necessary modifications have on fish habitat and stream structure can be minimized. Fish passage barriers can be identified and actions taken to provide passage, such as dam designs that allow passage. Roads and ditches can be maintained in order to have minimal sediment enter the stream system. Inadequate culverts can be replaced with 50-year or 100-year flood sized culverts. Opportunities exist for rerouting channelized sections of streams into their old channels. This would increase the length of stream channels and the amount of time that water stays within the watershed, thereby assisting with diminishing the intensity of peak flows and potentially decreasing the amount of time of low flows. **Increasing the amount of channel could be combined with riparian buffers (see Chapter 5: Riparian Areas) to improve the adjacent floodplain's ability to store and hold water, thereby increasing the amount of water available for release during low flows.**

Stream bank stabilization through the use of riprap and other man made materials is a channel modification that can ultimately do more harm than good. While temporarily preventing bank erosion, peak flow events can whittle stream banks out from behind riprap, causing even further erosion problems. Although sometimes necessary in the short term, manmade stream bank stabilization is best minimized in the long term. A long term alternative is riparian revegetation, which can provide natural bank stabilization that will not initially alter channel form.

Data Gaps

- Inventory of diversions
- Inventory of all possible fish passage barriers
- Culvert inventory on all culverts in the watershed

References

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

Tim Unterwegner, Physical and Biological Stream Survey Forms, Oregon Department of Fish and Wildlife, August 1971.

Chapter 10: Fish and Fish Habitat

Introduction
This chapter discusses fish presence and distribution, migration barriers, and habitat conditions in the Thirtymile Creek watershed.

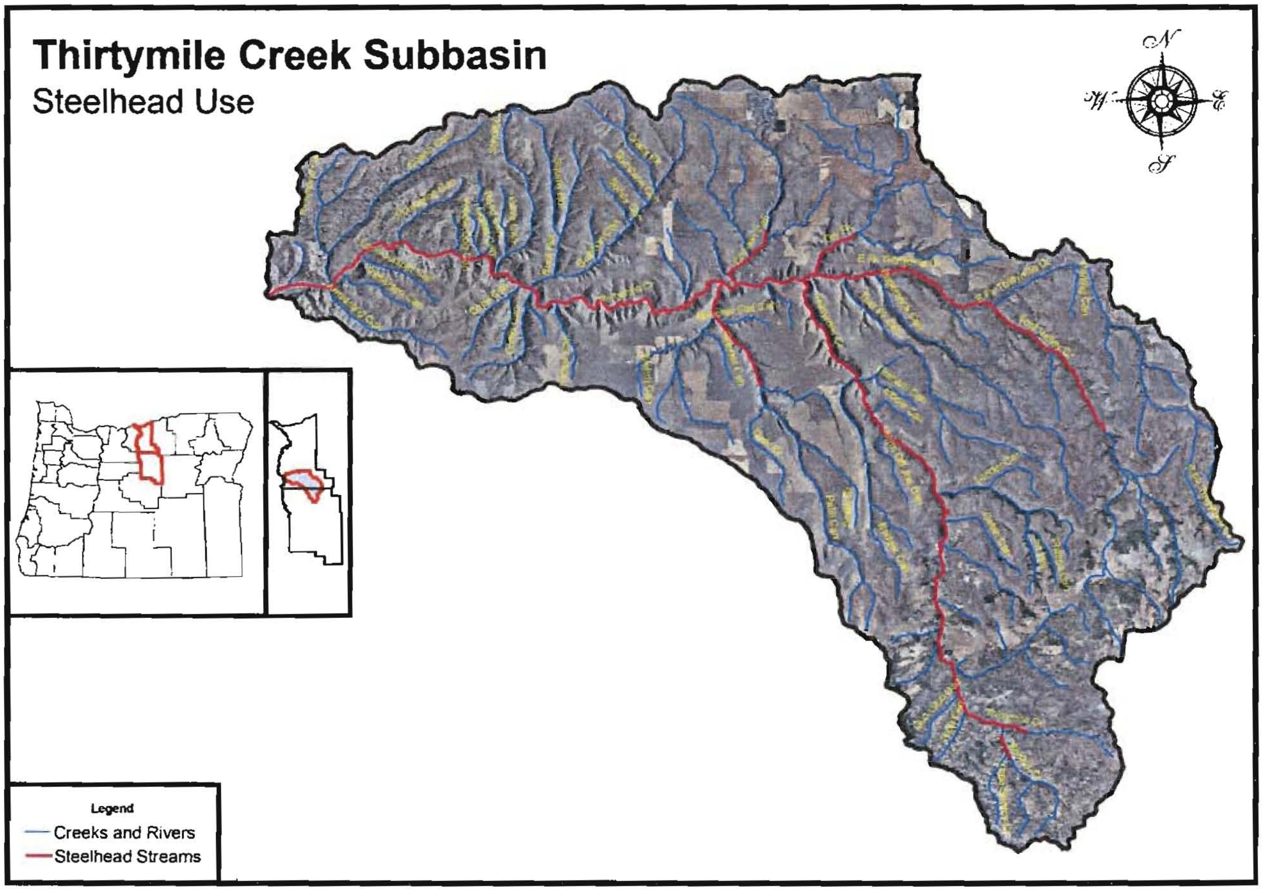
Background
Salmonids are the most widespread group of fish in the state of Oregon and are well recognized as indicators of watershed health (OWEB manual 1999). Thus, protecting and restoring salmonid habitat will ultimately result in improving the health of a watershed. To do so, we must understand salmonid life cycles and habitat needs and evaluate current habitat conditions.

Declining steelhead populations in the interior Columbia Basin have prompted the National Marine Fisheries Service to list the Middle Columbia Steelhead as threatened on March 25, 1999. Declining salmonid populations in the John Day Basin are believed to be caused by a combination of factors in the basin, along with the Columbia River and the Pacific Ocean. Habitat degradation in all habitats, fish passage barriers due to dams on the Columbia River, ocean conditions, and over exploitation of mixed-stock fisheries are the downstream causes of population loss (NPPC 1986, ref. in McIntosh 1992). In the John Day Basin, the major in-basin causes of salmonid population declines are in-channel and riparian habitat degradation, along with high summer and low winter water temperatures (per. comm., Tim Unterwegner).

The Oregon Department of Fish and Wildlife has developed a series of habitat benchmarks of undesirable and desirable conditions. Since loss of habitat complexity is a major cause of population decline, it is important to understand what provides complexity in streams. Important components of habitat complexity include: the amount of pools, riffles, and gravels, stream width to depth ratio, large woody debris, riparian vegetation and water quality and quantity. Removal of large woody debris beginning after the 1964 floods and the scouring affect of the flood has been two of the reasons behind loss of habitat complexity. Removing the large wood caused a drastic reduction in the pool area on streams (McIntosh 1992). Pools, mostly found on lower unconstrained channels, are important rearing habitat. Loss of riparian vegetation due to adjacent land uses has also reduced the amount of in-stream large woody debris and shade and increased width to depth ratios.

Methods
Stream surveys, fish presence surveys, redd surveys and salmonid distribution maps were obtained from the Oregon Department of Fish and Wildlife. Information from these sources and other published reports were used to document salmon life cycles, distribution, origin, population trends, habitat conditions, and limiting factors. Oregon Department of Fish and Wildlife fisheries biologists were consulted for additional assistance and professional opinions.

Map 10.1: Known Summer Steelhead Distribution in Thirtymile Creek Watershed



*** 55.9 miles of steelhead streams in Thirtymile Creek watershed.**

Results

Fish Life Cycles

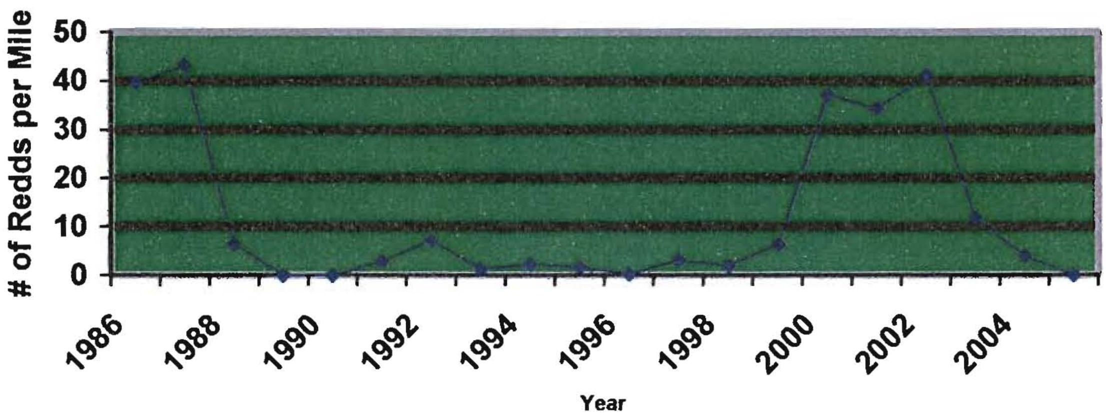
Summer Steelhead

Steelhead trout (Oncorhychus mykiss) are a sea-run, or **anadromous**, form of rainbow trout. Steelhead juveniles migrate in the spring to the sea and undergo a physiological transformation known as "smolting" to adapt to seawater. These steelhead in the John Day Basin are also known as summer steelhead. This signifies that juvenile steelhead return to freshwater from spring to early fall (May-Oct). They then mature and spawn from January through May of the following year (ODFW 1995).

Female steelhead dig redds and deposit eggs in gravel. The eggs hatch 35-50 days later, depending upon the water temperature. The alevins (young fish that still survive off their yolk sac) remain 2 to 3 weeks longer in the gravel, until the sacs are absorbed. They then emerge as fry and begin to feed (ODFW 1995).

Steelhead life cycles are unpredictable and juveniles can rear in freshwater from 1 to 4 years. Juvenile steelhead swim to the ocean as "smolts" when they are approximately 6-8 inches, migrating individually. Steelhead can remain in the ocean as little as a few months or as long as two years, until they return to spawn. (ODFW 1995).

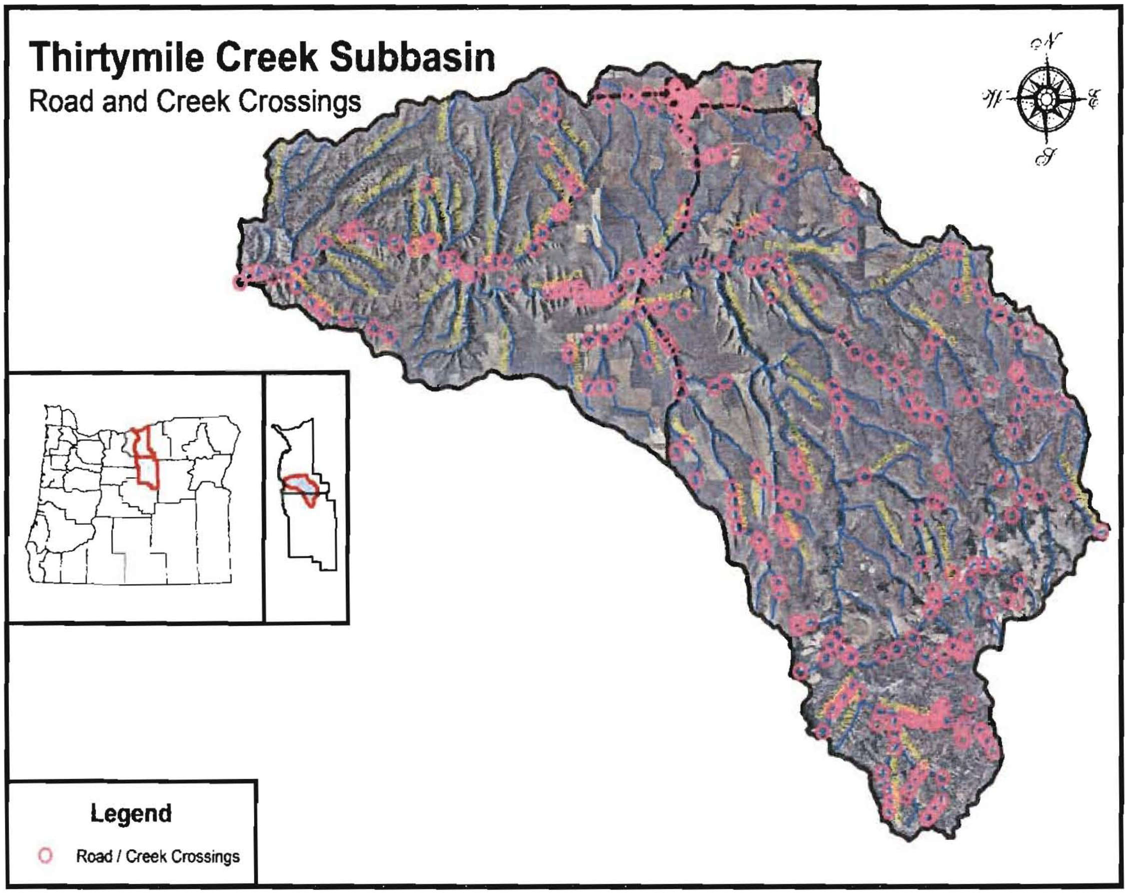
Figure 10.1: Redds per Mile on Thirtymile Creek



Distribution

Salmonid distribution maps for the Thirtymile Creek watershed have been created digitally by ODFW's state GIS department. **Map 10.1** show summer steelhead distribution in the Thirtymile Creek watershed. Thus, it is possible for steelhead to be present in other streams in the watershed, but there is no data to support this.

Map 10.2: Stream and Road Crossings



Discussion

Historically, Thirtymile Creek and its tributaries supported large runs of summer steelhead. These runs were historically plentiful, but now have diminished to where they have been listed as threatened under the Endangered Species Act.

Fish passage is one of the greatest concerns for salmonids. Dams and diversions can partially or completely cut off fish access to spawning habitat. On a large scale, dams on the Columbia have impeded fish access to the John Day Basin and thus Thirtymile Creek, thereby playing a role in declining fish populations. Within the Thirtymile Creek watershed, fish passage barriers are assumed but not located with the use of pushup dams for irrigation purposes.

Habitat conditions in the 1971 habitat surveys on Thirtymile Creek highlighted some undesirable conditions that were prevalent in all the tributaries also. Desirable and undesirable benchmarks were derived by Oregon Department of Fish and Wildlife as a method of comparing a stream against standards to determine its general condition. As different channel habitat types and geological location will cause variances in an individual reach's potential habitat, these are general guidelines. Width to depth ratios, percent open sky, fines in riffles, bank erosion, and large woody debris all fell into the undesirable category for many reaches along Thirtymile Creek. However, on all reaches, the percent gravel available in riffles was equal to or greater than the desirable benchmark.

What can be done to improve habitat conditions? Width to depth ratios of streams increase as streams widen. Streams widen from increased flows and/or eroding banks. As eroding banks are prevalent in many reaches of Thirtymile Creek and its tributaries, these streams are likely widening over time. Widening streams are undesirable for their effects on water temperature (see Chapter 7: Water Quality). Also, as streams widen, their ability to transport and handle their sediment loads changes. Stabilization of stream banks through riparian revegetation will help decrease the widening of streams. Stream widening is undesirable for fish because of the resulting increase in water temperature and substrate degradation.

The percent of open sky present out of 180° at a given point, is the opposite of shade. Thus, high percent of open sky numbers mean low shade. As shade limits exposure of the water to solar radiation, it helps reduce the warming of stream temperatures. By increasing the amount of shade in the stream profile, the availability of summer habitat and mobility of salmonids also increases, since too-high water temperatures can be fish barriers.

In Chapter 5: Riparian Areas, in-stream large wood and the recruitment potential of riparian areas for future large woody debris were shown to be limited. As large wood helps in the formation of pool habitat, a critical area for salmonids in the warm summer months, the enhancement of fish habitat in the Thirtymile Creek watershed will ultimately necessitate large woody debris being present in the stream system in greater amounts. This can be accomplished in the short term by large woody debris placement projects and in the long term through increasing the recruitment potential of riparian areas for large wood.

Improving fish habitat through establishing riparian vegetation, increasing shade, improving riffle and pool habitats, and the placement of large woody debris is part of improving conditions for fish in the watershed. It would also be beneficial to increase fish access by identifying and removing fish barriers and to increase surveys to determine population trends and the entire distribution of steelhead in the system.

Data Gaps

- Current stream habitat surveys
- Current redd surveys in the watershed
- Complete inventory of fish passage barriers
- Development of specific Habitat Benchmarks for the John Day Basin

References

Oregon Department of Fish and Wildlife Annual Reports, 1965 to current.

Chapter 4: Information Specific to Steelhead, Supplement on Steelhead, December 1997, The Oregon Plan, www.oregon-plan.org/supplement.12-97/st-04.html

Oregon Department of Fish and Wildlife. 1995 Biennial Report on the Status of Wild Fish in Oregon. Chapter 3: Rainbow/Redband/Steelhead Trout. www.dfw.state.or.us. 1995.

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

Tim Unterwegner, Physical and Biological Stream Survey Forms, Oregon Department of Fish and Wildlife, August 1971.

Appendix 10.1: ODFW Habitat Benchmarks for Eastern Oregon

	Undesirable	Desirable
Pools		
Pool Area (%)	<10	>35
Pool Frequency (Channel Widths)	>20	<8
Residual Pool Depth		
Low Gradient (slope <3%) or Small (<7m width)	<0.2	>0.5
High Gradient (slope >3%) or larger (>7m width)	<0.5	>1.0
Riffles		
Width/Depth Ratio (Gradient <3%). Eastside	>30	<10
Silt-Sand-Organics (% Area), Northeast	>20	<8
Gravel Availability (% Area)	<15	≥35
Shade (Reach Average, Percent)		
Stream Width <12 meters, Northeast	<70	>60
Stream Width >12 meters, Northeast	<50	>50
Large Woody Debris (15cm X 3 m minimum piece size)		
Pieces/100 m stream length	<10	>20
Volume (m^3)/100 m stream length	<20	>30
"Key" pieces (>50cm dia. And >ACW long)/100m	<1	>3
Riparian Conifers (30m from both sides of channel)		
Number >20in dbh/1000 ft stream length	<150	>300
Number >35in dbh/1000 ft stream length	<75	>200

Note: After personal communication with Tim Unterwegner, he has some question if the information above is accurate for the John Day Basin. He feels that the information was developed more for a forested area and needs to be reviewed for the John Day basin.

Chapter 11: Noxious Weeds

Introduction

This chapter identifies what noxious weeds are present in the Thirtymile Creek Watershed and discusses options for weed control.

Background

Weeds that invade native habitats are an increasing problem in the inland West. For the purposes of this assessment, the term noxious weeds will be defined as: "exotic, non-indigenous species that are injurious to public health, agriculture, recreation, wildlife or any public or property" (Oregon State Weed Board).

The majority of noxious weeds in the John Day and Umatilla ecoregions were introduced from Europe or Asia. They arrived in weed-infested crop seed and animal feed or as ornamentals and crop plants. It is believed that knapweed was first found in Gilliam County in the late 1930's. Now it has spread to almost all sections of the county. Seeds are spread locally by vehicles, machinery, crop seed, stock feed, livestock, wildlife, highways, irrigation ditches, trails, and landings.

Noxious weeds can negatively affect soils, plants, and animals. Noxious weeds, depending upon species, land, and invasion level, can increase erosion and runoff, alter seasonal water flows when highly infested in an area, increase soil evaporation, reduce organic matter in the upper inches of soil, and deplete soil nutrient reserves. They also can alter the composition of plant communities by out-competing native perennial grasses, changing the community composition, perennial, multiple species to a few annual species. By changing plant community composition, wildlife distribution changes as well. Animals that have co-evolved with a certain type of habitat often times cannot adapt to the degraded habitat that weeds create (Sheley & Petroff, 1999).

Weeds are also economically detrimental. They reduce land's carrying capacity for livestock. Some species are toxic to livestock; others are undesirable to animals as food. Land values can be dramatically reduced if invaded with noxious weeds. Weeds can also increase operating costs of ranches and farms through money invested to control weed outbreaks (Sheley & Petroff, 1999).

Proper management of noxious weeds involves prevention, early detection, and eradication. Ways of preventing invasion include: limiting seed dispersal, containing nearby weed infestations, minimizing soil disturbance, establishing competing grasses, changing the land management practices which created a favorable environment for the invasive species and properly managing grasses. Early detection is important because of the rapid reproduction rates of noxious weeds. Controlling a one acre problem is much easier than a 100 acre problem (Sheley & Petroff, 1999).

There are many options for weed removal. Cultural, biological, and chemical are the basic types of treatment. Cultural treatment includes the physical removal of weeds (tilling, pulling), replacing weeds with other plants through replanting, and creating barriers to weeds, such as windbreaks. Biological treatments involve the use of herbicides to kill and control noxious weed populations (Jaindl, 1996). Using a combination of treatments to remove weeds is recommended as the most effective method.

Methods
Noxious weed information was gathered through conversations and information gathered from Don Farrar, Gilliam County Weed Supervisor.

Results
Appendix 11.1 lists the noxious weed species the Gilliam County Weed Control Board has determined are in the county. Class A weeds are non-natives that have limited distribution or are unrecorded and pose a serious threat to the state. Class B weeds are non-natives with a limited distribution or are recorded 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 (personal conversation with Don Farrar). Diffuse knapweed is the most widespread noxious weed in the Thirtymile Creek watershed. Gilliam County Weed Board has taken the stand to not issue citations to private landowners at this time.

Information and methods of identification for these weeds can be obtained from the Gilliam County Weed Board.

Discussion
Noxious weeds are present in the Thirtymile Creek watershed, although not in as large numbers as other parts of Oregon. Un-maintained patches of weeds can quickly jump to large acreages taken over by weeds. Thus, it is important to control weeds while they are small problems and before it becomes a large and unmanageable one.

Diffuse knapweed, the most prevalent noxious weed in the watershed and other noxious weeds can cause serious land degradation. Diffuse knapweed has a weak root system and does not hold soil as well as the native grasses it replaces, thereby increasing surface erosion and decreases infiltration. In addition to land degradation, it reduces land values and limits the amount of forage available to livestock and wildlife.

Coordinated efforts in weed control are important to reducing weed numbers. If only one landowner is maintaining his or her lands free from weeds in a given area, weeds will invade from nearby landowners. This includes coordinating with Gilliam County Public Works, which maintain roadsides, and state and federal agencies that are property owners within the watershed. Coordinated efforts are cost-effective and prevent weeds from re-colonizing an area. Development of Global Positioning Systems (GPS) hand-held technology greatly aids in identifying sites for mapping and treatment and re-treatment of affected areas

For information on weeds and how to control them, contact:

Don Farrer
Weed Supervisor
Condon, Oregon
541-384-4222

Data Gaps
- Exact location of noxious weed sites on private, state, and federal lands
- Estimates on acreages of noxious weeds on private, state, and federal lands

References

Sheley, Roger L and Janet K. Petroff, eds. Biology and Management of noxious Rangeland Weeds. Oregon State university press, Corvallis, Oregon, 1999.

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

Appendix 11.1: Gilliam County 1995 Noxious Weed List

COMMON NAME	SCIENTIFIC NAME
CLASS "A" WEEDS	
Buffalobur	Solanum rostratum
Distaff Thistle	Carthamus lanatus
Field Dodder	Cuscuta pentagona
Hydrilla	Hydrilla verticillata
Johnsongrass	Sorghum halepense
Kudzu	Pueraria Montana var. lobata
Leafy Spurge	Euphorbia esula
Murtle Spurge	Euphorbia myrsinites
Musk Thistle	Carduus nutans
Poison Hemlock	Conium maculatum
Purple Loosestrife	Lythrum salicaria
Rush Skeletonweed	Chondrilla juncea
Salt Cedar	Tamarix aphylla
Spartina	Spartina alternaflora
Spotted Knapweed	Centaurea maculosa
Tansy Ragwort	Senecio jacobaea
Yellow Starthistle	Centaurea solstitialis
CLASS "B" WEEDS	
Bull Thistle	Cirsium vulgare
Canadian Thistle	Cirsium arvense
Dalmatian/ Yellow Toadflax	Linaria dalmatica
Diffuse Knapweed	Centaurea diffusa
Field Bindweed/ Morning Glory	Convolvulus arvensis
Himalayan Blackberry	Rubus discolor
Jointed Goatgrass	Aegilops cylindrica
Klamath Weed/ St. Johnswort	Hypericum perforatum
Kochia	Kochia scoparia
Puncturevine	Tribulus terrestris
Russian Knapweed	Centaurea repens
Sandburr	Cenchrus longispinus
Scotch Thistle	Onopordum acanthium
Spikeweed	Hemizonia pungens
Whitetop	Cardaria draba

"T" LIST

Dalmation Toadflax
Kochia
Leafy Spurge
Rush Skeletonweed
Spikeweed
Spotted Knapweed
Yellow Starthistle

"A" designated weed: A weed of known economic importance which occurs in the country in small enough infestation to make eradication/containment possible; or not known to occur but it's presence in a neighboring county makes future occurrence seem imminent.

Recommended Action: Infestations are subject to intensive control when and where found.

"B" designated weed: A weed of economic importance, which is regionally abundant, but of limited distribution in other counties.

Recommended Action: Moderate to intensive control at the state or county level.

"C" designated weed: All other weeds as listed on the state weed list.

"T" county priority weed.

Chapter 12: Forest Health

Introduction

This chapter discusses forest health as it applies to Blue Mountain forests, specifically the forest types found in the Upper Thirtymile Creek watershed. Most of the forest land in the Thirtymile Creek watershed is private lands with small partials of U.S. Forest Service lands that have recently been traded and converted to private lands. Because the private land is site specific to management, very little information is available on forest health, forest species composition, or forest stand size.

Background

Forest health has been a growing concern the last few decades in the Blue Mountains. Insect and disease outbreaks beginning in the mid-1970s killed millions of acres of trees, causing forest managers to seek solutions. What they found was a complex problem with no simple solutions. Selective logging, fire suppression, and grazing, among other factors, had changed forest structure and composition to types that were more susceptible to attacks by insects and disease (Langston 1995).

Historically, lower elevation and dry mid-elevation forests in the Blue Mountains were dominated by large Ponderosa pines (Jaindl 1996). Some of these forests, on south-facing slopes, were mostly pine, while north-facing slope forests contained more Douglas fir and Grand fir (Langston, 1995). Frequent fires on gentle slopes with non-brushy plant associations maintained open stands with little understory and grasses as ground cover. Wet mid-elevation forests, which had longer fire intervals, were composed of fire-intolerant conifers, including Grand fir, Western larch, and Douglas fir. At higher elevation, Lodgepole pine and Engelmann spruce were dominant species (Jaindl, 1996). Fire's role in higher elevation and moist middle elevation forests was more complex and variable. Fire intervals were longer in these forests, ranging from 40 to 150 years, and were usually stand replacing fires. Most trees were killed in these fires and new stands of pioneer species regenerated in their place.

By the 1930's, the U.S. Forest Service implemented a fire suppression policy for the national forests (Langston 1995). Oregon Department of Forestry was responsible for fire suppression on private forest lands. In the Blues, fire dependent forest types, such as the low elevation pine forest, would be dramatically changed in forest composition. Without fire to maintain the open, park like forests, fire intolerant species were able to invade these stands, resulting in mixed Ponderosa pine/Douglas fir forests on the drier southern slopes, and the entire replacement of Ponderosa pine with Douglas fir/true fir forests on the wetter northern slopes (Jaindl 1996). In addition to a change in species, a forest structural change was made as the forests coming in were smaller in size and denser (Langston 1995).

Selective logging has also played a large role in the changing forests. Selective logging is the practice of removing some trees from a stand and leaving others. Which trees are logged can be a determinant in the future composition of the forest. Ponderosa pine has traditionally been the economically valuable species in the Blue Mountains and thus the most often cut. High grading, the removal of large, high quality trees, while leaving the economically undesirable trees, was common in the early to mid 1900s (Langston 1995). On national forests, harvest levels increased drastically in the 1970s and early 1980s (Jaindl). These harvest were designed to change stands from uneven aged to even aged stands, in order to maximize timber production for the demands of a growing nation. Multiple species were planted.

When selective logging in the lower elevation forest removed Ponderosa pine from a stand, stands were not replaced with the same species. In the first crucial years, the Douglas fir and true firs can out compete the Ponderosa pine in denser stands. With the presence of historical fire, stands were kept more open, helping Ponderosa pine's survival. However, as fire was suppressed at the same time as timber harvesting, the acres of Ponderosa pine forests in the Blues decreased as the acres of mixed conifer forests increased.

Grazing in the Blue Mountains has also helped shape the current landscape. Livestock alter forest dynamics by reducing the biomass and density of understory grasses and sedges, which otherwise out compete conifer seedlings and prevent dense tree recruitment (Belsky 1997). Grazing thereby assists in the expansion of forests into grasslands. Grazing also affects forest structure and composition by reducing fuel loads in more open stands so fires do not kill as many young trees (personal communication, John Herbst).

Disease and insect outbreaks in the Blues are thought to have always occurred. In the 1920's, before most of the human impacts to forests took place, there were reports of loss of trees to disease and insects (Langston 1995). Climate plays a role in disease and insect outbreaks. Drier years stress the trees, opening opportunities for insects and disease to attack them. Nancy Langston argued in Forest Dreams, Forest Nightmares that insects and disease may be an integral part of the Blue Mountain ecosystem (Langston 1995). Others believe that the large scale disease and insect outbreaks in the 1980s and early 1990s were an indicator of unhealthy forests. Charles Johnson reported that "outbreaks of the beetle in east-side Lodgepole pine forests was an ecosystem response to the lack of stand replacement fire that normally would have burned many Lodgepole pine stands before they would become susceptible to bark beetles" (Johnson 1994).

Methods

Forest structure, composition, and fuels information was not available from the Oregon Department of Forestry for the watershed. Usually maps are created from ODF aerial photo interpreted GIS information on crown closure, tree species, stand sizes, and fuel modeling. This information was not available.

Discussion

Due to the lack of technical information, the author concludes that forest composition and structure in the Thirtymile Creek watershed have changed over time. Average tree size has decreased in size, with most stands currently small or medium in size classes. Crown closures are medium to dense, indicative of thick stands. The majority of forests are in dry mix or wet mix types. A smaller amount than historical are Ponderosa pine dominated stands.

Forest management is, and always has been, a highly debated issue in the West. People have different ideas about how a forest should be managed. Since how a forest is managed plays an integral role in forest health, how management is influenced should be understood. On public lands, forest management is often subject to public opinion. Private land management has some restrictions placed upon it by the Oregon Forest Practices Act. For the most part it is the landowners' decision on how to manage their forests.

Data Gaps

- Historical conditions of specific forest stand structure and composition

References

Jaindl, Raymond G. and Thomas M. Quigley, eds. Search for a Solution. American Forests, in cooperation with the Blue mountains natural Resources Institute. Washington, DC, 19965.

Johnson, Jr., Charles G. "Forest Health in the Blue Mountains: A Plant Ecologist's Perspective on Ecosystem Processes and Biological Diversity." September 1994. PNW-GTR-339.

Langston, Nancy. Forest Dreams, Forest Nightmares: The Paradox of Old Growth in the Inland West. University of Washington Press, Seattle and London: 1995.

Mutch, Robert W. et. Al. "Forest Health in the Blue Mountains: A Management Strategy for Fire-Adapted Ecosystems" February 1993. PNW-GTR-310

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

Wickman, Boyd E. "Forest Health in the Blue Mountains: The Influence of Insects and Disease". March 1992. PNW-GTR-295

Glossary

303(d) list: List of water quality impaired water bodies that do not meet ODEQ/EPA water quality standards.

4th-field HUC: Hydrologic Unit Code for sub-basin

5th-field HUC: Hydrologic Unit Code for watershed

6th-field HUC: Hydrologic Unit Code for sub-watershed

100-year floodplain: The area adjacent to the channel which has a 1 in 100 chance of being flooded in any given year.

Aggradation: The filling and raising of the level of a streambed by deposition of sediment.

Alluvium: Sedimentary material deposited by flowing water, as in a riverbed or delta.

Bankfull width: Width of a channel to the top of its banks, at the point where water begins to overflow onto the flood plain.

Beneficial uses: Uses of water specified in Oregon Water Quality Standards.

Best Management Practices: Practices developed to best address water quality problems in a specific area.

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

Connectivity: The physical connection between tributaries and the river, between surface water and groundwater, and between wetlands and these water sources.

Criteria: Elements of Oregon Water Quality Standards expressed as concentrations or narrative statements representing a quality of water that supports a particular use.

Crown closure: The amount of canopy cover in a given area. Canopy cover is the overhanging vegetation in a given area.

Debris flow: A type of landslide that is a mixture of soil, water, logs, and boulers which travels quickly down a steep channel.

Degradation: The general lowering of the earth's surface by erosion or transportation in running water.

Diameter Breast Height (DBH): A standardized measurement of the diameter of a tree, taken at breast height (approx. 4 feet).

Downcutting: When a stream channel deepens over time.

Drainage area: The region drained by a stream system.

Ecoregion: Land areas with fairly similar geology, flora and fauna, and landscape characteristics that reflect a certain ecosystem type.

Evaporation: The conversion of water into water vapor.

Evapotranspiration: The amount of water leaving to the atmosphere through both evaporation and transpiration.

Exceedence: When a measure of water quality exceeds the criteria. The exceedence needs to be evaluated with respect to natural or human causes.

Flood plain: The flat area adjoining a river channel constructed by the river in the present climate, and overflowed at times of high river flow.

Forest Practices Act: The Oregon Forest Practices Act, first enacted in 1972, regulates harvesting practices on private and state forest lands in Oregon.

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

Gradient: Channel gradient is the slope of the channel bed along a line connecting the deepest points (thalweg) of the channel.

Gully erosion: Erosion resulting in a ditch or channel cut in the earth by running water after precipitation.

Hydraulic gradient: Water level from a given point upstream to a given point downstream; or the height of the water surface above a subsurface point. Used in analysis of both ground and surface water flow, and is an expression of the relative energy between two points.

Hydrograph: A graph of runoff rate, inflow rate, or discharge rate, past a specific point over time.

Hydrologic Soil Group (HSG): Soil classification to describe the minimum rate of infiltration obtained for bare soil after prolonged wetting.

Hydrology: The science of the behavior of water from the atmosphere into the soil.

Impairment: An interpretation of criteria exceedence which indicates that the beneficial use is harmed.

Infiltration: The rate of movement of water from the atmosphere into the soil.

Large Woody Debris (LWD): Logs, stumps, or root wads in the stream channel, or near by. These function to create pools and cover for fish, and to trap and sort stream gravels.

Morphology: A branch of science dealing with the structure and form of objects. Geomorphology as applied to stream channels refers to the nature of landforms and topographic features.

Precipitation: The liquid equivalent (inches) of rainfall, snow, sleet, or hail collected by storage gages.

Raindrop splash erosion: Erosion caused as raindrops hit the ground during rain.

Ravel: Erosion caused by gravity, especially during rain, frost, and drying periods. Often seen on steep slopes immediately uphill of roads.

Redd: The gravel based nest of a salmonid fish.

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

Rill erosion: Erosion caused by water carrying off particles of surface soil.

Riparian area: Areas bordering streams and rivers in which ecosystem processes are within the influence of stream process.

Riparian Condition Unit (RCU): A portion of the riparian area for which riparian vegetation type, size, and density remain approximately the same.

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

Riprap: Rock and or concrete placed along stream banks for artificial stream bank stabilization.

Senate Bill 1010 (SB 1010): Oregon Senate Bill that placed Oregon Department of Agriculture in charge of developing water quality management plans for agricultural lands, across the state.

Sheet erosion: Soil erosion caused by surface water that occurs somewhat uniformly across a slope.

Sinuosity: The amount of curves or turns in a stream or river.

Sponge effect: The absorption of moisture into the banks that caused riparian areas.

Spring snowmelt: The time when the seasonal snow pack melts out.

Stream density: Total length of natural stream channels in a given area, expressed as miles of stream channel per square mile of area.

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

Total Maximum Daily Load (TMDL): A written plan and analysis established to ensure that water bodies will attain and maintain water quality standards.

Transpiration: Loss of water to the atmosphere from living plants.

Waterbar: A deep trough in a skid trail or road that is excavated at an angle to drain surface water from the skid trail or road to an adjacent area that is not compacted.

Wetland vegetation: Plants that are adapted to living in saturated or inundated conditions for at least part of the growing season.