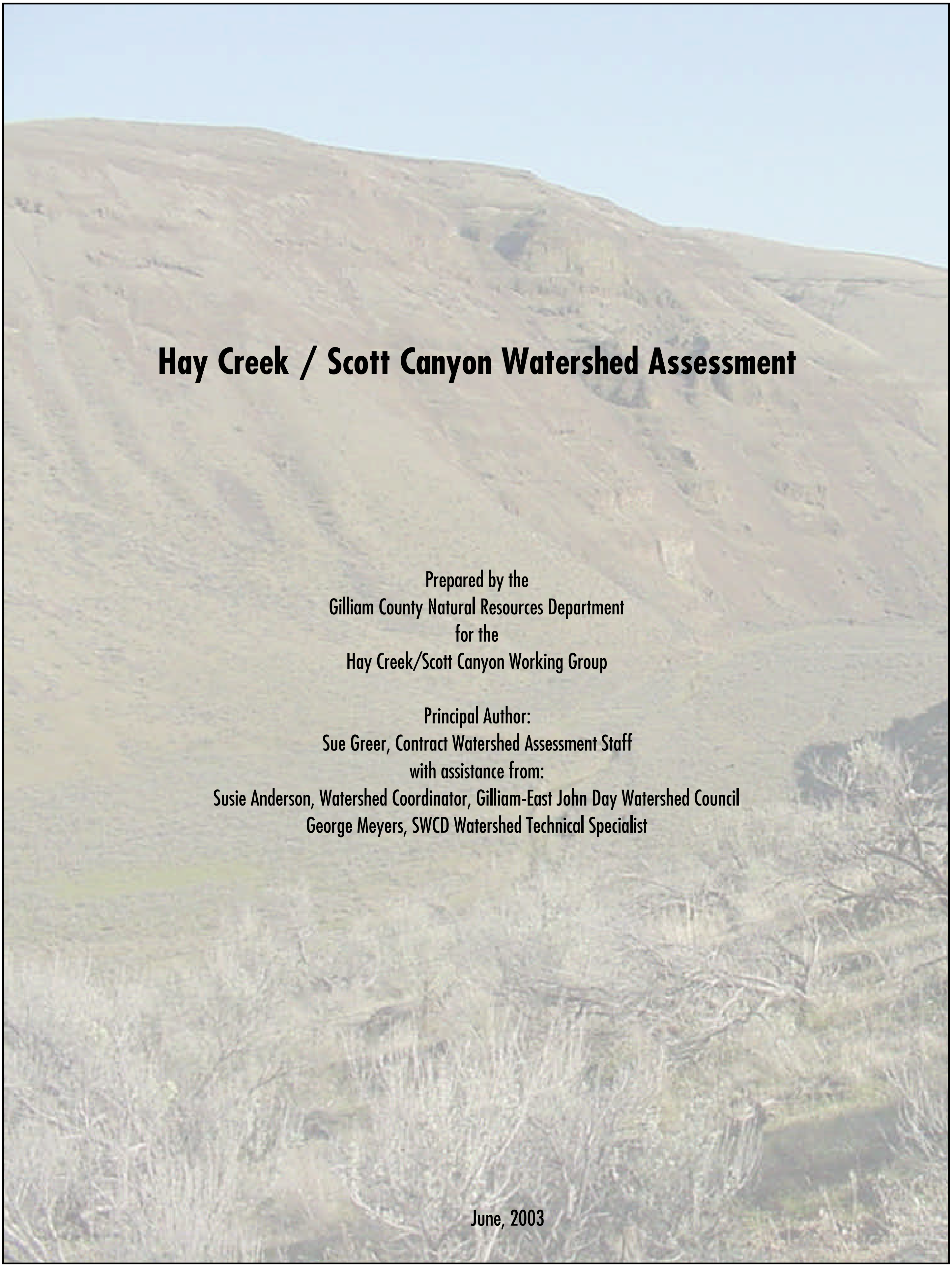


Hay Creek / Scott Canyon Watershed Assessment

Prepared by the
Gilliam County Natural Resources Department
for the
Hay Creek/Scott Canyon Working Group

Principal Author:
Sue Greer, Contract Watershed Assessment Staff
with assistance from:
Susie Anderson, Watershed Coordinator, Gilliam-East John Day Watershed Council
George Meyers, SWCD Watershed Technical Specialist

June, 2003

Hay Creek & Scott Canyon Watershed
Gilliam County, Oregon

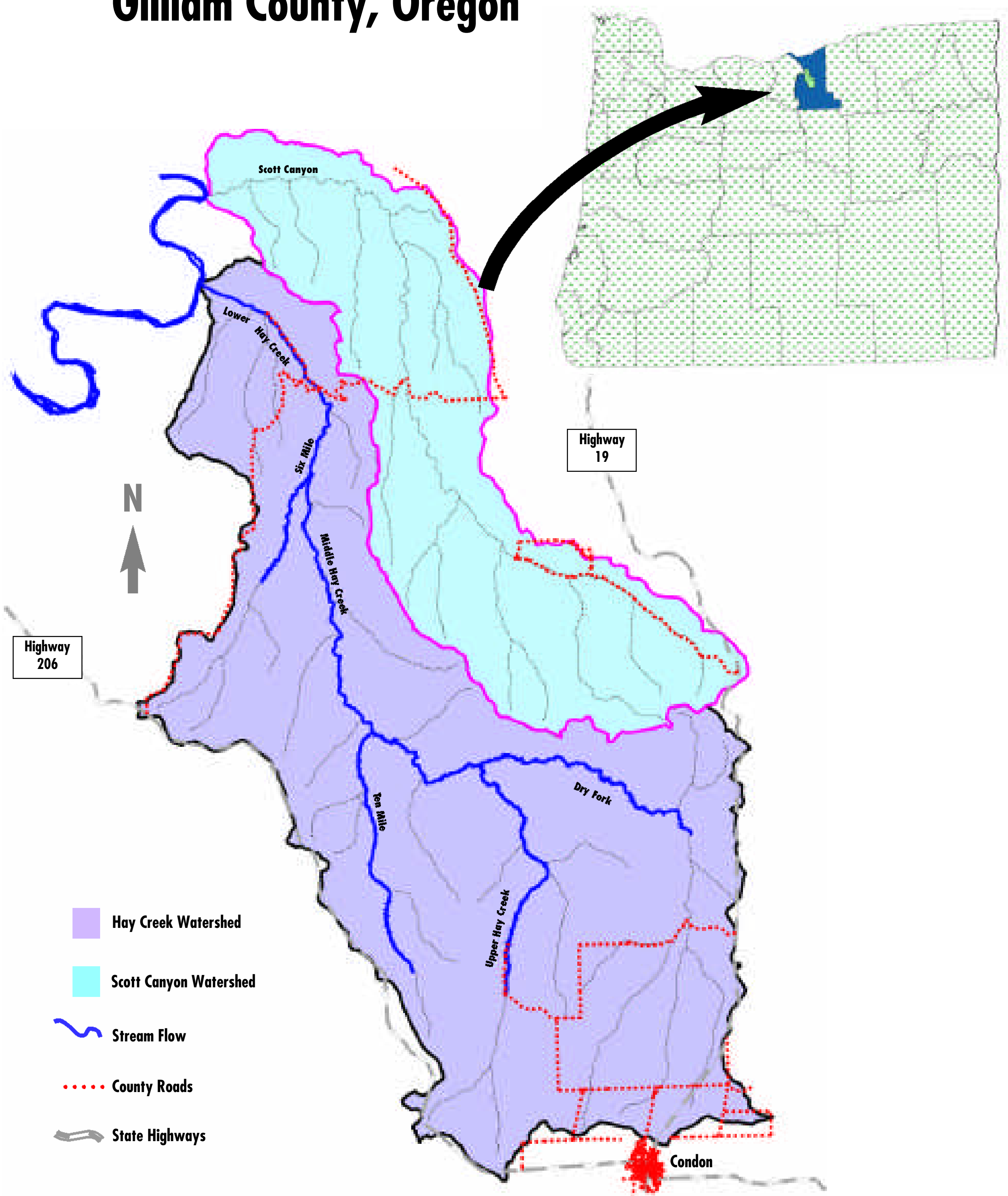


Table of Contents

CHAPTER 6 – SEDIMENT SOURCES

CHAPTER 7 – WATER QUALITY

CHAPTER 8 – RIPARIAN

CHAPTER 9 – FISH & FISH HABITAT

CHAPTER 10 – WATERSHED CONDITION SUMMARY

APPENDICES

CHAPTER ONE - INTRODUCTION

Welcome to the Hay Creek/Scott Canyon Working Group Watershed Assessment. This report provides an initial analysis of the natural and historical conditions in the watershed, based upon existing information and data, as well as identifies data gaps. Report organization is based on the Oregon Watershed Enhancement Board's Watershed Assessment Manual.

The assessment was coordinated by the Gilliam County Natural Resources Department at the request of the Hay Creek/Scott Canyon Working Group. The Hay Creek/Scott Canyon Working Group, established in March of 2000, is an all-volunteer group of ranchers, farmers, land owners, government agencies and other organizations working together to identify and pro-actively address watershed management issues in the Hay Creek/Scott Canyon Watershed.

Aspects of the watershed studied include stream conditions, hydrology, sediment transport, land and water use, vegetation, fish & wildlife habitat and water quality. The maps in this assessment show the extent and general location of certain watershed features and resulting human impacts.

The objective of the Hay Creek/Scott Canyon assessment is to create a working document that will help:

- identify aspects of the watershed that warrant more detailed study;
- identify riparian and upland areas that would benefit from restoration or enhancement;
- frame a future monitoring plan to fill data gaps;
- be used as a tool to prioritize and facilitate the funding and development of future watershed projects;
- document historical and current land use practices;
- begin an archive of photo monitoring of the watershed.

This assessment is not meant to pass judgement on any management practice, landowner decisions or activity. Rather, it provides a foundation to understand some of the human impacts to the watershed so that people can make informed choices regarding land use on public and private property and personal action. Finally, although restoration strategies are frequently mentioned in this document, this assessment does not determine what types of restoration should or will be sponsored by the working group.

This project would not have been accomplished without the help and support of many people. A sincere thanks goes to Jordan Maley, Extension Office; Ed Teel, District Conservationist, NRCS; Tim Unterwegner, Fish Biologist and Russ Morgan, Wildlife Biologist, ODF&W; Craig Obermiller, BLM Rangeland Management Specialist; and Fara Currim, Off-Reservation Habitat Biologist, Confederated Tribes of Warm Springs. Mac Stinchfield, editor of the *Times-Journal* and Karen Wilde, curator of the Gilliam County Historical Museum also contributed information and photos. Others include individuals who grew up here and shared their insights into the history of the watershed.

Copies of the Hay Creek/Scott Canyon Watershed Assessment are available from Gilliam County Natural Resources Department at Gilliam County Courthouse, 221 S. Oregon, Condon, Oregon. For more information, call (541) 384-3768.

Agencies & Jurisdictions

Agencies representing federal, state, county, city and local interests have different levels of jurisdiction in the Hay Creek/Scott Canyon Watershed. Many jurisdictions overlap in their areas of responsibility, and some overlap in geographical area as well.

Primary government agencies involved in managing the watershed's resources include:

- Gilliam County
- Gilliam County Soil and Water Conservation Districts (SWCD)
- Confederated Tribes of Warm Springs Indian Reservation
- Oregon Department of Environment Quality (DEQ)
- Oregon Department of Agriculture (ODA)
- Oregon Department of Fish & Wildlife (ODFW)
- Oregon Water Resources Department (OWRD)
- Oregon Department of Transportation (ODOT)
- U.S. Department of Interior (BLM)
- U.S. Department of Agriculture: Natural Resources and Conservation Service (NRCS)
- U.S. Fish and Wildlife Service (USFWS)
- National Oceanic Atmospheric Administration (NOAA)

Gilliam County Soil and Water Conservation District

SWCDs help landowners, ranchers and farmers plan and implement water and soil conservation measures, while working cooperatively with landowner working groups and other natural resource management agencies.

Oregon Department of Environmental Quality

DEQ is responsible for developing water quality standards that protect beneficial uses such as cold-water fisheries, salmonid spawning, drinking water, recreation and agriculture. The agency also monitors and periodically reviews available data to determine if these standards are being met. This agency manages both point and non-point pollution and implements the provisions of the 1972 Federal Clean Water Act. The agency is responsible for developing Total Maximum Daily Load (TMDL) allocations to those waterbodies that do not meet state adopted standards.

Oregon Department of Agriculture/Oregon State Weed Board

ODA is responsible for overseeing agricultural activities in the state. Under Senate Bill 1010, ODA is designated as the lead agency to address non-point source pollution related to agriculture. The Agricultural Water Quality Management Area Plan (1010 Plan) is developed to help address the agricultural portion of a TMDL. A local committee is currently working to develop a SB 1010 plan for the lower John Day Basin. This impacts both Hay Creek and Scott Canyon Watersheds.

The Oregon State Weed Board, a seven-member Board that broadly represents weed control interests in the State, assists counties in special projects and helps support biological control work. The Board and the ODA weed staff work together to set statewide priorities for funding of projects. The Board also develops and maintains the State Noxious Weed List.

Oregon Department of Fish and Wildlife

ODFW manages and protects fish and wildlife in Oregon. It establishes seasons and bag limits for hunting and fishing activities and provides technical assistance for state regulatory agencies and watershed councils. In the watershed they monitor fish and wildlife populations, including a small herd of Big Horn Sheep that migrated from the John Day River Basin.

Oregon Water Resources Department

OWRD manages and allocates waters of the state. This agency regulates surface and ground water withdrawal, issues water rights, classifies and regulates stream flow according to beneficial uses, and establishes minimum stream flow levels. OWRD hold certified in-stream water rights in trust for the State of Oregon.

Oregon Department of Transportation

ODOT is responsible for state and interstate road planning, construction and maintenance. Their jurisdiction includes Highway 206 and Highway 19, bordering the south and east sides of the watershed, respectively.

Federal Level

Bureau of Land Management (United States Department of the Interior)

The BLM administers 6,031 acres of land in Hay Creek and Scott Canyon watershed. This area is managed under the guidelines of the Prineville District BLM Resource Management Plan.

Natural Resources and Conservation Service (United States Department of Agriculture)

NRCS provides technical and financial cost-share assistance to landowners for planning and implementing conservation practices. Studies have been conducted to provide guidelines for grazing management plans for local livestock producers. NRCS also have been involved in cost-sharing on spring developments, off-stream livestock watering systems.

Farm Service Agency (United States Department of Agriculture)

The Farm Service Agency (FSA) is a partner with NRCS providing conservation payments for the Conservation Reserve Program (CRP) that pays annual crop producers (wheat) to plant permanent cover. The FSA is also a partner with the state of Oregon in the Conservation Reserve Enhancement Program (CREP) that pays an annual conservation payment for restoring riparian buffers along streams supporting listed fish species.

U.S. Fish and Wildlife Service

USFWS is responsible for tracking and maintaining viable populations of plant and animal species. The OSFWS administers the Endangered Species Act (ESA) for resident fish, wildlife and plants. It also oversees the listing, restoring, and protection of endangered and threatened species.

NOAA Fisheries (U.S. Department of Commerce)

NOAA Fisheries, formerly National Marine Fisheries Service, is part of the National Oceanic and Atmospheric Administration (NOAA). It is responsible for managing and sustaining living marine resources and administers the ESA for marine and anadromous fish species.

Conferated Tribes of Warm Springs

In the watershed, the Warm Springs Tribe manages 1,420 acres in the form of allotments and tribal lands administered by the Bureau of Indian Affairs. The tribes has treaty rights for lands ceded to the United States in 1855. These rights apply primarily o the right to fish and hunt in “usual and accustomed places” and to cultural sites.

Legislative and Management Plans

The following is a list of federal, state and local legislation and management plans that affect resource management in the Hay Creek/Scott Canyon Watershed.

Federal Legislation/Plans

Clean Water Act of 1972 and amendments
Endangered Species Act of 1973
Farm Bill

State Legislation/Plans

Oregon Plan for Salmon and Watersheds, 1998
Healthy Streams Initiative

Oregon Department of Agriculture

Senate Bill 1010
Confined Animal Feeding Operations (CAFO)

Oregon Department of Environmental Quality

Water Quality Conditions / DEQ 303(d) list, 2002
Water Quality Limited Streams, Total Maximum Daily Loads (TMDL)
Nonpoint Source Pollution Program
319 Grant Program

Oregon Department of Fish and Wildlife

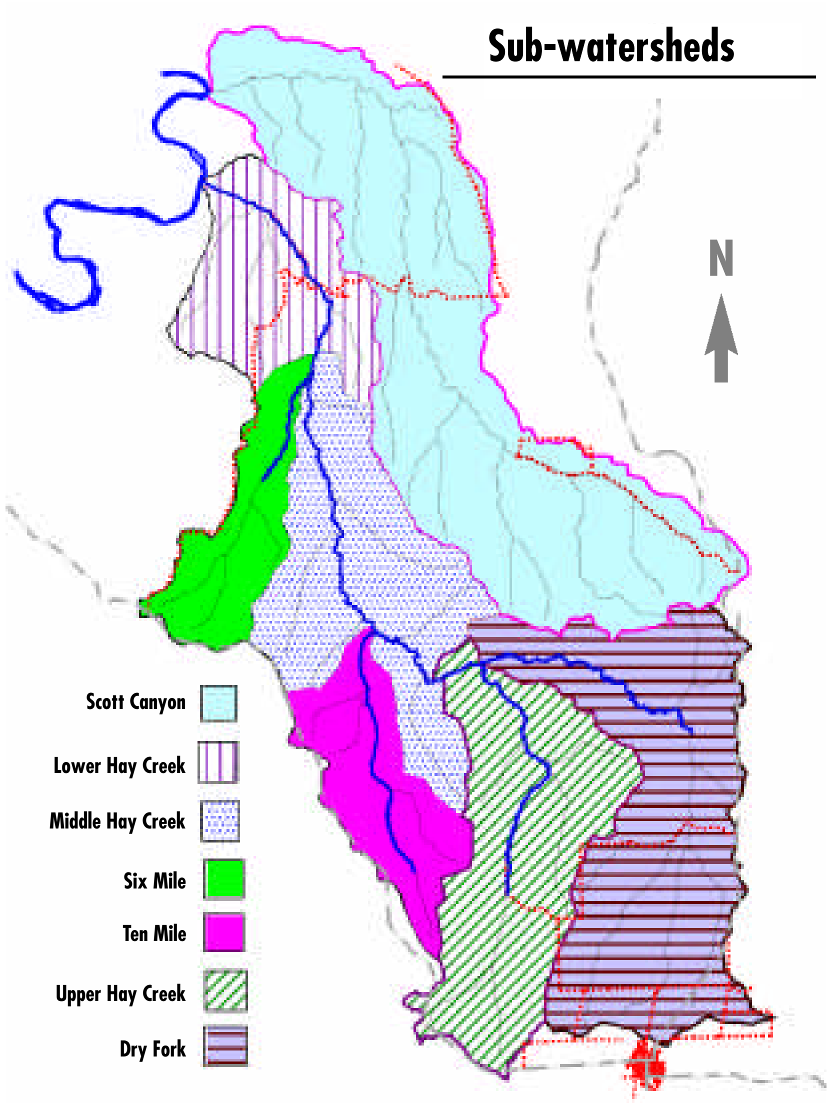
Oregon Endangered Species Act of 1987

Oregon Water Resources Department

Instream Water Rights Law, 1987
Conserved Water Rights Law

WATERSHED DESCRIPTION

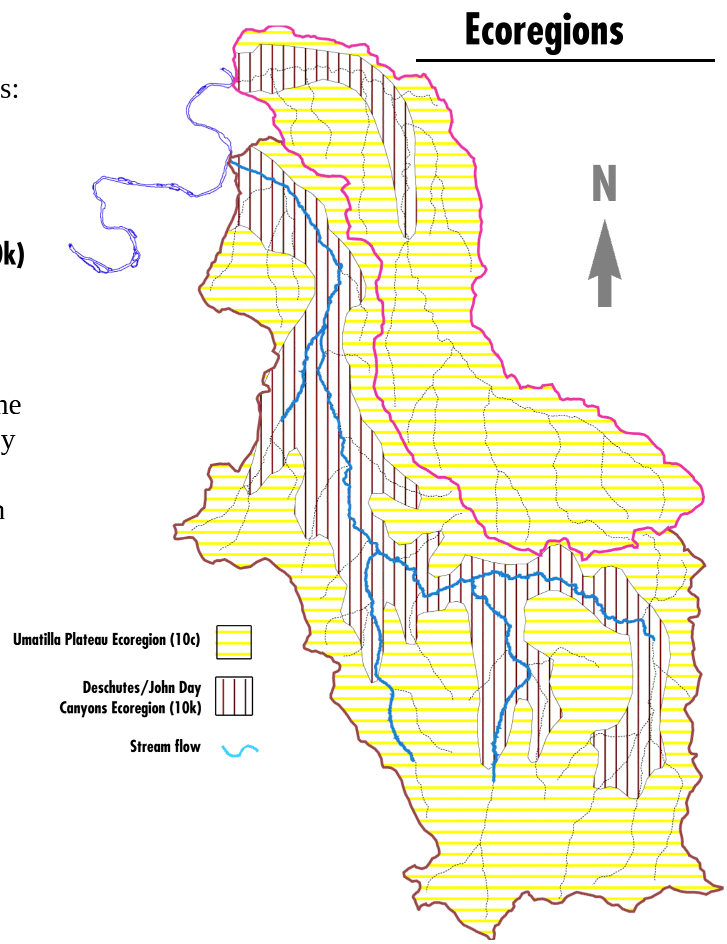
The Hay Creek/Scott Canyon watershed drains approximately 96,888 acres of land located in the middle west portion of Gilliam County. The watershed can be divided into two main watersheds: Hay Creek, draining 66,774 acres, with headwaters originating on the west side of the town of Condon and flowing north/northwest 24.7 miles into the John Day River at river mile 29.5; and Scott Canyon, draining 30,114 acres 19.5 miles in a north/northwest direction, ending up at the John Day River at river mile 26.5. There are three major tributaries in the Hay Creek watershed: Dry Fork (12.6 miles), Ten Mile (8 miles) and Six Mile (7 miles). Hay Creek watershed was divided into six sub-watershed to assist in identifying and focusing on the specific landscape features and land uses that impact water quality, in-stream habitat and riparian zone conditions. Sub-watershed divisions also provide a framework for future water quality monitoring studies, prioritizing restoration activities and identifying other issues of concern. The six subwatersheds are: Lower Hay Creek, Six Mile, Middle Hay Creek, Ten Mile, Upper Hay Creek, and Dry Fork. The upland portion of the watershed is almost entirely dryland agriculture and rangeland. Nearly all arable acreage is being farmed or has been farmed at one time, primarily for wheat production in a summer-fallow crop rotation. All the upland rangeland is considered natural grassland with less than 10% canopy of woody species in original ecological status. There is no current BLM or NRCS range condition data available for this area.



Ecoregions

The State of Oregon is divided into ecoregions that have been identified based on climate, geology, physiography, vegetation, soils, land use, wildlife, and hydrology. Ecoregions are relatively uniform geographic areas that respond in a similar manner to physical activities (rainfall, fire, land use activities, etc.). The identification of ecoregions within a watershed context is an important exercise in determining how the different portions of the watershed will respond to physical alterations. Ecoregion descriptions used in this assessment came from the *OWEB Watershed Assessment Manual.*

Hay Creek/Scott Canyon watershed is situated within the Columbia Plateau Province under two level IV Ecoregions: Deschutes/John Day Canyon ecoregion and the Umatilla Plateau ecoregion.



Deschutes/John Day Canyons Ecoregion (10k)

29% of Hay Creek/Scott Canyon Watershed

This ecoregion designation contains gorges that have been deeply cut into the basalt layers of the Columbia Plateau by river action. The canyons fragment the surrounding Umatilla Plateau ecoregion and the depth of those canyons create much drier conditions than the surrounding plateau. Mean annual precipitation is about 9 - 15 inches. Climate is continental with a marine influence. The relatively dry climate is due to the rain shadow effect from the Cascade Mountain range. Winters are cold and summers are hot with an occasional thunderstorm. A majority of the precipitation falls during the winter months of November, December and January, mainly as snow in the higher elevations.

Erosion rate is moderate. Most erosion occurs during high intensity runoff events during snow melt periods or thunderstorms. Shallow landslides usually occur in steep depressions along canyon walls and often trigger debris torrents that travel to the mainstem of the stream.

Vegetation is sparse on rocky, colluvial soils. It consists of bunchgrass in steeper areas and sage and cheatgrass in areas that are grazed. Riparian vegetation is often limited to sedges, rushes, willows or cottonwoods at the water line. Upland vegetation consists of agricultural crops (primarily wheat). Native vegetation includes bluebunch wheatgrass and Idaho fescue.

Land use is primarily agriculture with some recreational hunting.

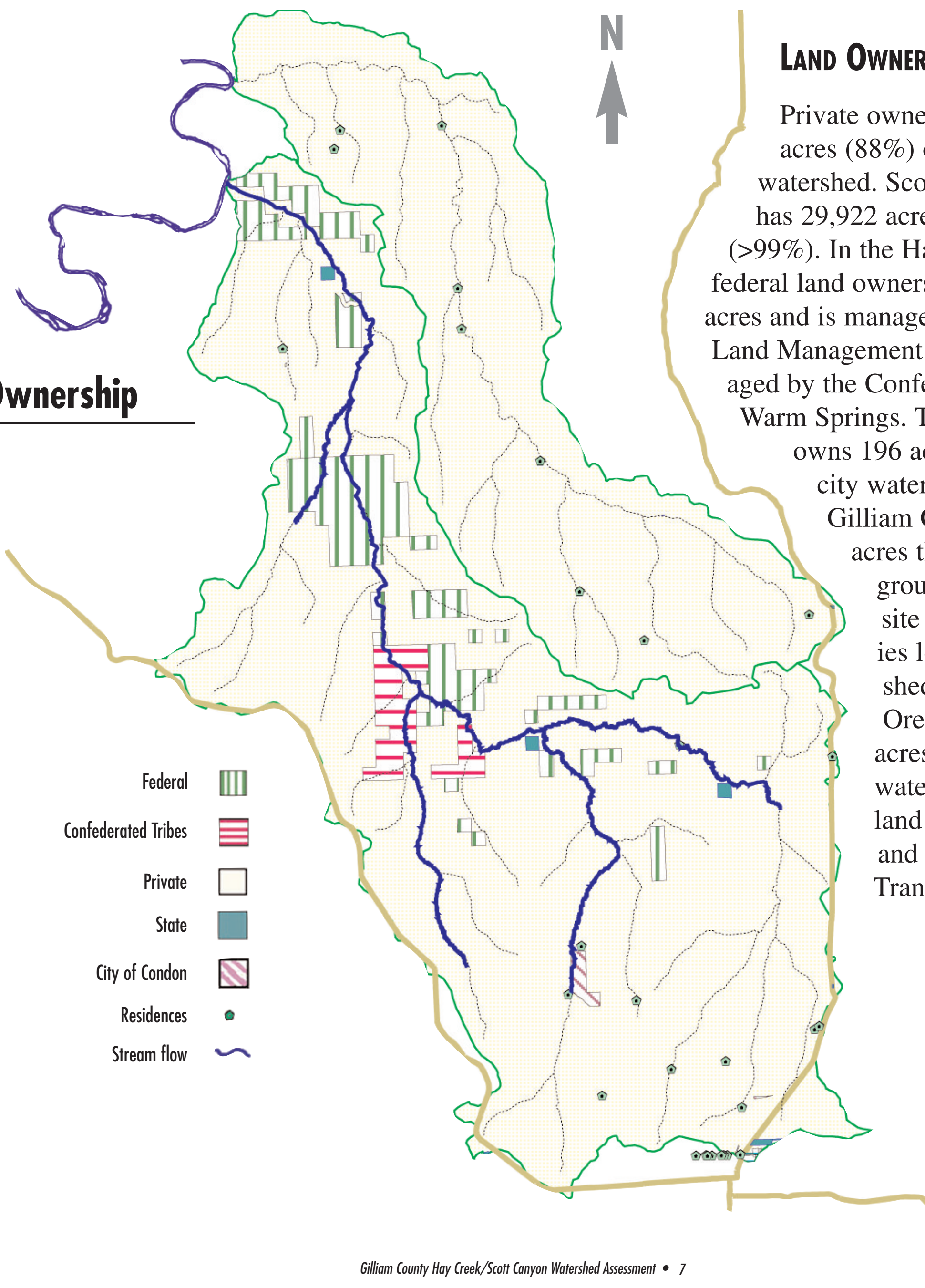
Smaller stream channel substrate on the lower gradient portions is gravel; on the higher gradient portions substrate is identified as cobble.

Umatilla Plateau (10c)

71% of Hay Creek/Scott Canyon Watershed

The Umatilla Plateau consists of wind deposited soil underlain by basalt. The soil tends to be deep in the north and thin in the south. Topography consists of undulating hills and plateaus dissected by steep-sided canyons (see Deschutes/John Day Canyon -10k). Streams have a moderate gradient. Erosion rate is moderate; precipitation is usually low, yet high-intensity thunderstorms can occur during summer, causing rill and gully erosion. Climate is continental with a marine influence just like 10k ecoregion. Mean annual precipitation is 9 – 20 inches with the majority of precipitation falling during late fall, winter and early spring. Most precipitation during the winter months falls as snow and snowmelt minimally contributes to runoff. Deep snowpacks rarely develop below 3,000 feet elevation. Streamflows are highest in the spring months. Substrate for smaller streams are fines and/or gravel at lower gradients and gravel at the higher gradients. Generalized crown closure estimates for upland stands of native grasses are noted at less than 30%.

Ownership

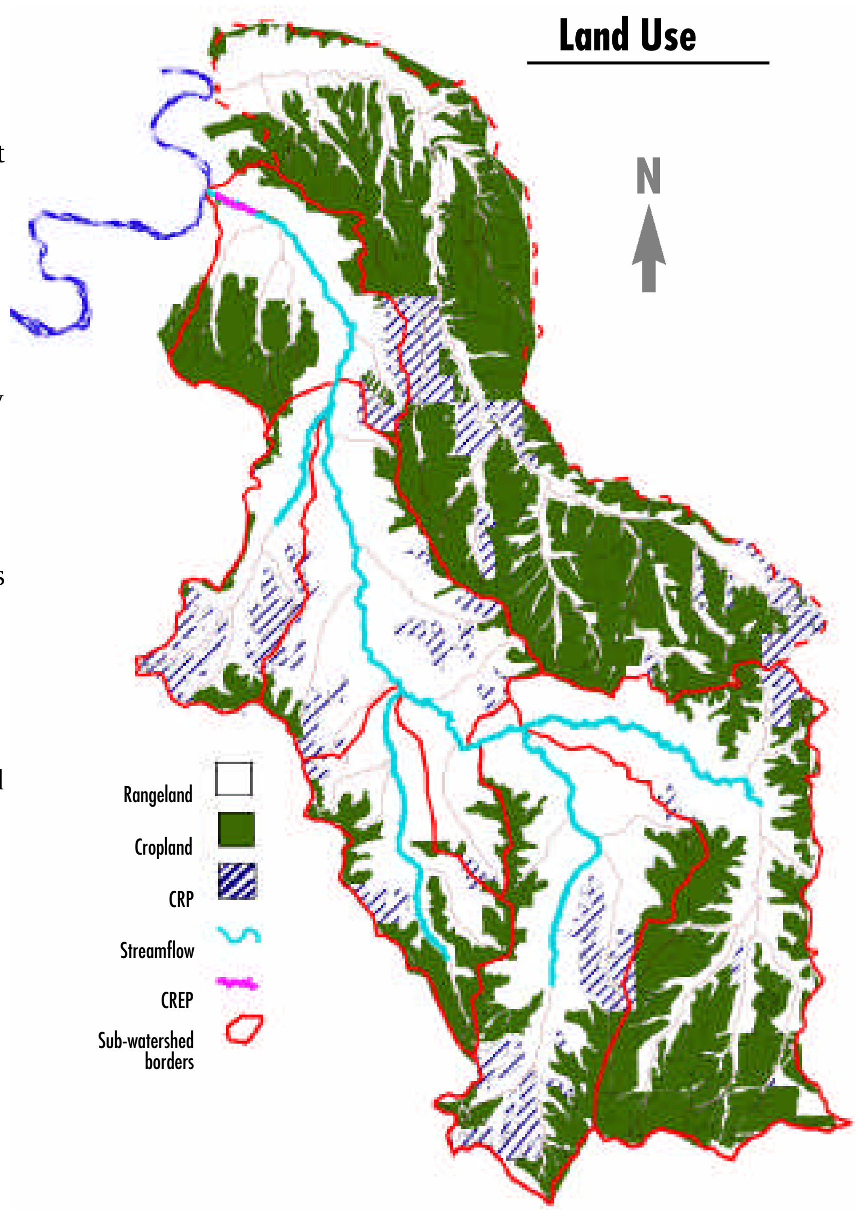


Land Ownership

Private ownership totals 58,951 acres (88%) of the Hay Creek watershed. Scott Canyon watershed has 29,922 acres of private ground (>99%). In the Hay Creek watershed, federal land ownership totals 6,031 acres and is managed by the Bureau of Land Management. 1,420 acres is managed by the Conferated Tribes of Warm Springs. The city of Condon owns 196 acres that include the city water supply system. Gilliam County owns 31 acres that include the fairgrounds, garbage pickup site and various cemeteries located in the watershed. The State of Oregon manages 147 acres of land in the watershed that include land around the airport and Department of Transportation lands.

Land Use

Of the 96,888 acres in the watershed, approximately 39,717 acres (49% Hay Creek / 51% Scott Canyon) are cropland, 48,871 acres (83% Hay Creek / 17% Scott Canyon) are rangeland or canyonlands. About 8,300 acres (68% Hay Creek/32% Scott Canyon) are currently enrolled in the Conservation Reserve Program (CRP). In the year 2000, approximately three miles of riparian lands were enrolled in the Conservation Reserve Enhancement Program (CREP) on the lower reaches of Hay Creek.



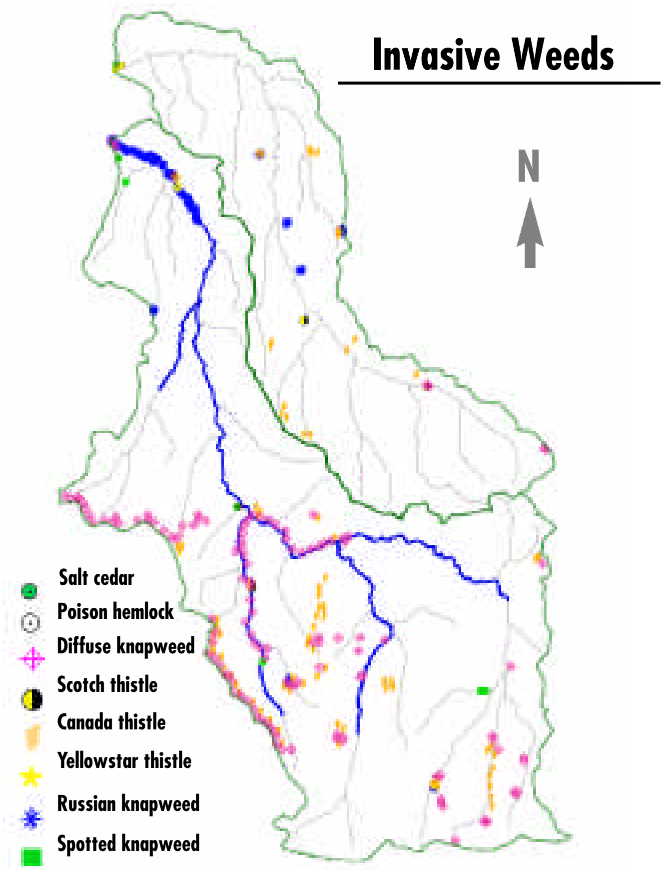
Seawest, Inc has leased approximately 25 acres on the upper end of the Hay Creek watershed for 61 wind turbines used for energy production. The land is zoned exclusive farm use with a conditional use permit.

Almost all of the land in the Hay Creek/Scott Canyon watershed is used for agricultural purposes. The ranches in the watershed primarily raise small grains. The grain is traditionally winter wheat in a summer fallow rotation with an occasional crop of spring grain. Some farmers are using conservation tillage (no-till or minimum-till) farming practices. Flood irrigation is used on a very small section on lower Hay Creek. No large-scale irrigated agriculture occurs in the watershed.

Many of the ranches raise cattle as well as wheat. Stubble is used as a forage base to supplement rangeland grazing. The rangeland in the watershed varies from excellent condition to poor. A decrease of perennial bunch grasses and a corresponding increase in annual grasses and sagebrush is a problem in some areas. Certain sections have incised channels with a lowered water table, extremely narrow riparian zones and encroaching sagebrush stands.

Noxious & Invasive Weeds

Noxious weeds are defined by the Oregon State Weed Board as exotic, non-indigenous plant species that are injurious to public health, agriculture, wildlife or recreation on private or public property. Non-native invasive weeds species are plants that reduce the productivity of agronomic, range and forestry systems by displacing desirable native species by capturing and utilizing valuable resources. They disrupt ecosystems by displacing native species with invasive monotypic weed stands which impact wildlife by altering habitat and food sources. Many invasive exotics short circuit the water cycle by intercepting precipitation and transpiring it back to the air, reducing soil storage (e.g. cheat grass, juniper). Other invasives have similar effects on nutrients. Some invasive weed species can also increase erosion and runoff in their stands.



Noxious and invasive weeds found in the Hay Creek/Scott Canyon watershed include: Russian, Diffuse and Spotted knapweed, Yellow star thistle, Scotch thistle, Canada thistle, Dalmation toadflax, Poison hemlock. Medusahead rye, Field bindweed, Jointed goatgrass, Puncture vine, Salt cedar, and Cheatgrass.

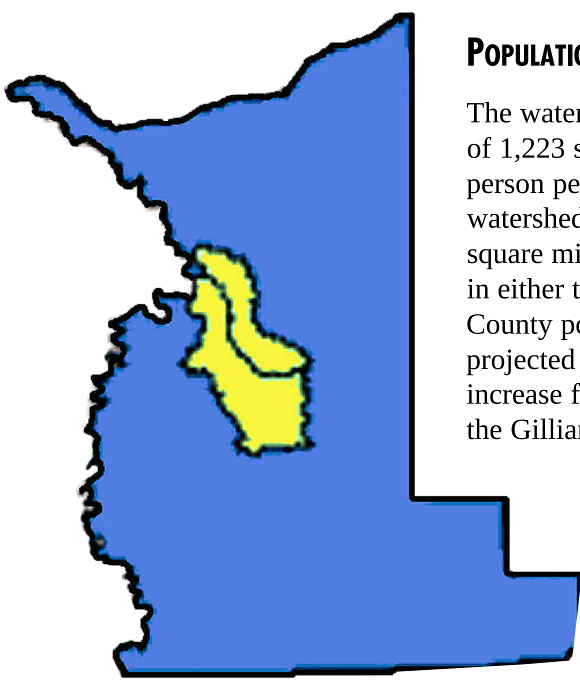
Field bindweed, Canada thistle, Russian thistle, Jointed goatgrass and Cheatgrass plague the tilled fields. Where grazing has been more intense, Cheatgrass, Medusahead rye and Knapweed have become a problem. Some species, including Salt cedar and Dalmation toadflax, occur along the John Day River and at the mouth of Scott Canyon and Hay Creek. Areas alongside roads or where the soil has been disturbed are also problematic. Heavy infestation of sagebrush has had a detrimental effect on desirable plant species in many areas of the watershed. The dominant variety of sage is Big sagebrush. It has a broad ecological tolerance and can survive under the greatest range of environmental conditions. Still, it grows best in deep, relatively moist soils that are mildly basic (ph). As soil conditions deteriorate and water availability decreases, tall sagebrush grows progressively smaller. And, even though it has a broad tolerance of conditions, Big sagebrush is not necessarily a strong competitor. In more moist extremes it tends to be replaced by grasses, shrubs or trees. One defensive tactic of Big sagebrush is the release of a toxic compound when it's fallen leaves decay. This apparently limits the growth of would-be competitors. Sage can be controlled by chemical means or by alternative grazing practices using goats.

Efforts of the Gilliam County Weed department, BLM, Gilliam-East John Day Watershed Council and private landowners are being implemented to contain and reduce the spread of invasive and noxious weeds in the watershed.

Fish & Wildlife


Mule Deer

The dry climate of the Hay Creek/Scott Canyon watershed makes wildlife distribution dependent on perennial stream flows, which are low and short for most of the year. Many stream segments have intermittent reaches. Wildlife also utilize seeps and springs which are located throughout the watershed. The environment provides important habitat for game animals and birds, including mule deer, elk, big-horn sheep, chukar, Hungarian partridge (huns), ring-neck pheasant, California quail and doves. It is not known when chukars, pheasants and huns were introduced to the Hay Creek/Scott Canyon area, but ODFW documentation shows chukars being released in eastern Oregon in 1951; huns in 1912; and in the Willamette Valley, pheasants were introduced in 1882. There are also many species of non-game animals and birds living in the area. They include coyote, bobcat, cougar, badger, beaver, porcupine, rabbits, muskrat, weasels, skunk, raccoon and ground squirrels. The bird species include red-tailed hawks, Swainson's hawk, rough-legged hawk, marsh hawk, golden eagle, bald eagle, owls, herons, magpies, kingfishers, meadowlarks, swallows and many other species of small birds, both resident and migratory. Canadian geese and many species of ducks use the area during migration. Reptiles which may inhabit the watershed include the Oregon rattlesnake, desert gopher snake, western striped racer, bull snake, western collared lizard, horned toad, leopard lizard and the desert whip-tailed lizard. Fish species may include Torrent sculpin, Mottled sculpin, Summer steelhead, Redband trout, Speckled and Longnose dace, Redside shiner, Bridgelip and Largescale sucker and possibly even the Pacific lamprey. *See appendices XXXIII for fish and wildlife species in chart form.*



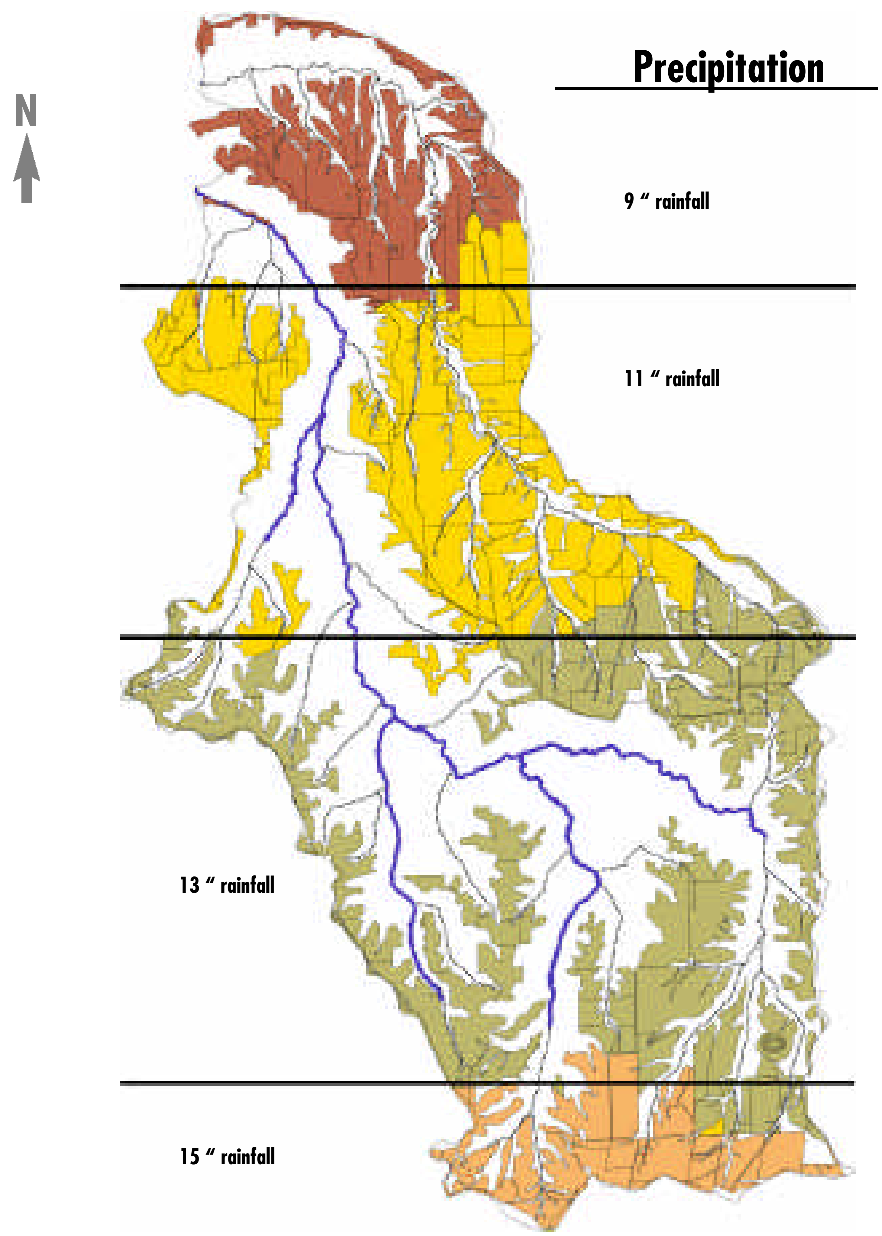
Population

The watershed is entirely within Gilliam County, an area of 1,223 square miles with a population density of 1.5 person per square mile. In the Hay Creek/Scott Canyon watershed there are twenty full-time residents in 152 square miles. The majority of the county population lives in either the town of Condon or Arlington. Gilliam County population was 1,915 in the year 2000. The projected population for the year 2020 is 2,616, a 31% increase from the present population as documented in the Gilliam County Statistics 2002 Certified Ratio Study.

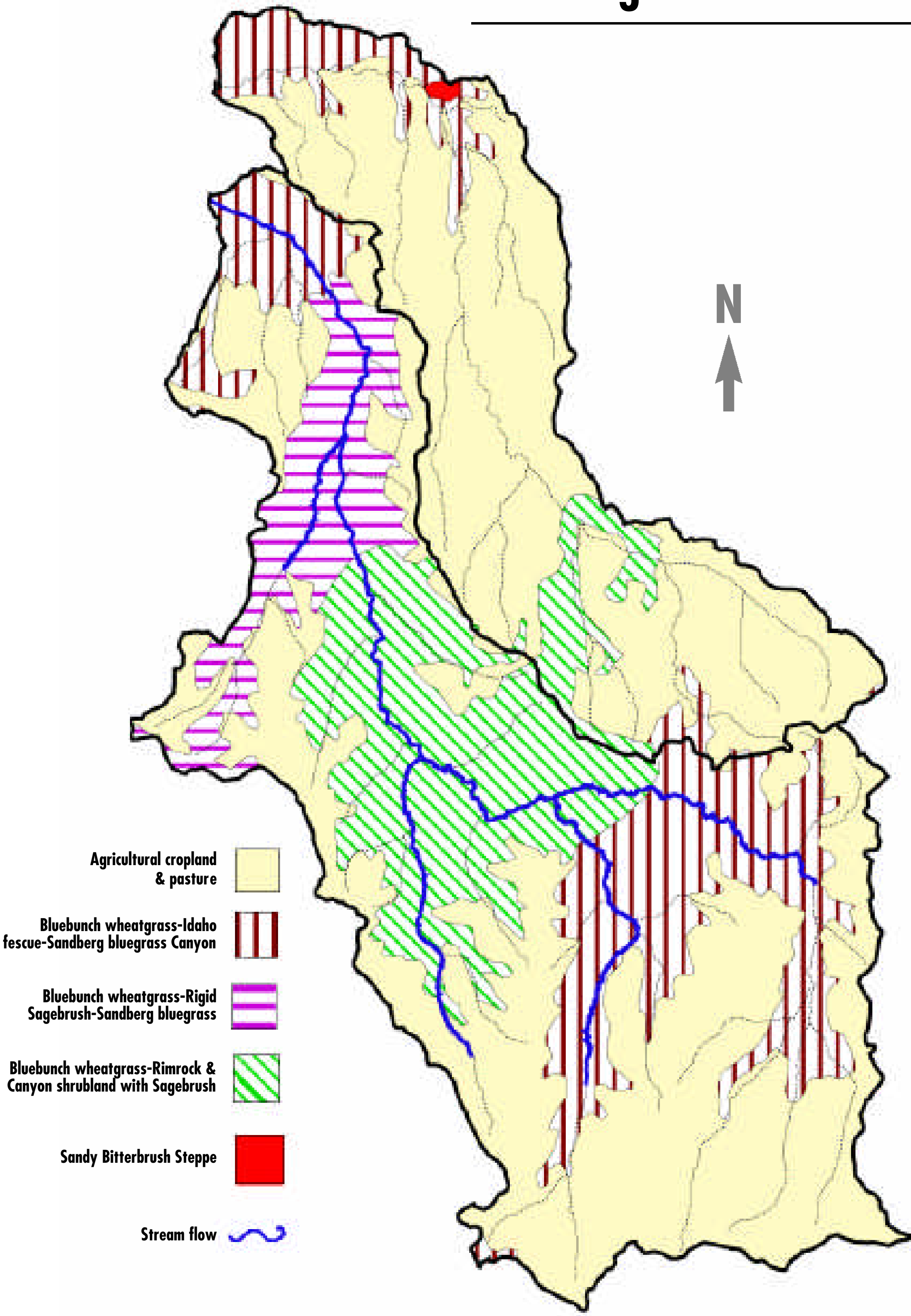
Climate & Precipitation

Temperatures recorded for a 72 year period show an average high of 61° Fahrenheit and an average low of 38° Fahrenheit. The extreme high record temperature was recorded on July 1928 as 111° and extreme low record temperature was -22° in 1930, 1933 and 1990. Monthly snowfall records from the Condon station show 14 years out of the 74 recorded having over 40" of snow. The highest snowfall occurred in 1955-56 with a total of 77.5 inches falling between November and March.

In the Hay Creek/Scott Canyon watershed the months with the highest precipitation tend to be November, December and January. Heavy spring rains tend to fall mostly during May. Annual amounts of precipitation average between 9" to 15" with the higher rainfall occurring at the higher elevations. The precipitation calculations came from the NRCS Prism project which identifies precipitation in farm fields only.



Vegetation Zones



Vegetation Zones

Different plant communities reflect the environment and land use history of the site. Potential natural vegetation occupies different zones characterized by soils, climate, elevation and topography. There are five vegetation zones located in the Hay Creek/Scott Canyon watershed. They are agricultural cropland and pastureland; Bluebunch wheatgrass-Idaho fescue-Sandberg bluegrass canyon grassland; Bluebunch wheatgrass-Rigid sagebrush-Sandberg bluegrass; Bluebunch wheatgrass-rimrock & canyon shrubland with Sagebrush; and Sandy bitterbrush steppe. This information is from the *1992 Manual of Oregon Actual Vegetation for the Oregon Gap Analysis Program.*

Agricultural cropland and pasture *59% of the watershed*
Low stature annual cropland and intensively grazed pastureland.

Bluebunch wheatgrass-Idaho fescue-Sandberg bluegrass Canyon Grassland
18% of the watershed
Medium-tall grassland with scattered shrub patches. It is often found in a mosaic with Sandberg bluegrass and Rigid sagebrush scablands, and with sagebrush and juniper steppe. The characteristic grass is Bluebunch wheatgrass with Sandberg bluegrass as the codominant. Idaho fescue can be found on the north slopes. Columbia needlegrass, Prairie junegrass and Cheatgrass can also occur in this area. The dominant shrubs which can be found in this area are Curl-leaf mountain mahogany, Big sagebrush, Desert bitterbrush and Blackthorn. Shrub cover is always extremely low in this grassland type. Arrowleaf balsamroot, Parsnipflower buckwheat and Longleaf phlox are the forbs commonly found in this area of the watershed.

Bluebunch wheatgrass-Rimrock & Canyon Shrubland with Sagebrush *16% of the watershed*
These areas are actually a mosaic of the Bluebunch wheatgrass-Idaho fescue-Sandberg bluegrass Grasslands and Rimrock and Canyon Shrubland with Sagebrush. The vegetation structure is diverse tall and medium shrubs, barren slopes with bunchgrasses and forbs interspersed. Bluebunch wheatgrass and Cheatgrass are the most widespread grasses. Basin wildrye can be found in patches. Blue wildrye, Columbia needlegrass, Needle & thread, Idaho fescue and Sandberg bluegrass can also be found. Curl-leaf mountain mahogany, Currant, Spiny greasebush, Chokecherry, Little sagebrush, Big sagebrush, Owyhee sage, Shadscale saltbush and Antelope bitterbrush make up the shrubs located in this area. Forbs include Arrowleaf balsamroot, Longleaf phlox and Parsnipflower buckwheat. Juniper exists, but is not prolific.

Bluebunch wheatgrass-Rigid sagebrush-Sandberg bluegrass *7% of the watershed*
A low shrub community or shrub-bunchgrass mosaic in which Rigid sagebrush is dominant with an understory of very short grasses and forbs. Sandberg bluegrass is the dominant grass, making up most of the vegetative cover. Onespike danthonia, Columbia needlegrass, Henderson's needlegrass are occasionally found. Where other shrubs are found they are usually Big sagebrush and Antelope bitterbrush. The forbs found in these areas include Douglas buckwheat, Rock buckwheat, Matted buckwheat, Bitterroot, Largehead clover, Desert parsley, Trumpet flower, Fleabane and Sandwort species.

Sandy Bitterbrush Steppe *<1% of the watershed*
Typically a medium-tall shrubland steppe with bunchgrass or Cheatgrass understory. Bitterbrush is usually dominant. Needle and thread is the characteristic native bunchgrass but if degraded Cheatgrass usually replaces it. Sandberg bluegrass can be codominant. Other shrubs found in this area include Desert bitterbrush and Yellow rabbitbrush. Big sagebrush occurs along the silty margins of the community.

SOILS

The Hay Creek/Scott Canyon watershed consists of a variety of soil types. The highest percentage of soil types, located in the uplands, are silt loams classified as **Ritzville**, **Mikkalo**, **Rhea**, **Willis**, **Condon & Valby**. These are moderate to very deep, well-drained silt loams formed in loess and colluvium. Water permeability is moderate. These soils are susceptible to runoff erosion in all but almost level areas. Sedimentation from runoff can be moderate or high, depending upon the slope and the land management practiced. A small area in the watershed is typed as **Warden Silt Loam**. This very deep, well-drained soil in located on the uplands on 20 to 40% slopes. It is formed in the loess and the underlying calcareous, lacustrine silt. The permeability of this soil is moderate with rapid runoff and a high hazard of erosion. **Nansene Silt Loam**, on 35 to 70% slope, is another very deep, well-drained soil located on north-facing exposures formed in loess. The erosion hazard is high on this soil type with moderate permeability and rapid runoff.

The next highest percentage of soil type in the watershed is the **Lickskillet Rock Outcrop Complex**. This complex is on south-facing exposures of canyons. Average slope is 50% and is made up of a combination of Lickskillet soils and rock outcrops. Permeability of the Lickskillet soil is moderate. Runoff is rapid, and the hazard of erosion is high. The rock outcrop consists of exposed areas of basalt bedrock.

Lickskillet Very Stony Loam is identified as shallow, well-drained soil on south and west facing exposures. Permeability is moderate and runoff can be rapid, with the hazard of erosion high. **Wrentham-Rock Outcrop Complex** is on north-facing exposures on the uplands. The permeability factor for Wrentham-Rock is moderately slow, but runoff is rapid and the hazard of erosion is high. The rock outcrop portions are exposed areas of basalt. Both Lickskillet Very Stony Loam and Wrentham Rock Complex were formed in loess mixed with colluvium from basalt. Sedimentation from runoff can be low to moderate. Maintaining maximum plant cover on rangeland with these types of soils help contain erosion and sedimentation.

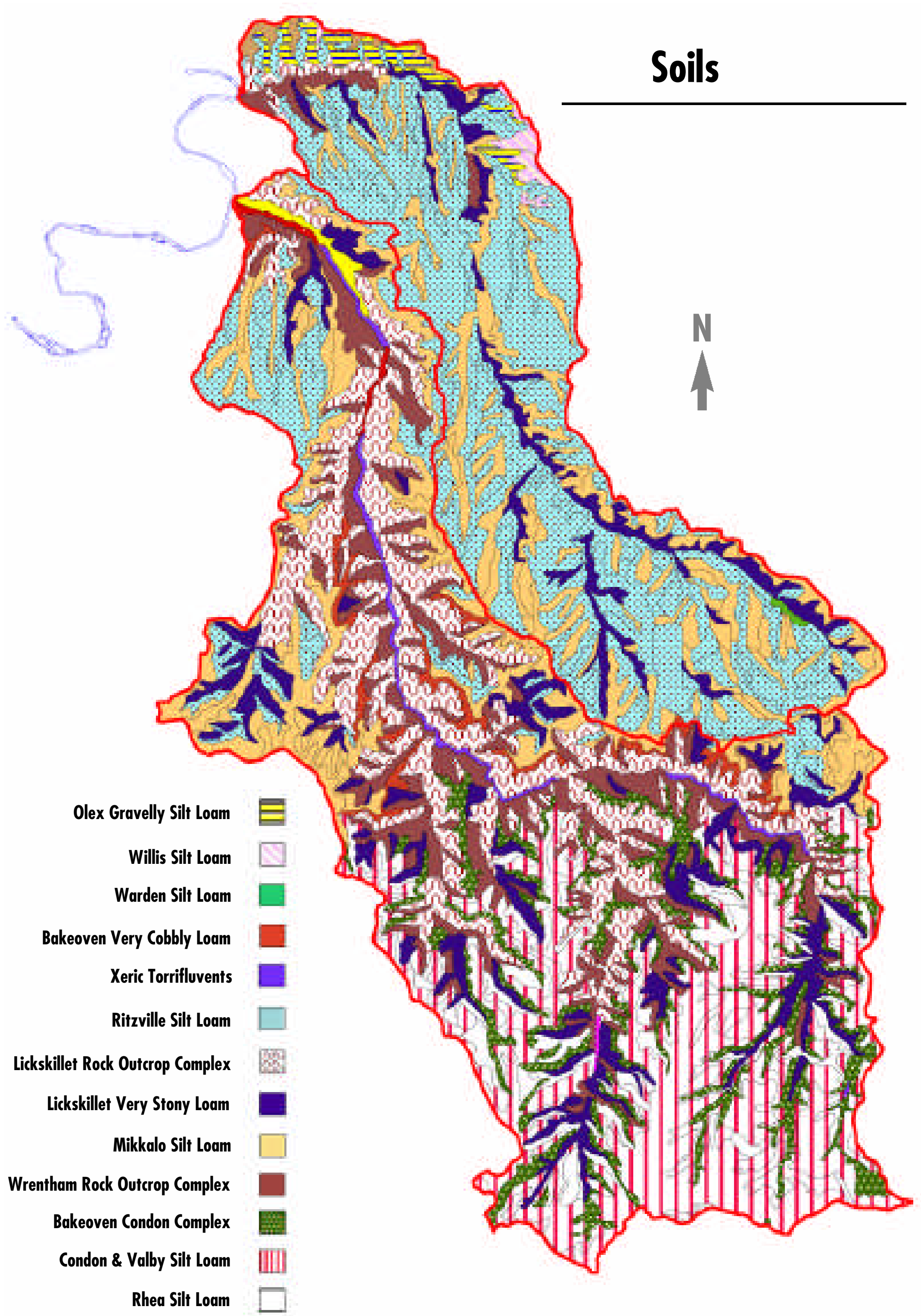
Bakeoven-Condon soils are on ridgetops and are often called biscuit-scablands. The permeability of this type of soil complex is moderate with runoff slow to medium, and the hazard of erosion slight to moderate. The management of these types of soils focuses on maintaining vegetation to help control erosion.

Bakeoven Very Cobbly Loam is a very shallow, well-drained soil on ridgetops and plateaus. Water permeates this type of soil moderately slow with runoff being slow to medium. Erosion hazard is moderate.

Hermiston Silt Loam make up less than 1% of soils identified in the watershed. It is very deep, well-drained soil on alluvial bottomlands. It is formed in alluvium from loess and volcanic ash. The permeability is moderate, runoff is slow and erosion hazard is slight. **Kimberly Fine Sandy Loam** is similar except that permeability is moderately rapid but runoff is slow and erosion hazard slight. Stabilizing streambanks in these types of soils is an important management focus.

Olex Gravelly Silt Loam is very deep, well-drained soil located on uplands. It formed in loess and very gravelly alluvial deposits. Olex soil permeability is moderate with rapid runoff and a high erosion hazard.

Xeric Torrifluvents make up less than 1% of the watershed soils but it is a important one to note as it makes up the majority of the soil type associated with the stream bed and riparian zones. These are very deep, somewhat excessively drained soils on the bottom lands of streams. They formed in alluvium and windlaid materials. Permeability of Xeric Torrifluvents is rapid, runoff is slow, and the hazard of erosion ranges from slight to high, depending on location. Wind erosion is moderate to high when vegetation cover is minimal.



Historical Timeline Hay Creek & Scott Canyon

1862 • Gilliam County (then called Wasco County) first settled.

1870 • Columbia river floods in 1870, 71 76, 80

1875 • R.G. Robinson brought the first band of sheep into Gilliam County.

1880 • Push up dam on lower Hay Creek installed.

1881 • The first wheat crop was raised by William and Al Weatherford.

1881 • Noted as the "double winter" 90 – 95% of all stock in the county either froze or starved to death.

1885 • This region becomes Gilliam County.

1887 • Simon Barker, father of CC Barker, came to the area and began herding sheep.

1889 • The hardest winter was the winter of 1889. A thaw came in February. On the 14th, it turned cold. Practically all the cattle died of starvation. People were very hard up the next year.

1890 • Population in Gilliam County was 3,600.

1891 • Rock Creek area had a severe water spout and hurricane. Much damage was done – roads and bridges washed out. Rocks thrown up onto fields, etc.

1898 • Great flood of The Dalles.

1899 • Condon's water system was first installed on Hay Creek

1906 • A well of 410 feet was drilled at the city farm and claimed 40 gpm.

1909 • Horse drawn equipment was used until the first gas powered machines came into the county. EC Rogers first used this equipment near Mikkalo.

1915 • Another double winter. Many stock died.

1923 • Hay Creek Water Supply project began for the City of Condon.

1927 • Another well drilled to 65 feet and had pumping equipment capacity of 100 gpm.

1930 • Population in Gilliam County was 3,467.

1948 • Cattle numbers in Gilliam County 20,000.

1950 • Population was 2,817.

1954 • Flood event. High precipitation impacted Hay Creek/Scott Canyon watershed

1956 • Flood event. High precipitation impacts watershed.

1964 • Extremely severe rainstorm follows large snowfall accumulation. Much flooding, many bridges and roads taken out, houses flooded or destroyed. Hay Creek scoured of all riparian vegetation.

1976 • Five wells were registered with the water board for use at the Condon Water Supply, known also as the City Farm.

1980 • Direct seeding farming practices begun.

1985 • First CRP contracts in Gilliam County were established.

1996 • Floods. High precipitation impacts watershed.

1997 • Push up dam (fish passage barrier) on lower Hay Creek removed.

1999 • Three shallow wells were drilled ranging in depth of 43.5 feet to 103 feet. Wells tested at 90 gpm; 50 gpm; and 107.5 gpm respectively. Temperature of water during pumping testing was between 55 and 59 degrees.

2000 • Seawest, Inc. began installing wind power generation farm.

2002 • Cattle numbers in Gilliam County estimated at 26,100.

CHAPTER THREE – Historical Perspective on Hay Creek Watershed

Introduction

This chapter summarizes available information on historic conditions and changes in land use in the Hay Creek/Scott Canyon watershed. Knowledge of historic conditions and the cumulative effects of land use can help guide restoration actions and improve their chances for success. This chapter was compiled from research gathered from historical museums and websites, county records, extension service journals and interviews with people who were born and raised in this area. The interviews proved invaluable in getting a real sense of historic events and how they impacted the watershed.

Geology

The oldest formations in the Columbia Plateau region are the Blue and the Wallowa Mountains which stand like islands above a flood of basalt. When these mountains were new they were part of a chain of coastal mountains that embraced an ocean bay that has since become most of central and northern Oregon. About 35 million years ago a line of volcanic islands shifted to the present north-south trend of the western Cascades, cutting off the ocean and creating an inland sea. After a rest of 5 million years, volcanic activity started again sending enormous clouds of light-colored ash over Central Oregon. Then in the Miocene era, about 25 million years ago, volcanic activity shifted more to central and then to eastern Oregon and involved eruptions of enormous floods of basalt, some of which covered thousands of square miles with single lava flows. The volcano that impacted the Gilliam County area the most was the **Grand Ronde volcano**, which may well be the largest single volcano known on earth. Some of the flows poured down the valley of the ancestral Columbia River all the way to the Pacific Ocean.

The old soils sandwiched between the Miocene lava flows represent a type of soil that develops only in wet, tropical climates. These traces of soils indicate that during the Miocene time period Oregon had a wet, tropical climate and was covered by lush jungles. About 12 million years ago the lush climate ended and it became extremely dry and much cooler, staying that way for the next 10 million years. At least four ice ages came and went during that time. An ancient lake basin in this area is geologically related to the era of glacial melt following the ice age. Geologists have found that the glacial melt impacted our area in several ways: the Missoula flood(s); the ice jam near The Dalles that backed up water to form Lake Condon; and the ice floes that contained sand, silt, gravel, and other glacial debris and erratics. When the ice floes melted, these erratics and debris were deposited over the landscape in the lake basin. Along the perimeter of this ancient lake basin there is a lakeshore terrace at about 900 feet elevation where it butts up against adjacent uplands. The lake basin, with its underlying strata of gravel beds, hardpans, and other materials is mainly located east of the watershed. However, small remnants of this lakeshore terrace can be found about 4 miles up the Deschutes River from Highway 84, which may indicate that the lake may have covered the area as far west as the Deschutes River. One explanation for the lack of terrace remnants in this area may be when the ice jam broke at The Dalles, the water in the lake rushed down the Columbia Gorge and scoured out all but traces of the silty lakeshore terrace lying western end of the ancient lake basin.

CLIMATE

Since the last ice age, which spanned approximately 100,000 to 10,000 years ago, the global climate has become considerably warmer and dryer. Within this relatively warm period, average global temperatures are thought to have fluctuated between 14º to 16º C, the warmest interval which was between 9,000 and 7,000 years ago (Thompson et al, 1993). More recently, a "little ice age" took place between the mid-1400s until the late 1800s with an average temperature estimated to be 0.5º - 1º C colder than present. This was the time when explorers and immigrants were discovering North America (Crowley 1996).

VEGETATION

The major plant communities seen in the watershed today began to develop during the last 10,000 years. Not much documentation can be found concerning the vegetation resources in the Hay Creek and Scott Canyon watershed before exploration and settlement. Written interviews of some of the early pioneer families suggest that when the first settlers came to this area in 1862, they found "hills covered with tall bunchgrass and sagebrush, the creek bottoms with such a heavy growth of sagebrush it had to be cleared before the soil could be cultivated." Hay Creek was so named because of the wild grass growing in abundance along its banks which was cut and used for hay by early settlers. There is no reference to species of grass was growing there.

Historic photos show cottonwoods and willows growing in upper Hay Creek where the city water supply is located. There are old logs and woody debris left in some sections of Hay Creek further demonstrating the existence of historic tree communities. Large scale flood events have significantly shaped riparian and aquatic habitat conditions as evidenced by the deposition of large log remnants and scouring of the stream channel.


Upper Hay Creek • circa 1922

NATIVE AMERICAN USE

Evidence of humans on the Columbia Plateau dates back 15,000 years (Aikens, 1993), corresponding to the last of the Missoula flood events. Tribes that may have used the area around the Hay Creek/Scott Canyon watershed included the Wascos, Tenino, Wyams, Tygh or Ty-ichs, Snakes and Piutes.

The book, *The First Oregonians*, describes some of the tribes living in the Columbia Plateau area. Those that lived east of Celilo Falls, including the Umatilla, John Day, Celilo, Tenino and Tygh Valley peoples, were of the Sahaptian language and culture. Sahaptian speakers included those who spoke the related languages of the Nez Perce and Sahaptin.

These tribes were seasonal gatherers and hunters, living during the winter along the Columbia River or lower tributaries in tule houses sheltered from the wind. In late February the Indians harvested Indian celery and in March they caught spawning suckers, both of which could be found near the winter villages. In April the women may have established camps a few miles from the river in tributary canyons, such as Hay Creek, and climbed adjacent ridges digging bitterroot and various tuberous lomatiums—key starchy staples. Back at the village they would dry the roots for future food. Chinook salmon runs peaked in early May and families with claims to fishing sites at Celilo Falls might have moved there for the duration of the runs. In summer, tribes focused on salmon and steelhead, intercepting successive runs that began with blueback salmon in July, peaked with fall Chinooks in early September, and ended with silver and dog salmon in October. Many families left the river during the heat of late summer to go on berry expeditions in the meadows of the Blue Mountains. John Day families would dismantle their winter lodges and began a series of moves southward, camping successively at Rock Creek, Olex, Condon, Fossil and Spray—moving east to Monument, then south again, climbing to the camas meadows in Fox Valley. In the Blue Mountains, after the winter snows had melted, Umatilla and John Day people mingled with their Cayuse and Nez Perce relatives and friends while gathering, fishing and hunting.

It is difficult to find documentation of specific tribes that resided in the Hay Creek/Scott Canyon area but in *The History of Gilliam County*, written by Mariam C. Thouvenel, she writes of pioneers remembering Indians traveling through the area on the way to hunt or gather food in the mountains. During the early days, Indians traversed the county in great numbers. They traveled single file in well-worn paths, coming in groups of one to 200 with as many as 150 head of horses. Indians sold wool in Condon, having gathered it from dead sheep and fences. They came in from Hay Creek and camped in front of Carroll Barkers. Old Chief Billy was the Indian Leader. The Indians gathered couse here in the spring and then came back in the fall for mowich or deer. They came from Celilo on their way to the Blue Mountains.

This area was also where many skirmishes between tribes took place. In Ferry Canyon, just south of the Hay Creek drainage, it was reported that in the late 1850s over 100 Columbia River Indians were killed by a marauding tribe of Snake Indians. Only two Columbia River Indians survived to tell of the battle. Many years ago you could still see skeletons and artifacts in that location, but artifact hunters have since stripped the area clean.

In an 1857 Indian Agency report from the office in The Dalles, R.R. Thompson, Indian agent, listed the tribes in his region (Eastern Oregon) as the Dog River or Cascade Indians, Wascos, Ty-ichs, Des chutes, John Days, Utillas, Walla-Wallas, Cayuses, Nez Perces, Flatheads, Mountain Snakes, Bonnacks and Diggers, the last three being subsets of the Snake Indian Tribe.

No archeological sites have been documented in the watershed but locals tell of finding arrowheads and other artifacts in many locations in the area.

PRESENCE OF FISH AND WILDLIFE

Goose Hunt • circa 1917

Settlers told of an abundance of grass, fish, birds and wildlife. In the summer rattlesnakes could be found around the water holes and in the grass, so a person had to be on the alert. The tall sagebrush made an ideal place for ticks to breed, which was another problem for pioneers to overcome. On the prairies there were also horn toads, but they were harmless. The settlers had "rabbit roundups" to try and reduce the high numbers of Jackrabbits that had become a nuisance, consuming crops and gardens. Bobcats and coyotes were also prolific, preying on sheep and other livestock. During migration season in the early 1900s, the fields were dark with wild geese and farmers hired men to kill the geese because they were so destructive to the crops.

It was also noted in some of the pioneer interviews that Hay Creek and Thirty Mile Creek, as tributaries of the John Day, were places where trout and steelhead were caught in great abundance. Wild geese, ducks, pheasants, doves and quail were hunted there. Mule Deer and Elk were also present but no historical documentation was found that verifies population numbers.

In the early 1800s the British government, through Hudson Bay Company, pursed a policy of beaver extirpation south to the 40th parallel (Simpson, 1825). This policy was expected to halt the westward expansion in the U.S. By the time the settlers began arriving in the 1840s, the beaver population had been essentially eliminated within the interior Columbia River basin. However, the extirpation project did little in influencing the Americans westward settlement.

NATURAL DISTURBANCE PATTERNS

Most natural disturbance processes in the watershed are driven primarily by climate. There are many notations of severe rain, snow and flood events in the settler's time. The first mention is the winter of 1881-82. The settlers called it the "double winter." 90 to 95% of all stock in the county either froze or starved to death. The settlers gathered what hides they could and sold them in 1882 to try and survive. Another hard winter hit in 1889, a thaw came in early February then on the 14th it turned cold again. Practically all the cattle died of starvation. People were very hard up the next year. In 1891 it was reported, in the Rock Creek area, that a severe waterspout and hurricane occurred. Roads and bridges were washed away. Boulders were thrown on the fields and meadows.

In 1915-16 another double winter occurred. Many families were snow bound and the livestock either froze or starved to death. Serious drought occurred in 1934 and 1935. But in 1938-1939 water erosion caused serious damage, according to the extension office journals.

One of the storm events best documented occurred in the winter of 1964. After an extremely frigid winter with subzero temperatures that froze the ground and left 8" of snow, a severe rain storm of 7" then hit the county, creating a torrent of water that caused much property and land damage. The following is an excerpt from the *Condon Times*, 12/25/64: **Raging Storm Leaves Thousands of Dollars Damage Throughout Gilliam County**. "*Following on the heels of an Arctic Storm, which brought sub-zero weather with it, Gilliam County and the surrounding area was struck with a violent rain storm Monday night and Tuesday morning. Although severe erosion occurred on nearly every wheat field in the county, biggest immediate damage to some farmers was the* *loss of buildings, equipment and fences. Hardest hit were Tom Cimmiyotti and Jack Campbell. Cimmiyotti lost trucks, a tractor, buildings, livestock and corrals on his Hay Creek ranch. The house was the only building on the farm that withstood the torrent that swept down the hills North and West of Condon. Word of this disaster arrived from Chuck Bolin who walked into the ranch with Tom's son, Craig Cimmiyotti, Tuesday afternoon. Tom Cimmiyotti and his hired man, Garret Wood, were at the ranch and the only way in or out was by horseback or on foot.*" Cimmiyotti's relatives tell that Tom was working cattle at the corrals when the "wall of water" came down the canyon. He had to scramble up the hillside to avoid being swept away.

More evidence that supports the great magnitude of the '64 flood are old bridge footings that washed 1/4 mile downstream from the site of the former bridge on lower Hay Creek. The blocks are four feet by five feet square of solid concrete. According to a newspaper article in the *Condon Globe-Times* (1/1/65), one local who had lived on Rock Creek for 50 years had never seen so much water. This was the same response of many of the people in the county. The article also stated that many wheat fields were severely eroded and gullies were so deep that they had to be bull-dozed or plowed shut in the spring so equipment could be driven across them. Harvest would be slow since the combines would have to negotiate the ditches and gullies in the fields. One local who grew up on lower Hay Creek tells that before the '64 flood Hay Creek was full of willows and brush. When the '64 event occurred it not only scoured out the vegetation but severely down cut the banks and permanently altered the stream morphology.

Fires caused by lightening or human activity have occurred in this watershed but not to a large degree. The Bureau of Land Management has records of fires on BLM land from 1970 to 2000. In 1981 there was only one large fire on BLM land in the Hay Creek watershed, mostly affecting the lower drainages and tributaries. A local fire department volunteer recalled another fire, a small one of approx. 300 acres, on the upper area of the Dry Fork drainage in 1996. From field observations along Hay Creek and its tributaries, there hasn't been a significant fire in that drainage for a long time, with the amount and size of large heavy sagebrush communities along the entire system. Scott Canyon, surrounded by cultivated fields, may have had some field burning or stubble fires occur from lightening strikes but nothing has been documented.

Footburner Plow
circa 1880s

Settlement

Early travelers along the Oregon Trail found vast natural grasslands broken by brushy draws and tree- and rimrock-bordered streams with numerous springs. Because of the deep loess soils, mild climate and the presence of adequate moisture, much of this region provided model farmland.

The first settlers came to the Gilliam area in 1862. They raised cattle for several years but then moved on. The following year many homesteaders came to the region, settling in Rock Creek and surrounding areas. They cleared the land of sagebrush and prepared the soil for farming, planting the first grain crop in 1869. It was cut for hay. The foot burner plow was used to work the soil.

In 1890 the Gilliam area had a population of 3,600, increasing to an all time high of 3,906 in the year 1920.

LIVESTOCK & FARMING


Sheep grazing the hills above Hay Creek • circa early 1900s

Early on, many settlers ran cattle, sheep and bands of horses on open range. R.G. Robinson brought in the first band of 1,500 sheep in 1875. Simon Barker, father of CK Barker, came to the area and began herding sheep in 1887. Barkers ran sheep all along the Hay Creek watershed. C.K. Barker summered ewes & lambs in the Hay Creek area. In 1938, 80,000 head of sheep were reported in Gilliam County. By 1947 the number had dropped to 15,000. Sheep husbandry began to decline in 1930 because of inability to secure dependable labor, the coyote predator problem and low prices for wool and meat.

In 1863, homesteaders started raising cattle and horses. There were no fences and stock had access to unlimited range. Many settlers ran from 200 to 1,500 head of cattle and sometimes as many as 750 horses. In 1948 the cattle numbered 20,000 in Gilliam County.

Farming grain crops began in 1881. This was the beginning of land being taken from native grasslands and tilled using summer fallow/wheat rotation farming practices. Wheat was originally grown in small patches of 10 to 15 acres and was threshed using a tread power machine. During the next ten years large threshing crews handled the wheat during harvest season, the equipment used was the huge stationary type, which required about 22 men and a large number of horses or mules. The combines came later, which were pulled by up to 32 horses and/or mules. Plowing and harrowing was also done with large teams, averaging from 16 to 20 horses. One farmer, William J. Keeney who operated a ranch near Olex, had a 42 mule outfit, which he drove himself, using one jerkline.


Horse powered combine • circa 1910

Gasoline engines came into use in the county to pull plows and other farm equipment around 1909. E.C. Rogers was the first rancher to venture out with this new modern equipment on his ranch near Mikkalo. As the machines became more mechanized, the acres going into cultivation increased. By the late 1930s, 265,000 acres were being tilled in Gilliam County.

The Gilliam Soil and Water Conservation District (SWCD) was created in 1948 to provide assistance in erosion control practices and other conservation methods for local producers. The first contracts for CRP in the county were established in 1985 to help reduce sedimentation and erosion from farm fields.

Roads and Rails

Most road improvements were taken over by the county by 1898 in the interest of moving wheat to the Columbia River. The streets of Condon were paved in 1913.

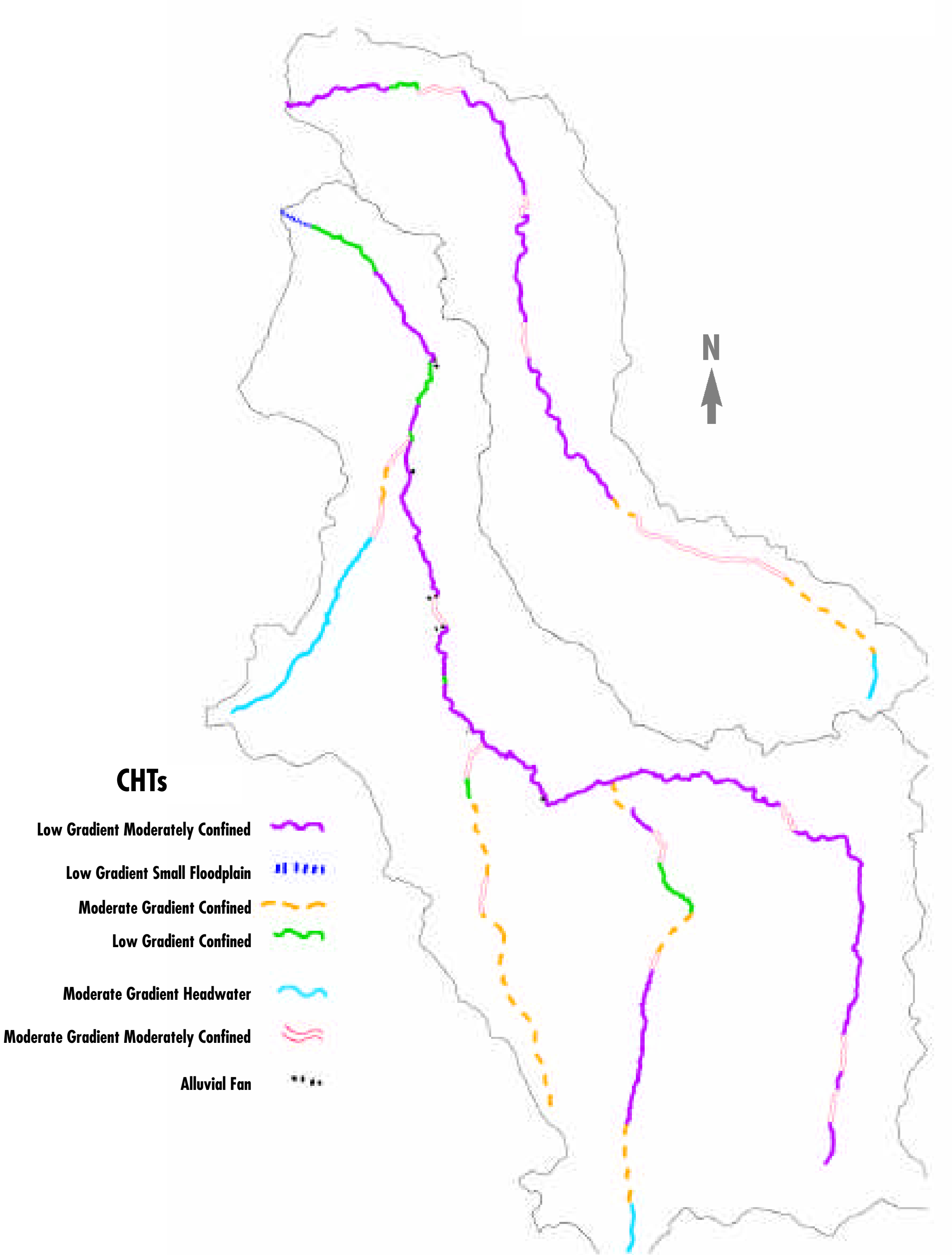
The stage road that ran between Fossil and Arlington became the John Day Highway and is now called Highway 19. In 1913 the highway was graded as far as Thirty Mile Creek. Records indicate it was paved sometime prior to 1945. Highway 206 to Wasco was a dirt road until 1953 when it was paved.

The railroad was built from Arlington to Condon in 1905. The town of Mikkalo was built around the rail water stop. The railroad was used to haul freight up until the mid 70s. And sometime in the 1990s the tracks & rails were abandon by Union Pacific Railroad and removed.

City Water Supply

Condon's first water system was installed in 1899. It was primarily surface water and subject to serious pollution. In 1923 the Condon Water Supply project began. This project was a revision of the former supply that was abandon some years before. The new project included securing a new water supply, collecting and storing the water flowing from the springs which form the headwaters of Hay Creek; a pumping plant and a pipe line from the source to the city reservoirs. Tile was laid below the bed of Hay Creek at a depth varying from 6 to 12 feet. A reinforced concrete reservoir, having a capacity of 109,000 gallons received and stored the flow from the tile. This reservoir was built across the streambed also acting as a dam. The capacity of the plant was 155 gallons a minute. The measured flow at the Hay Creek Springs before development of the supply (September 10, 1921) showed a minimum of about 127,000 gallons per day. When flow was measured into the reservoir on May 18, 1923, it was 143 gallons per minute or about 206,000 gallons per day. 1927 saw another well drilled to 65 feet and had pumping equipment capacity of 100 gpm. In 1976 five wells were registered with the water board for use at the Condon water supply. The amount of water claimed was 415 gallons per minute, being 69 gpm from #1; 90 gpm from #2; 75 gpm from #3; 60 gpm from #4; 130 gpm from #5. In 1999 an application for a change in point of diversion at the Condon Water Supply at Hay Creek was submitted. Three shallow wells were drilled ranging in depth of 43.5 feet to 103 feet. Wells tested at 90 gpm; 50 gpm; and 107.5 gpm respectively. Temperature of water during pumping testing was between 55 and 59 degrees.

Channel Habitat Types



CHAPTER FOUR – CHANNEL HABITAT TYPES & CHANNEL MORPHOLOGY

INTRODUCTION

Identifying channel habitat types (CHTs) was a primary task in the watershed assessment process. Knowing the distribution and location of CHTs in the watershed improves the understanding of stream channel responses to land use activities and helps identify areas with the best potential for stream and riparian restoration projects.

Stream classification systems can be organized on different scales within a watershed: from as large as the entire channel network down to individual pools or microhabitats within those pools. The *OWEB Assessment Manual* provides a classification system centered in the middle of this hierarchy and incorporates landscape features such as valley type as well as stream reach features such as gradient. The variables selected to describe each channel type remain relatively constant within time scales of concern to land management. The scale is small enough to predict patterns in channel physical characteristics, yet large enough to be identified from topographic maps and limited field-work.

METHODS

The attributes used to identify channel habitat types are channel gradient, channel confinement, channel pattern, valley shape and stream size. The procedure used to identify the channel habitat types follows:

- 7.5' USGS topographic maps and aerial photos of the watershed were studied.
- Arcview 3.2a was used for mapping and compiling data.
- The channel network was divided into stream gradient classes.
- Channel confinement and valley shape were estimated.
- Channel habitat types were designated using CHT keys and extensive CHT descriptions provided in the *OWEB Watershed Assessment Manual* and the *Field Guide for Stream Classification* by Rosgen & Silvey, second edition.
- Mapping was validated by field surveys at 45 sites.
- Field surveys sites were noted on GPS and data collection included up/down stream photos; width & depth measurements; bankful and modern floodplain measurements and downloaded to GIS maps.

The two main reasons for identifying and mapping CHTs are first, it allows identification of sensitive channel segments that may warrant special attention and protection. A highly sensitive channel is more responsive to changes in peak flows, stream bank modifications and input of sediment. The channel may respond to these changes by altering its pattern, location, width, depth and sediment deposition. Natural processes (e.g. floods) and/or land use practices can lead to more overland runoff, which creates higher stream flows during storm events and may lead to stream bed scouring. Secondly, CHT classification helps predict how different channels may respond to restoration efforts. Channels with medium to high sensitivity will show the most response to restoration. Following is a list of restoration potential for those CHTs found in the Hay Creek/Scott Canyon watershed.

CHANNEL HABITAT TYPES IDENTIFIED IN THE WATERSHED

Channel Habitat Type		Gradient	Channel Confinement	Restoration Potential
Low Gradient Small Floodplain	(FP3)	< 2%	moderate to unconfined	high
Alluvial Fan	(AF)	1-12%	variable	low
Low Gradient Moderately Confined	(LM)	< 2%	moderately confined	high
Low Gradient Confined	(LC)	< 2%	confined	medium
Moderate Gradient Moderately Confined	(MM)	2-4%	moderately confined	high
Moderate Gradient Confined	(MC)	2-4%	confined	medium
Moderate Gradient Headwater	(MH)	1-6%	confined	medium

POTENTIAL FOR RESTORATION BY CHANNEL HABITAT TYPE

FP3 – The limited power of these streams [i.e. stream flow] offers a better chance for success of channel enhancement activities than the larger floodplain channels. While lateral movement [i.e. meandering] of the channel will limit the success of many efforts, localized activities to provide bank stability or habitat development can be successful.

AF – Many alluvial fans are actively moving at rates greater than most channels and are generally not well-suited to successful enhancement activities. Although they are considered responsive channels, long-term success of enhancement activities is questionable.

LM – Like floodplain channels, these channel types can be among the most responsive of channel types. Unlike floodplain channels however, the presence of confining landform often improves the accuracy of predicting channel response to activities that may affect channel form. Also, these controls help limit the destruction of enhancement efforts common to floodplain channels. Because of this, LM channels are often good candidates for enhancement efforts. Channels of this type in watersheds such as Hay Creek/Scott Canyon watershed are often very responsive to bank stabilization efforts such as riparian planting and fencing. Beavers are often present in the smaller streams of this channel type, and fish habitat in some channels may benefit from beaver introduction through side-channel and scour pool development.

LC – These channels are not highly responsive and channel enhancements may not yield intended results. In watersheds where water temperature problems exist, the confined nature of these channels lends itself to establishment of riparian vegetation. In this watershed, these channels may be deeply incised and prone to bank erosion. These channels may benefit from livestock access control measures.

MM – These channels, like LM types, are among the most responsive of channel types. The slightly higher gradient impart a bit more uncertainty as to the outcome of enhancement efforts when compared to LM reaches. MM channels, however, are often good candidates for enhancement efforts.

MC – Like the LC reaches, these channels are not highly responsive, and in-channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable.

MH – These channels are moderately responsive. The stable banks generally found in these channels lend themselves to establishment of riparian vegetation where water flows exist.

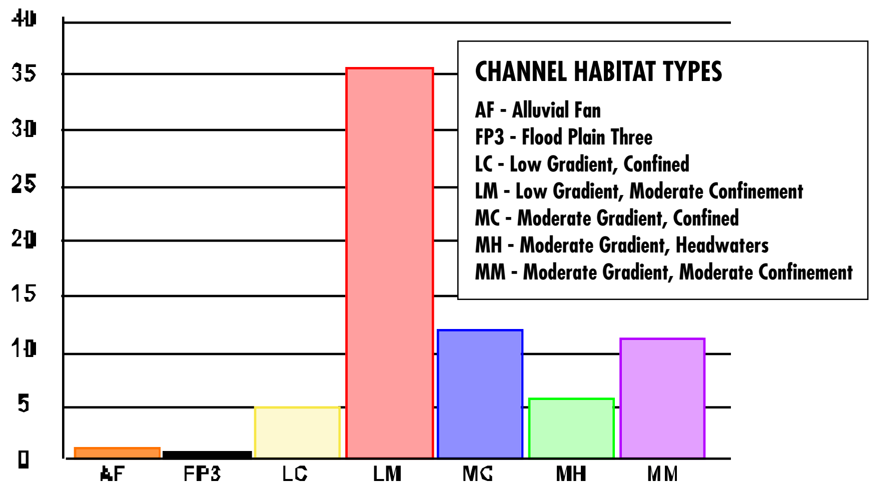
HAY CREEK

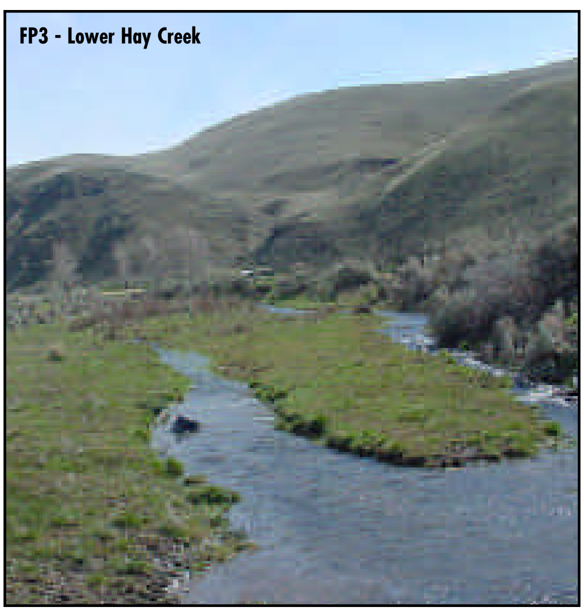
Hay Creek and its tributaries were identified as having all seven listed CHTs. This steam system is mainly a low to moderate gradient system except in the headwater drainages, where it becomes much steeper and only has water flow during runoff or flashy events.

SCOTT CANYON

Scott Canyon qualified in five of the listed CHTs. This drainage system is made up of mainly low and moderate gradients. The entire drainage serves as a conduit for flashy storm events, flowing for only hours at a time. There are a few springs and seeps in the lower part of Scott Canyon that create a short section of ephemeral flow, flowing only during months of higher precipitation.

Percentage of Channel Habitat Types in the Hay Creek/Scott Canyon Watershed





FP3 - Lower Hay Creek

Low Gradient Small Floodplain (FP3)

1% of the Hay Creek System
0% of the Scott Canyon System

FP3 streams are located in valley bottoms and flat lowlands. They frequently lie adjacent to the toe of foot slopes or hill slopes within the valley bottom of larger channels, where they are typically fed by high-gradient streams. They may be directly downstream of a small alluvial fan and contain wetlands. FP3 channels may dissect the larger floodplain. These channels are often the most likely CHT to support beavers, if they are in the watershed. Beavers can dramatically alter channel characteristics such as width, depth, form and most aquatic habitat features. Sediment routed from upstream high- and moderate-gradient channels is temporarily stored in these channels and on the adjacent floodplain.

Alluvial Fan Channel (AF)

2% of the Hay Creek System
0% of the Scott Canyon System

Alluvial fans are generally tributary streams that are located on foot-slope landforms in a transitional area between valley floodplains and steep mountain slopes. Alluvial fan deposits are formed by the rapid change in transport capacity as the high-energy mountain-slope stream segments spill onto the valley bottom. Channel pattern is highly variable, often dependent on substrate size and age of the landform. Channels may change course frequently, resulting in a multibranched stream network. Channels can also be deeply incised within highly erodible alluvial material.

Low Gradient Moderately Confined Channel (LM)

48% of the Hay Creek System
53% of the Scott Canyon System

These channels consist of low-gradient reaches that display variable confinement by low terraces or hill slopes. A narrow floodplain approximately two to four times the width of the active channel is common, although it may not run continuously along the channel. Substrate varies from bedrock to gravel and sand. They tend to be slightly too moderately sinuous, and will occasionally possess islands and side channels. Multiple roughness elements are common, with bedrock, large boulders or wood generating a variety of aquatic habitat within the stream network.

Low Gradient Confined Channel (LC)

8% of the Hay Creek System
3% of the Scott Canyon System

LC channels are incised or contained within adjacent, gentle landforms or incised in volcanic flows or uplifted coastal landforms. Lateral channels migration is controlled by frequent bedrock outcrops, high terraces or hill slopes along stream banks. They may be bound on one bank by hill slopes and lowlands on the other, and may have a narrow floodplain in places, particularly on the inside of meander bends. Stream-bank terraces are often present, but they are generally above the current floodplain. The channels are often stable, with those confined by hill slopes or bedrock less likely to display bank erosion or scour than those confined by alluvial terraces.

High-flow events are well-contained by the upper banks. High flows in these well-contained channels tend to move all but the most stable wood accumulations downstream or push debris to the channel margins. Stream banks can be susceptible to landslides in areas where steep hill slopes of weathered bedrock, glacial till, or volcanic-ash parent materials abut the channel.

Moderate Gradient Moderately Confined Channel (MM)

13% of the Hay Creek System

26% of the Scott Canyon System

This group includes channels with variable controls on channel confinement. Alternating valley terraces and/or adjacent mountain-slope, foot-slope, and hill-slope landforms limit channel migration and floodplain development. Similar to the LM channels, a narrow floodplain is usually present, and may alternate from bank to bank.

Moderate Gradient Confined Channel (MC)

18% of the Hay Creek System

14% of the Scott Canyon System

MC streams flow through narrow valleys with little river terrace development, or are deeply incised into valley floors. Hill slopes and mountain slopes composing the valley walls may lie directly adjacent to the channel. Moderate gradients, well-formed flows, and large-particle substrate indicate high stream energy. Landslides along channel side slopes may be a major sediment contributor in unstable watersheds.

MC - Six Mile Canyon

Moderate Gradient Headwater Channel (MH)

10% of the Hay Creek System

4% of the Scott Canyon System

These moderate-gradient headwater channels are common to plateaus in Columbia River basalts, young volcanic surfaces, or broad drainage divides. These channels are similar to LC channels, but occur exclusively in headwater regions. These gentle to moderate headwater streams generally have low streamflow volumes and, therefore, low stream power. The confined channels provide limited sediment storage in low-gradient reaches. Channels have a small upslope drainage area and limited sediment supply. Sediment sources are limited to upland surface erosion.

Fish Barriers

There are two references to fish barriers in the Hay Creek watershed, the first, a pushup dam used for irrigation purposes, was located in lower Hay Creek but was removed in 1997. The second is the concrete dam built when the city of Condon developed their water system. It is located at the headwaters of Hay Creek but is not an impediment to fish movement because it is located above the fish bearing portion of the stream. There are no culverts on the Hay Creek watershed that present a barrier to fish passage.

PHOTOS

TOP: Middle Hay Creek, 3/03

MIDDLE LEFT: Upper Hay Creek, 2/02

MIDDLE RIGHT: Middle Hay Creek, 3/03

BOTTOM: Upper Hay Creek, 12/02

CHAPTER FIVE – HYDROLOGY & WATER USES

INTRODUCTION

The purpose of this chapter is to evaluate the potential impacts of land and water use practices on the hydrology of the Hay Creek/Scott Canyon watershed. Hydrology can be affected by both natural events and man's land use practices.

Historic and current land use practices in the Hay Creek/Scott Canyon watershed have no doubt altered the storage, movement and character of the water resource. Changes in hydrologic cycle are demonstrated by excessive runoff, altered peak flow regimes, lack of ground water recharge, reduction in soil moisture storage, and low late-season flow. Historic and current events, in combination with hydrologic changes, have resulted in some portions of the watershed having stream channel instability, shown by channel widening, down cutting, vertical cut banks and excessive gully development.

HISTORY

This watershed has an elevation range from 280 to 3,000 feet. Drainage networks and riparian corridors developed in this shrub-steppe/bunch-grass prairie, generally following folds or structural fractures in the underlying basalt. First and second-order streams originate within the cropland area of the plateau. On the plateau, the riparian communities historically appear to have been composed of willow or cottonwood galleries, judging from current soil characteristics and relic vegetative stands. As evidenced by the development and persistence of steep slopes, the hydrologic response of streams originating on the plateau would have been slow and fed by shallow groundwater and deeper subsurface flow. Depending on the annual precipitation, headwater elevation, and the presence or absence of springs or seeps, a mix of low-flow perennial and intermittent streams probably flowed through riparian areas handling flashy storm events with vegetative cover, roughness of cobble and boulders and the meander of the stream channel. Mt. Mazama ash in toe slopes indicate that stream bottoms are sites of considerable colluvial deposition, but the presence of this material in large pockets of several cubic meters suggests that once it accumulated, it has not been subject to significant stream erosion.

Gilliam County lies within the Columbia Plateau which is underlain by Columbia River Basalt. Out of the five basalt subgroups found in the county, the two oldest predominate in the Hay Creek/Scott Canyon watershed. They are identified as **Grande Ronde basalt** and **Wanapum basalt** in a study done for Gilliam County in 1998 (George Chadwick Consulting.) Grande Ronde units of basalt dominate in the southern and western portions of the watershed. It is usually present at the surface of the land. Wanapum basalt shows up in patches among the Grande Ronde but also dominates in the northern end of the watershed. Where present, the Wanapum units are generally less than 200 feet thick. Not too much is known regarding the maximum thickness of the basalt in this region except for one exploratory well dug by the Standard Oil Company in 1957. The well records show that 2,439 feet of the Columbia River Basalt Group were penetrated at this location. The entire well depth was 8,726 feet. This places the bottom of the Columbia River Basalt at approximately 560 feet above mean sea level at this location in the watershed.

Fire, resulting from lightening, most likely created shifting patterns in the prairie and shrub-steppe. But in all but the most extreme cases, fires would not have consumed riparian vegetation. The hydrologic effect from these fires would have been localized, short-lived (1 year) and probably without major influence on third-order stream hydrology. However, the abundance of Big sagebrush in the riparian areas has been impacted by the lack of fire.

Peak Flows

Peak flow can be generated by many events, including rainstorms, winter rain-on-snow events, spring snowmelt, cloudbursts and thunderstorms. Peak flows are also impacted when storm events are combined with climactic variables such as temperature, precipitation, snowpack, frozen ground and wind.

There are no stream flow gages in the Hay Creek/Scott Canyon watershed to gain historic or current peak flow rates. The *Hydrologic Process Identification for Eastern Oregon,* a study prepared for OWEB, was used in this assessment to extrapolate information from similar watersheds in the region, along with studies of local climactic data and interviews with locals. From this research it was determined that most water in the Hay Creek watershed comes from springs and seeps, with increased flows occurring from upland discharges during storm events. Discharge flows usually peak between November and March and seasonal low flows typically occur between August and October. Intense summer storms with hail and fast, heavy precipitation can occasionally occur. Flood events usually occur in December and January, when warmer temperatures and high precipitation results in rain on snow events, which lead to extreme runoff. Scott Canyon's peak flows occur around the same time as Hay Creek but primarily result from flashy storm events, draining the extensive farm ground that it is surrounded by.

Intermittent stream section on Middle Hay Creek

In the ecoregion descriptions for Deschutes/John Day Canyons it shows peak flow magnitude (2-year recurrence interval) of 6 cfs/mi^2 to 20 cfs/mi2, with few greater than 20 cfs/mi^2.

Sections of the Hay Creek stream system were documented during field studies going underground during certain times of the year. Two sections in middle Hay Creek total just under a mile (.95) and one section on upper Hay Creek went underground approx. 1/8 of a mile (.18). The field observations were noted mid-December, 2001.

Water Rights

There are eleven water rights on file for the Hay Creek/Scott Canyon area. Of those, five are for wells at the headwaters of Hay Creek that currently supply the city of Condon's water. The earliest water right for the City Farm was granted in 1906 for triplex plunger pumps. Major improvements to the water supply system was granted in 1922. In 1921 the measured flow at the Hay Creek Springs (City Farm) showed a minimum of about 127,000 gallons per day. When the tile and reservoir project was completed in 1923, the flow was measured again and it had come up to 206,000 gallons per day. Currently the City Farm is entitled to 2.17 cubic feet per second (900 gallons per minute.)

The oldest water rights certificate on file in the watershed was granted in 1880 for irrigation and livestock water. Several other water rights were granted soon after for use in irrigation, domestic and livestock water. In 1980 two wells were given permits for a large scale irrigation project. The project never occurred and hence, the wells were not extensively used.

Three of the eleven water right certificates are for 21 livestock watering ponds, all located on side canyons of upper Hay Creek.

GROUND WATER

It is difficult to obtain an accurate count of all the wells in the Hay Creek/Scott Canyon Watershed. Many old wells are located on private ground and at the time of drilling were not required to be filed with the state. Now the State of Oregon requires any new well log be submitted to the Oregon Water Resources Department (OWDR). In the Hay Creek/Scott Canyon watershed there are twenty sites on file with the OWDR.

The two types of hydrogeologic units in the watershed are Wanapum and Grand Ronde basalt. Published studies (Vaccaro, 1991) contain estimates of aquifer properties of hydraulic conductivity, transmissivity, and coeffiecent of storage. Hydraulic conductivity accounts for properties of the aquifer material and characterizes the capacity of aquifer materials to transmit water. Transmissivity is defined as the hydraulic conductivity of a material multiplied by the material thickness, and is used as a measure of an aquifer's ability to transmit water. The storage coefficient characterizes the amount of water release from storage by an aquifer during pumping. Estimates of these aquifer characteristics are as follows:

UNIT	HYDRAULIC CONDUCTIVITY	TRANSMISSIVITY (cm/sec)	STORAGE COEFFICIENT (gpd/ft)
Wanapum Aquifer	$9x10^{-4}$	5,460	$5x10^{-3}$ – 0.05
Grande Ronde Aquifer	$5x10^{-4}$	12,730	$5x10^{-3}$ – 0.05

Gpd/ft is gallons per day per foot. Cm/sec is centimeters per second

Groundwater quality in the Wanapum and Grand Ronde aquifers is generally suitable for most uses. The dominate minerals in the water are calcium-magnesium bicarbonate (Vaccaro, 1991) However, the study areas were derived from locations across the Columbia Plateau region so whether the watershed aquifers would test that same is unknown. Many factors, including land use practices and make-up of overlaying sediment, could influence the chemical makeup of the water.

Safe yield is the amount of groundwater that can be withdrawn from an aquifer without producing an undesirable result. Groundwater removed from the system due to pumping will alter the established equilibrium of the aquifer. This disturbance will be reflected in changing water levels and groundwater discharge to seeps, springs and streams. Development of groundwater resources will always alter the hydrologic balance.

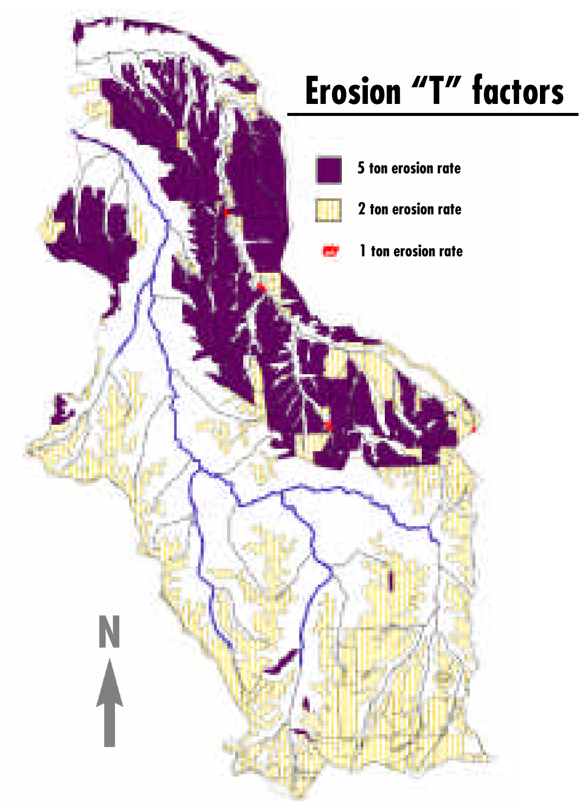
ROAD DENSITY

Road density is an indicator of potential hydrolic change and sediment delivery within a watershed. Impervious surfaces, roadside ditches, and culvert placement all play a part in the increase of runoff. The Hay Creek/Scott Canyon watershed was analyzed as two separate watersheds. All county and state roads were identified and noted on maps using Arcview GIS. A formula from the *OWEB Watershed Assessment Manual* was used to calculate road density. It was determined the potential for increased peak flows from road density was very low (< .5%) in both watersheds. However, during field observations it was noted there were several gullies to the north of State Highway 206 that indicated severe runoff due to the impervious surfaces of Highway 206 and the relative high susceptibility of the loess soils *(see page 14*). Culvert placement is addressed in the next chapter on sediment.

INTRODUCTION

Erosion is a stream systems way of balancing the energy of the stream against its capacity to move sediment. Stream adjustment by erosion occurs with flow variation. If factors affecting stream energy are changed (extreme high flows, confined or concentrated flows, etc.) sediment movement can change and is evidenced by erosion or deposition of sediment. Sediment can enter a stream through a variety of natural and human-related causes. During field studies done in the Hay Creek watershed several occurrences of bank sloughing were noted. Bank sloughing is caused by the lateral movement of stream channels. This section of the assessment focuses mainly on sedimentation due to human impacts, such as crops, grazing and road systems.


Sloughing bank on Hay Creek • 12/02



FARMING

As noted earlier, the majority of the land in the Hay Creek/Scott Canyon watershed is used for agriculture based on dryland wheat farming and grazing. Winter grain/summer fallow rotation cropping systems used in this watershed leaves much of the soil exposed during the critical months for winter runoff and intense summer storms. Erosion from concentrated water flows is a problem on fields that have no terraces and fields with old, wide-spaced terraces even when good residue management is practiced. The historic use of traditional cropping systems has led to a decline in the level of soil organic matter and related soil health. Water intake rates and water holding capacity have been reduced and erosion potential increased.

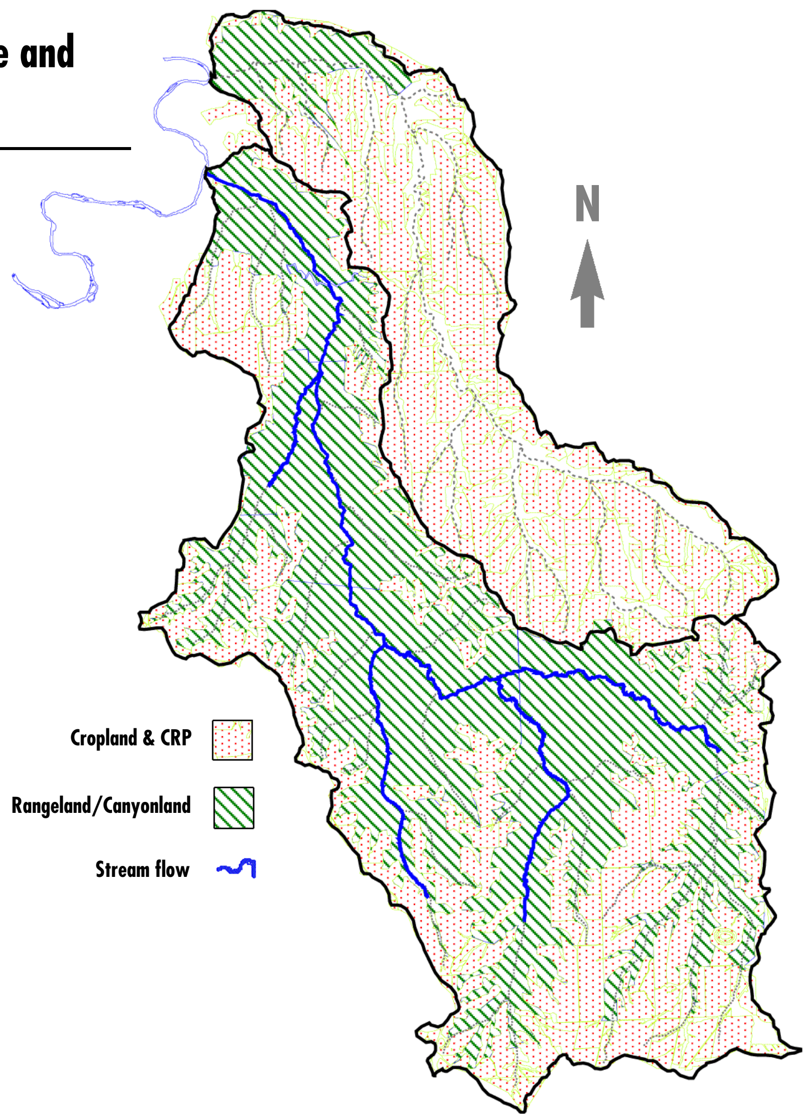
However, the change from conventional moldboard plowing to a tillage system that leaves crop residue on the surface has reduced average erosion. The map on the left indicates the tolerable soil loss in tons per acre per year for the cropland in the watershed. It was calculated by the Gilliam County Extension office using the modified Universal Soil Loss Equation. This formula was developed by the USDA Agriculture Research Service. The erosion rate factors in rainfall, soil erodibility, slope length & steepness and vegetation management to determine the acceptable loss of tons of soil per acre per year. In Scott Canyon 7% of the farmground came under the 2 ton determination; 37% of the acreage could tolerate only 5 ton per acre per year loss and still be sustainable. In the Hay Creek watershed, 45% of the acreage came under the 2 ton figure and 11% qualified as the 5 ton rate loss.

Water erosion rates on cropland in the grain-fallow rotation can vary from 2 to over 8 tons per acre per year. This rate would even be higher without the existing conservation practices, including annual cropping, contour farming, filter strips, minimum tillage, direct seeding, terraces, residue management, sediment basins and grass waterways. The seriousness of erosion becomes evident when equated to a soil profile thickness, which varies in the watershed from 1.5 to 5 feet deep over most of the cropland. On shallower soils, loss must be less than two tons per acre per year to avoid long-term loss of sustainability. NRCS estimated that by 1992, the Columbia Plateau region, where Hay Creek and Scott Canyon are located, had lost 68 percent of its topsoil.

Grazing

Historically sheep were extensively grazed in the Hay Creek/Scott Canyon watershed. Now cattle are the primary livestock grazed here, both on private and leased lands. On private lands, management practices include year-round grazing, late fall to early spring rotations or rest/rotation grazing plans. On BLM leased allotments grazing is managed by season-specific grazing and/or rotational grazing plans.

Cropland, Range and Canyonlands



The majority of upland stubble ground is used for winter grazing. Salt and mineral supplements are often used to lure the livestock to upland forage. In some areas of the watershed, ranchers use riparian flats as winter feeding or calving grounds. Sometimes the stream channel is fenced off with water gaps for the livestock's needs; other areas have the cattle watering out of the stream. In places where cattle graze in the lowlands and riparian areas for most of the year, there is some shearing of stream banks, ground compaction and loss of riparian vegetation, all of which contribute to sedimentation. When cattle go to riparian areas from the surrounding steep rims, their trails can also begin to erode, becoming gullies during high rainfall events.

Management of the riparian areas cannot be done without considering the management of the uplands as well. Livestock grazing can be achieved in riparian areas when managed in harmony with land management objectives, and when the function, capability and potential of each site are considered in the development of the grazing management prescription. No one grazing plan will fulfill the entire stream system's recovery needs. When developing a grazing plan it is beneficial to have a basic understanding of the soil types and related characteristics.

The soil types alongside stream channels in the rangeland area are mostly narrow strips of Xeric Torrifluents and Kimberly Fine Sandy Loam. Permeability is rapid in these soils and runoff is slow. The hazard of erosion varies, depending on the rate of stream flows and in-channel characteristics. Wind erosion can be a factor where vegetation is sparse. In the headwater areas, above where the stream begins to flow, the stream channel soils included Rhea Silt Loam and Hermiston Silt Loam. These are well-drained silt loams with the sedimentation factor depending upon the gradient of the slope, plant coverage and the land management practiced.

The dominate soil types in the steep canyons of the rangeland bordering Hay Creek are Wrentham Rock Outcrop (north facing) and Lickskillet Rock Outcrop (south and west facing.) Where the slope was analyzed, it was steep, anything from 46 – 80%. Both Lickskillet and Wrentham are a mosaic of stony loams and basalt bedrock outcrops. The soils have moderate permeability, rapid runoff capacity and a high hazard of erosion. Where there are soil patches, sedimentation varies with the amount of plant cover left. In many stretches of Hay Creek there are overhanging or vertical bluffs of basalt rock.

In the range uplands, deeper silty soils are located on ground either too steep to farm or in areas bordering farm fields. The soils types are diverse, depending on where they are located. The list included Olex Gravelly Silt Loam, Ritzville Silt Loam, Lickskillet Very Stony Loam, Mikkalo Silt Loam, Bakeoven Very Cobbly Loam, Bakeoven Condon Complex, Condon & Valby Silt Loam and Rhea Silt Loam. Basis the soil types, if the slope is steep then there is a high risk of erosion and sedimentation if plant cover is removed or during extreme high precipitation events.

Scott Canyon is also used for grazing but mostly on stubble fields or on the lower section where there is some rangeland located. The farmland in Scott Canyon is predominately Mikkalo and Ritzville Silt Loams. The rangeland portion includes Wrentham Rock Outcrop, Lickskillet Rock Outcrop, Lickskillet Very Stony Loam and some Ritzville Silt Loams.

CRP & CREP

The Conservation Reserve Program (CRP) reduces soil erosion and sedimentation in streams, improves water quality, establishes wildlife habitat, and enhances riparian resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers.

9% of the land (8,313 acres) in the Hay Creek/Scott Canyon watershed is enrolled in the Conservation Reserve Program and is protected with permanent vegetative cover. The first CRP contracts were established in Gilliam County in 1985. Gilliam County now has enrolled the maximum allowable acres for CRP.

In 2000 approximately three miles of riparian area on lower Hay Creek was enrolled in the Conservation Reserve Enhancement Program (CREP). Beavers are beginning to come back into the stream system, the stream channel has broadened, begun to meander and sedges and rushes have reestablished in good order. *See appendix XXXV for photos of this CREP section.*

Road and Culvert Condition

In the watershed there is a total of 103 miles of public roads: 37 miles are paved and 66 miles are graveled. There are also 87 miles of private jeep trails and field roads in the watershed. These are dirt tracks rarely or seasonally used and not maintained. Of these primitive roads, 44 miles are located in Scott Canyon and 43 miles are located in the Hay Creek watershed.

Erosion off of Highway 206 • 4/03

Out of 73 total culverts in the watershed, 11% were identified as having steep upslopes. Six culverts with upland slopes of more than 50% grade were noted in the lower Hay Creek watershed, one culvert located in the upper drainages of Hay Creek and one culvert in Scott Canyon. Two of the six culverts would be at risk of failure during a heavy rainfall event due to the build up of sediment load inside the culvert.

Lower section of same erosion • 4/03

The State of Oregon Department of Transportation did not have a culvert survey for the stretch of highways bordering the watershed. However, while doing some upland field studies it was noted that runoff from Highway 206 had contributed to severe gullies through CRP and ungrazed grass areas.

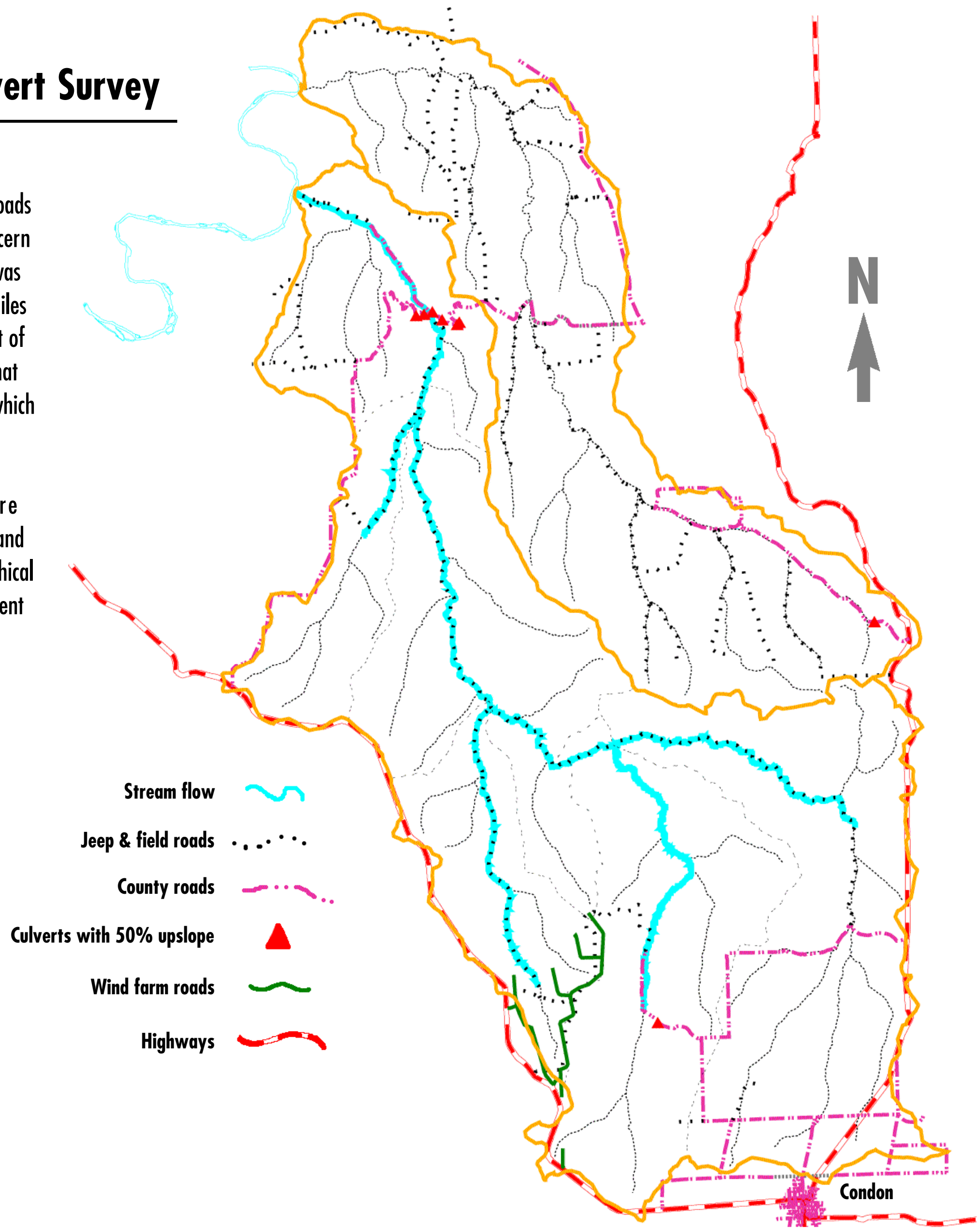
Analysis of road sections at risk areas in relation to stream channel

Subwatershed	area (mi^2)	roads <200'from stream Length(mi)/density(mi/mi^2)	roads <200' + >50% upslope Length(mi)/density(mi/mi^2)	roads <200' + >50% upslope Low to medium use Length(mi)/density(mi/mi^2)	roads <200' + >50% upslope jeep trails – rarely used Length(mi)/density(mi/mi^2)	roads <200' + >50% upslope field roads – seasonal use, light Length(mi)/density(mi/mi^2)
Lower Hay	13.3	3.8/.29	.36/.027	.3/.022	.06/.005	n/a
Six Mile	8.5	3/.35	1.5/.185	n/a	1.5/.185	n/a
Middle Hay	21.0	9.3/.44	1.79/.085	n/a	1.79/.085	n/a
Ten Mile	10.5	6/.57	1.04/.104	n/a	1.04/.104	n/a
Upper Hay	23.0	4/.17	.86/.037	.55/.02	.31/.013	n/a
Dry Fork	29.0	10.3/.36	2.2/.075	1.4/.05	.79/.03	n/a
Scott Canyon	47.0	29/.62	5.8/.123	2/.04	.86/.02	2.9/.06
Totals	152.3	65.4/.43	13.55/.636	4.25/.132	6.35/.442	2.9/.06

Road and Culvert Survey

Methods

In figuring which of these roads in the watershed are of concern to the streams involved, it was first calculated how many miles of roads are within 200 feet of the stream channel, then what type of road they are and which of those roads also had an upslope of more than 50%. Culverts on county roads were mapped using Arcview GIS and then overlaid with topographical maps to identify slope gradient and determine if there was potential risk for peak flow transport system failure.



Left: Section of Lower Hay Creek that is in CREP. This photo is at the same location as the photo on page 35, but this photo was taken on 4/03.

Lower left: This is also on a section of CREP where the stream is beginning to pool up. 2/03

Lower right: A shot looking down on Six Mile. Note willow colonies. 12/02

CHAPTER SEVEN – WATER QUALITY

INTRODUCTION

Water quality includes a number of factors that can negatively affect beneficial use of water. The factors most relevant in the Hay Creek watershed include temperature, dissolved oxygen and turbidity. The beneficial uses on the Hay Creek stream system are salmonoid spawning and livestock water.

Water quality data in the Hay Creek/Scott Canyon watershed is virtually non-existent. In 1994 the BLM did some temperature monitoring during the summer at four locations on lower to middle Hay Creek showing stream temperature higher than Oregon's 64 degree standard. Because of that data, Hay Creek was listed on the 1998 303(d) list as temperature sensitive. When the 303(d) list was reviewed in 2002, Hay Creek was de-listed because the data used as a temperature determination had been gathered in a drought year and DEQ declared it inadmissible. DEQ now identifies Hay Creek as a "potential concern" stream but with no immediate plans for stream monitoring.

Since 1985 the acres put into CRP have had a substantial effect in reducing sediment inputs in both Hay Creek and Scott Canyon watersheds. Locals say that before CRP, muddy water ran off plowed fields and rushed down the side canyons to Hay Creek after big storms. That seldom occurs now since many erosion-prone fields have been planted to permanent vegetation in the CRP program.

Temperature is the most commonly documented water quality parameter in the state of Oregon. Cool water temperatures are a basic requirement for native salmon, trout, amphibians and other aquatic life. Stream temperature is affected by natural factors, such as the temperature of seeps and springs entering the stream, climate, flow volume and the amount of streamside vegetation. A stream with lower flows and/or less vegetation will heat faster than a stream with higher flows and/or more vegetation. Cold water refuge, found in pools near seeps and springs, help fish exist in streams that at first glance may seem temperature stressed. Stream temperatures are measured in moving water approximately 12-18 inches deep.

Dissolved Oxygen is another factor that is critical for a healthy stream ecosystem, especially for salmonoid spawning. Oxygen is dissolved in running water in equilibrium with the atmosphere. The water temperature and pressure determine the percent oxygen saturation from the atmosphere. The colder the water is, the higher the concentration of oxygen. Dissolved oxygen levels fluctuate on a daily cycle tied to the change in temperature and the photosynthesis and respiration of aquatic organisms.

Turbidity is the measure of the clarity of water. Often streams are cloudy due to runoff of sediment so turbidity can be a useful tool. Turbidity varies with the type of soil in a landscape. The small particle sizes, such as silt, will stay suspended for long periods and cause turbidity. Soils that break down into sand-sized fractions will settle to the bottom and result in comparatively low turbidity values. During storm and runoff events, turbidity will naturally increase but with monitoring the stream and acquiring data over a period of time, the levels of turbidity over the natural occurring sedimentation for stream can be assessed.

RIGHT: Section of Lower Hay Creek that is in CREP.

BELOW LEFT: At the mouth of Hay Creek where it flows into the John Day River

BOTTOM: Upper Hay Creek

CHAPTER EIGHT – RIPARIAN VEGETATION AND CONDITION

INTRODUCTION

Human and natural events can alter the vegetation patterns in a watershed. Events potentially affecting the Hay Creek/Scott Canyon watershed's riparian condition include farming practices, grazing management and flood events. Riparian vegetation not only affects the esthetics of a stream system but more importantly, impacts the stream's ability to capture and filter sediment, slow down scouring and bank erosion during a flood event, broaden the riparian area and increase the groundwater recapture potential, and reduce water heating by direct shading and increased flows. The amount of site potential shade available is dependent on many factors including soils, water availability and stream orientation. Large woody debris is not a factor in the Hay Creek/Scott Canyon watershed. Except for several isolated pockets of cottonwoods, there is no large wood supply.

METHODS

After an extensive and unsuccessful search for infrared or color aerial photography of this watershed, black and white aerial photos were used to identify distance and types of riparian vegetation. Field observations and photo monitoring were ultimately more useful in this task.


Upper Hay Creek • 2/03

OVERVIEW

Grazing by ungulates (cows, deer, elk, bighorn sheep, etc.) can reduce the amount of riparian vegetation below the desirable threshold. Careful management of livestock can keep browse levels within acceptable levels. The impact of riparian grazing changes depending on the season of use and amount of grazing allowed before removing animals. Grazing may severely impact young plants trying to become established along streams. Grazing management must provide an adequate cover and height of vegetation on the banks and overflow zones to promote natural stream functions (sediment filtering, bank building, flood energy dissipation, aquifer recharge and water storage). Once shrubby vegetation is well established, it is not easily damaged as it has a rapid rebound rate. Overgrazing can result in shrubs being difficult to identify as even present, yet the areas can quickly rebound when grazing pressure is removed.

Field observations in the Hay Creek watersheds showed certain sections having a lack of riparian vegetation and an abundance of Big sagebrush close to the stream channel. Grazing has altered the vegetative stands, but without historical aerial color photos it is difficult to assess what the true natural state of riparian vegetation along this stream system was. Historically it was noted that pioneers had to clear the stream beds of large dense populations of sagebrush in order to plant crops. But how much riparian vegetation existed, we may never know.

The *NRCS Technical Field Guide* states that in loamy bottom-type soils along streams, basin wildrye was the predominate grass until overgrazing created an environment where bluegrasses increased. Basin wildrye depends on good subsurface moisture. When channels become deeper and wider, the resulting drop in the water table affects Basin wildrye stands. With further deterioration, big sagebrush communities increase and annuals, such as cheatgrass, invade.

This region has had less than average rainfall over the last four years. In 2002 Gilliam County was declared a state drought disaster area. This environmental condition impacts the growth and regrowth of the riparian vegetation.

From the black and white aerial photos used in this assessment, it was apparent in some sections of Hay Creek there was abundance of upland Big sagebrush growing in the riparian zone. Field observations confirmed this. This abundance of sagebrush is a direct result of the lack of fires in the watershed canyonlands. In some areas there is sagebrush growing right up to the modern floodplain. Where channel terraces exist, sagebrush sometimes grows right up to the edge of the terrace lip, overhanging the channel. In areas on Middle Hay Creek there is an abundance of boulder and cobble debris and a lack of soil adjacent to the channel, perhaps inhibiting riparian vegetation recruitment. Many sections have basalt cliffs or high terraces that inhibit riparian vegetation but at the same time provide shade during certain times of the day. There are also sections where roads are within the riparian zone, however most of the time those roads are on top of the incised banks—with the banks becoming the inhibiting factor rather than the roads.

With good land use management, sections of Hay Creek with the low and moderate stream gradient have good potential to restore riparian vegetation. Exclusion or specific timing of grazing in certain riparian areas would encourage recruitment of willows and increase rush and sedge growth along the channel.

Vegetation associated with the soil types along the Hay Creek channel *(xeric torrifluevents, hermiston silt loams and kimberly fine sandy loams)* include Needleandthread, Bluebunch wheatgrass, Indian ricegrass, Basin wildrye, Idaho fescue, Sandberg bluegrass. Woody species, however sparse, are Alder, Sumac, Black cottonwood and Willows. Riparian vegetation identified included Cattails, Diverse-leaved water starwort, Small-flowered bulrush, Stinging nettle and Horsetail.

In the section of CREP along lower Hay Creek, seven different varieties of trees were planted in 2001. Survival of the saplings varies along the creek, with many tree starts showing good growth after two years. In the Six Mile sub-watershed, good stands of older willows exist and younger stands of willows are emerging. Middle Hay Creek varies in the health of the riparian zone. Some sections have sedges and rushes around pools and riffles, other areas have hedged willow stands growing and stands of alder and sumac growing where the springs and seeps are located within the first 50' of canyon walls, but not alongside the stream channel. Ten Mile sub-watershed has potential for vegetation recruitment but shows some unraveling of the channel in several areas. Upper Hay Creek has good stands of riparian vegetation with areas of good potential for vegetation recruitment. Dry Fork also has good stands of riparian vegetation for recruitment.

In sections of Scott Canyon dry wash, no riparian vegetation exists except in areas where seeps and springs have created a short section (approx. 100 yards) of small puddles and muddy areas. A few older willows and some sedges and rushes are growing in those areas. Most of the stream channel is extremely scoured out and has a high incidence of boulder and cobble rubble. Upland shrubs, mostly sagebrush, is growing where there is soil in and alongside the historic channel.

CHAPTER NINE – Fish & Fish Habitat

Introduction

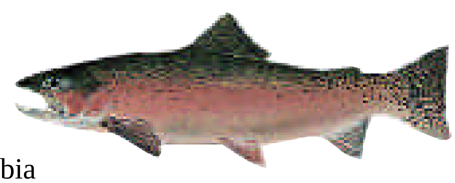
This chapter describes the fish and fish habitat within the Hay Creek/Scott Canyon watershed.

Methods

Very little historical information about fish populations is available on the watershed but extrapolation from *BPA John Day River Sub-basin Summary* (dated 8/3/01) and data gleaned from NOAA fisheries and other sources gives a snapshot of the species and their habitat requirements.

Species

Of the fish listed in the *BPA John Day River Sub-basin Summary*, ten native species may use the Hay Creek watershed as spawning or rearing habitat. They include: Torrent sculpin, Mottled sculpin, Summer steelhead/Redband trout, Speckled dace, Longnose dace, Redside shiner, Bridgelip and Largescale sucker and the Pacific lamprey. Of these species the one of most concern is Summer steelhead. In 1999, the National Marine Fisheries Service (NMFS) listed Middle Columbia Summer Steelhead (*Oncorhynshus mykiss*) as a threatened species under the Endangered Species Act. In a study done in 2001 (Mark W. Chilcote) evaluated the six sub-populations within the John Day sub-basin with respect to viability and found that all six subpopulations were at no risk of extinction. Although steelhead are defined as anadromous O. mykiss, there are areas where the separation between redband trout and steelhead is obscured. Where *O. mykiss* becomes landlocked they can residualize and continue to exist as the nonanadromous form, Redband trout. It is also noted that sometimes growth rate can determine residualization as well. (Mullen et al. 1992)



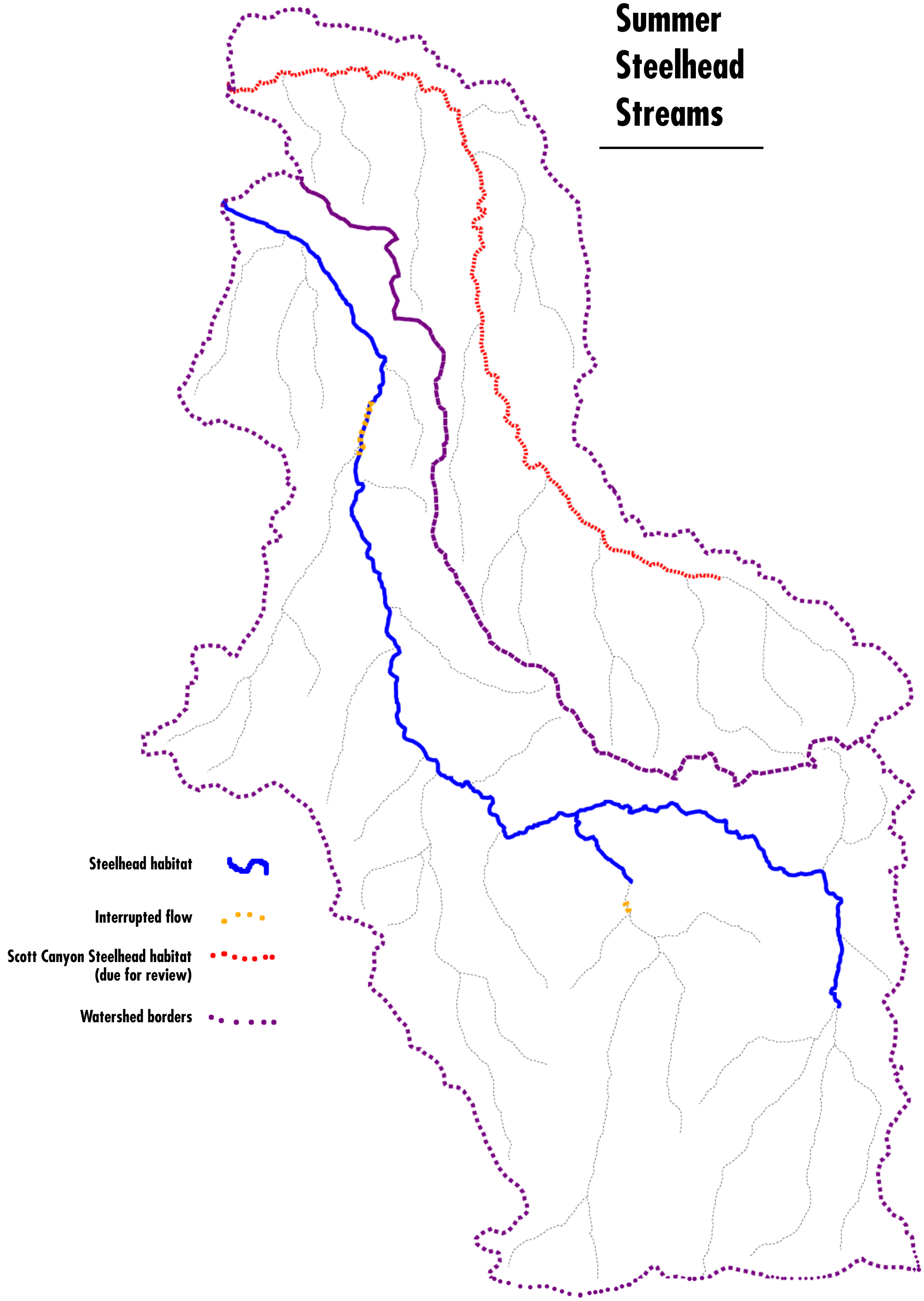
Summer Steelhead

The John Day River supports what may be the largest wild run of summer steelhead in the Columbia River Basin with estimated runs of between 5,000 and 40,000 fish. No hatchery steelhead have been released in the John Day River since the late 1960s and those releases were from a stock that had very little probability of survival. However, stray hatchery fish coming from as far away as the Snake and Wallowa River hatcheries have been captured by anglers in tributaries of the lower John Day River. The fishery of wild steelhead has been limited to catch and release since 1996.

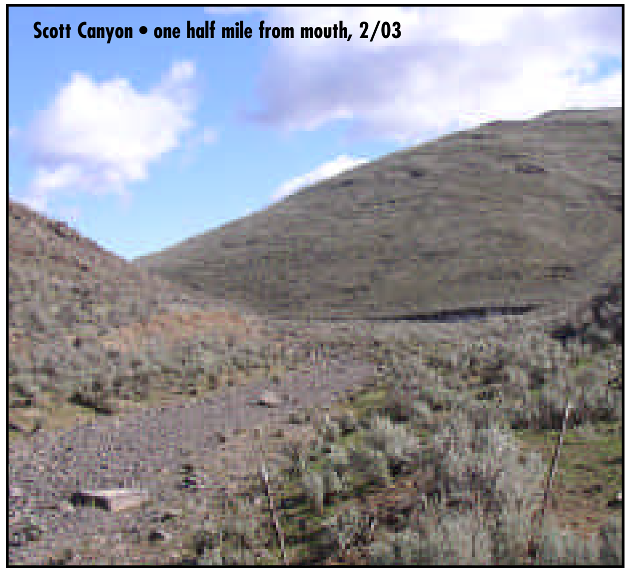
Low, warm waterflows in the lower John Day River during summer months precludes adult summer steelhead from exiting the Columbia River and entering the John Day River until mid- to late September. Spawning commences in the lower tributaries, such as Hay Creek, sometime around April depending on the water level. Emergence of summer steelhead fry is usually complete by mid-July. Information indicates that steelhead smolt primarily as 2-year-olds and spend one year in the ocean before returning as adults. A smaller proportion of fish smolt as either 1 or 3 year olds or spend 2 years in the ocean before returning as an adult. (BPA 2001)

Hay Creek is listed by the Oregon Department of Fish and Wildlife as Summer steelhead spawning and rearing habitat from the mouth up 17 miles of the main stem and 7.7 miles on the

Summer Steelhead Streams



Dry Fork. Those same sections are listed as year-round habitat for Redband trout. ODFW documents Hay Creek from the mouth to Ten Mile as having serious habitat constraints, including streambank degradation, low water flow levels, sedimentation and high temperatures. In the year 2000, approx. three miles of CREP were put in on a section of lower Hay Creek. Since it was established, the habitat and channel health has improved dramatically.


Scott Canyon • one half mile from mouth, 2/03

Scott Canyon is listed as having 15.8 miles of Summer steelhead spawning and rearing habitat. After field studies and interviews with several locals it was determined that this watershed system may not be true steelhead habitat. As noted earlier in this document, Scott Canyon is a dry wash most of the year, and only flows for hours at a time during extreme flash storm events. ODFW was contacted and has expressed an interest in re-evaluating Scott Canyon by field survey sometime in 2003.

Life Cycle Factors for Summer Steelhead

Incubating summer steelhead eggs are less likely to be destroyed during winter floods because steelhead spawn during January-June when the likelihood of a channel-disturbing flood is low. However, juvenile steelhead spend two to four years rearing in fresh water which makes them more vulnerable to related impacts such as sediment load from flashy storm events and during drought cycles, extremely low flow and higher water temperature. Juvenile steelhead must have downstream access to perennial flows or they will perish.When natal streams resume fall and winter flow, juvenile steelhead must be able to move back to these areas, which are a refuge from winter floods. Juvenile steelhead repeat these seasonal migrations from small to larger streams until they are large enough to smolt and migrate to the sea.

Steelhead are a fast water fish. Juvenile steelhead seek out the heads of pools and fast water around boulders. Flow is very important for juvenile steelhead. Juvenile steelhead can tolerate short periods of high water temperature as long as strong flows in riffles provide life supporting food and high oxygen saturation. During periods of temperature stress, juvenile steelhead will concentrate in small cold pockets where temperatures are five to ten degrees cooler than the main current. These cold pocket refuges are dependent on subsurface flows in gravel bars and springs from side slopes. As flows decrease, these cold pockets disappear or become inaccessible. Steelhead cannot survive and grow in puddled stream reaches with little or no flow in riffles.

Fish distribution varies from year to year, depending on the runoff and other actors. Steelhead are particularly vulnerable to droughts. During these periods of naturally low flows steelhead populations can plummet because of decreased summer rearing habitat and also because low winter flows prevent adult summer steelhead from accessing preferred spawning tributaries.

CHAPTER TEN – WATERSHED CONDITION SUMMARY

INTRODUCTION

This chapter summarizes and integrates information from each component of the Hay Creek/Scott Canyon Watershed Assessment. There has not been adequate information collected to make a judgement on the Hay Creek/Scott Canyon Watershed's present condition. Neither Hay Creek or Scott Canyon are 303(d) listed streams, but that is probably because there has not been adequate monitoring to date. There is very little data available for Hay Creek or Scott Canyon. Currently there are no stream gages on Hay Creek and no coordinated monitoring efforts. The data assembled in this watershed assessment serves as baseline information to be used with other resources available to guide restoration efforts.

DATA GAPS

During the process of compiling the information for the Hay Creek/Scott Canyon watershed assessment it became apparent there was an lack of data for streamside and upland management purposes. These are called data gaps and include:

- temperature, water quality and streamflow data
- sediment and turbidity measurements
- aerial infrared and color photography of stream systems
- inventory of riparian, upland and range conditions
- stream morphology surveys
- fish surveys
- weed site/control inventory
- rangeland inventory including trend analysis
- farming practices inventory
- historical and current vegetation mapping
- riparian conditions over time
- fish use in tributaries

RESTORATION POTENTIAL

The summarizing of current and historical conditions and data gaps within a watershed will help to identify how current and past resource management impacts resources. Through this summarization, we have attempted to create a decision-making framework for identifying potential restoration activities. The assessment is conducted on a watershed level recognizing that all parts of the watershed function as a whole and the alteration or loss of one watershed process can affect many other processes in the watershed.

Following are some restoration possibilities for the Hay Creek/Scott Canyon watershed. Landowners have already requested assistance in improving land-use practices. They include:

- weed control
- brush control and brush removal
- off-stream livestock watering systems
- fencing
- alternative forage sources *(forage kochia, austrian peas, etc)*
- increase vegetation where there is site potential
- terracing on farmground
- sediment basins
- spring developments
- CREP
- grazing management plans
- reduced tillage practices

Overview Hay Creek

Some restoration practices work better in some Channel Habitat Types (CHT) than others. The 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. While lateral movement of the channel will limit the success of many efforts, localized activities to provide bank stability or habitat development can be successful.

AF - although they are considered responsive channels, long-term success of enhancement activities is questionable.

LM - this CHT has some of the best potential for restoration. The addition of streamside vegetation can be a good option. Physical constraints work well. Pool frequency and depth may increase and side channel development may result.

LC - the addition of streamside vegetation is the best option as these channels are not highly responsive and channel enhancements may not yield intended results. Plans must be made carefully.

MM - among the most responsive of channel types. A good candidate for channel enhancements. Riparian vegetation additions highly successful.

MC - not highly responsive to channel enhancement. Riparian vegetation establishment often successful.

MH - these CHTs located in the headwaters are moderately responsive to channel enhancement efforts. Riparian vegetation establishment can be successful.

Much of the Hay Creek stream system has been altered in the past by both natural and human-related causes. It appears that the channel has widened and has become shallower over the years in some places. That could be partially in response to naturally occurring historic flood events as well as historic land-use practices.

While it is true that Hay Creek is an interrupted stream, it is also true that even in low water years there is some water flowing in most reaches of the stream. Because water appears in some places and not others, it means that water is flowing subsurface in certain areas. This would tend to cool the water and may hold potential for increase in cold-water refugias. In Lower Hay Creek there are pools where fish can hold over the summer unless they are taken by predators.

In certain stream segments the stream tends to be wide and shallow, therefore 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 can be expected between night and day or cloudy days and sunny days. Landforms also contribute to cooling through shading of several reaches where canyon walls are high and steep.

There are reaches of Hay Creek that have high potential for restoration efforts. Channel complexity could be increased by the addition of vegetation that include willows. In some places the planting of riparian vegetation could increase shade on the water when it is on the surface. These enhancements could take place on both public and private lands.

Certain sections of the Hay Creek do not appear to be degrading at this time. These sections are relatively stable, but do not appear to be improving substantially. There are also areas that appear to be unraveling and show signs of becoming unstable. The good news is that the stream system in Hay Creek has a high potential for recovery. The landowners willingness to participate will increase restoration opportunities. Is it important that credit be given to individuals and agencies that have been restoring and improving the Hay Creek watershed thus far.

Overview Scott Canyon

There are many issues with fish passage, fish habitat and riparian vegetation in Scott Canyon.

Restoration efforts as identified by channel habitat types do not apply to Scott Canyon because of the lack of stream flow. The only water found in Scott Canyon during field observations were from occasional seeps. Extreme weather events have played the major role in the degradation of the Scott Canyon. Historic farming practices have also no doubt impacted the system, too. Because of the variable rates and intensities of natural disturbances, we will likely never see a time that even with man's best efforts Scott Canyon will reach full site potential. However, with modern and improved farming practices such as direct seeding, stubble mulching, chemical fallow and terraces, the channel has potential to show some improvement over time.

Watershed Summary

- Sheet and rill erosion from fields has the potential to add sediment to the stream. Controlling field erosion is an important conservation priority.
- Grazing plans that include off-stream watering improvements and mineral supplementation to help encourage livestock to move off the riparian areas. Also programs that assist ranchers in utilizing rotational grazing practices should be explored. Organize a PFC (proper functioning condition) workshop on Hay Creek.
- The CRP has helped to reduce sediment inputs to the streams in the watershed. Promoting this program is another important conservation priority. Gilliam County has already signed up the maximum number of CRP acres allowed.
- While there is not widespread sedimentation input from roads, there are specific sites that need treatment, such as runoff areas from highways bordering the watershed.
- CREP is showing encouraging results after only three years on lower Hay Creek. This program could have a significant impact on Hay Creek's recovery. Organizing a tour of the lower Hay Creek CREP to landowners with potential interest may encourage more users.
- Invasive and exotic weed concentrations need continual treatment and monitoring.

References

Biological Assessment for Conservation Practices within the Counties of Gilliam, Sherman and Wasco, NRCS, 2001

NRCS EQUIP project summary, Hay Creek/Scott Canyon, 2002

2001 & 2002 Certified Ratio Study, Gilliam County Statistics, Gilliam County Clerks Office

Natural Heritage Database: http://oregonstate.edu/ornhic

John Day Subbasin Summary, August, 2001. Prepared for the Northwest Power Planning Council

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

USDA-NRCS Prism Climate Mapping Project

Western Regional Climate Center: http://www.wrcc.dri.edu

Oregon Climate Services: http://www.ocs.orst.edu

Manual of Actual Vegetation in Oregon, 11/1992, Prepared for the Oregon Gap Analysis Program, directed by the Idaho Cooperative Fish & Wildlife Reseach Unit, University of Idaho, in cooperation with the Oregon Department of Fish and Wildlife and the Oregon Natural Heritage Program

USDA, NRCS. 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA70874-4490 USA

Roadside Geology of Oregon, David D. Alt and Donald W. Hyndman1988

Archaeology in Oregon. Aikens, C.M. 1993, BLM/OR/WA/ST-9316+8100, United States Department of the Interior, BLM

Gilliam County Extension Agency Journals, 1918 to 1983

Annie's Story, by Marilyn Baker Froman. 1999

A Pictorial History of Gilliam County Oregon, 1983, The Gilliam County Historical Society

History of Gilliam County, Compiled by Marian C. Thouvenel and Lovena S. Palmer, 7/1952

The Robinson Story & John Jackson's Story
Gilliam County Historical Story, Grades 3 & 4, Miss Bessie Golay & Miss Blanche Hicks, 5/1947

The First Oregonians: An illustrated collection of essays on traditional lifeways, federal-Indian relations, and the state's native people today. Published by Oregon Council for the Humanities, 812 SW Washington, Suite 225, Portland, OR 97205.

Oregon Historical Quarterly, Vol. 67 (June 1966), Oregon Sheep, Wool and Woolen Industry. The Cattle Industry of Eastern Oregon

Roads and Rails South from the Columbia, John F. Due, Frances Juris Rush. 1991. ISBN 0-89288922497

Hay Creek Water Supply Project, Stevens & Koon May 1923

Applied River Morphology, Dave Rosgen. Wildland Hydrology 1996. ISBN 0-9653289-0-2

Field Guide for Stream Classification, Dave Rosgen and Lee Silvey, Wildland Hydrology. 1998
ISBN 0-9653289-1-0

Channel Habitat Type Descriptions. Watershed Professional Network, 1999. *Oregon Watershed Assessment Manual.* June 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon

Hydrologic Process Identification for Eastern Oregon, Watershed Professional Network. Oregon Watershed Assessment Manual. February, 2001. Prepared for the Governor's Watershed Enhancement Board, Salem, Oregon

Groundwater Resource Investigation, Gilliam County, Oregon. January 1998. Prepared for Gilliam County by George Chadwick Consulting

No-till influence on Hydrology and Stream Morphology in Dryland Crop Areas. John D. Williams and Stewart B. Wuest. Station Report 1026, June, 2001. Columbia Basin Agricultural Reseach Center Annual Report

USDA-NRCS Average Soil Erosion by Water on Cultivated Cropland as a Proportion of the Tolerable Rate (T), 1997.

Froese, R. and D. Pauly. Editors. 2003. FishBase. www.fishbase.org, version 21 April, 2003

West Coast Steelhead Fact Sheet, March 1999 www.nwr.noaa.gov

NOAA Technical Memorandum NMFS-NWWFSC-27 *Status Review of West Coast Steelhead from Washington, Idaho, Oregon and California*. August, 1996.

Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes & Invertebrates (Pacific Northwest) *Biological Report: Steelhead Trout*, USF&W Service, 1986

The Ecological Provinces of Oregon, E. William Anderson, Michael M. Borman & William C. Krueger, May 1998, Oregon Agricultural Experiment Station

Rare, Threatened and Endangered Plants and Animals of Oregon, February 2001, Oregon Natural Heritage Program

Soil Survey of Gilliam County of Oregon, USDA-NRCS, May 1984

Biological Assessments for Conservation Practices within the Counties of Gilliam, Sherman and Wasco. USDA-NRCS draft January 2002

Oregon List of Threatened, Endangered or other Species of Conservation Concern. www.pacificbio.org

Streamnet: Fish distribution of Summer Steelhead and Redband Trout, Hay Creek #17070204, http://query.streamnet.org

Monitoring the Vegetation Resources in Riparian Areas, USDA-NRCS, April, 2000

Going with the Flow: Understanding Effects of Land Management on Rivers, Floods and Floodplains, 2002. Barbara Ellis-Sugai and Derek C. Godwin. ISBN 1-881826-27-9

Riparian Area Management for Lotic Areas, TR 1737-15, 1998 USDA-NRCS

Using Aerial Photographs to Assess Proper Functioning Condition of Riparian-Wetland Areas, TR 1737-12, 1996 - revised 1999 USDA-NRCS

Weeds of the West, ISBN 0-941570-13-4 Western Society of Weed Science, 9th edition, 2000

Plants of the Pacific Northwest Coast, Polar & Mackinnon 1994

Sagebrush Country: A Wildflower Sanctuary, Ronald J. Taylor 1992

USDA-NRCS *Field Office Technical Guide* • Section II - iii B Rangeland MLRA, 1987 & 1999

Glossary

Anadromous – fish that move from the sea to fresh water for reproduction.

Alluvial – sand, clay, etc. deposited by flowing water, especially along a river bed.

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 of how much a channel can move within its valley before it is stopped by a hill slope or terrace.

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

Cobble – Midsize rocks in the streambed. Identified by Rosgen as rocks that range in size from 60 millimeters up to 250 millimeters in diameter.

Downcutting – When a stream channel deepens over time.

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

Ephemeral – A stream that is dry for a portion of the year and most often contains water during and immediately after a rainfall event.

Extirpation – to eradicate.

Fines – small fragments of rock, soil and organic matter transported and deposited into streambeds by wind, water or gravity. Identified by Rosgen as particles in streambeds that range from .125 to .25 millimeters in diameter.

Hydrologic Cycle – The circulation of water around the earth, from ocean to atmosphere and back to the ocean again.

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

Intermittent Stream – A stream that flows only seasonally, or sporadically. Surface sources involve springs, snow melt, artificial controls, etc. Often this term is associated with flows that re-appear along various locations of a reach, then run subterranean.

Lacustrine – Soils that originated from lake bottoms.

Loess – a fine-grained, yellowish-brown, extremely fertile lam deposited by the wind.

Monotypic – Having only one type.

Natal Stream – Native stream.

Perennial Stream – A stream that flows all year long.

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

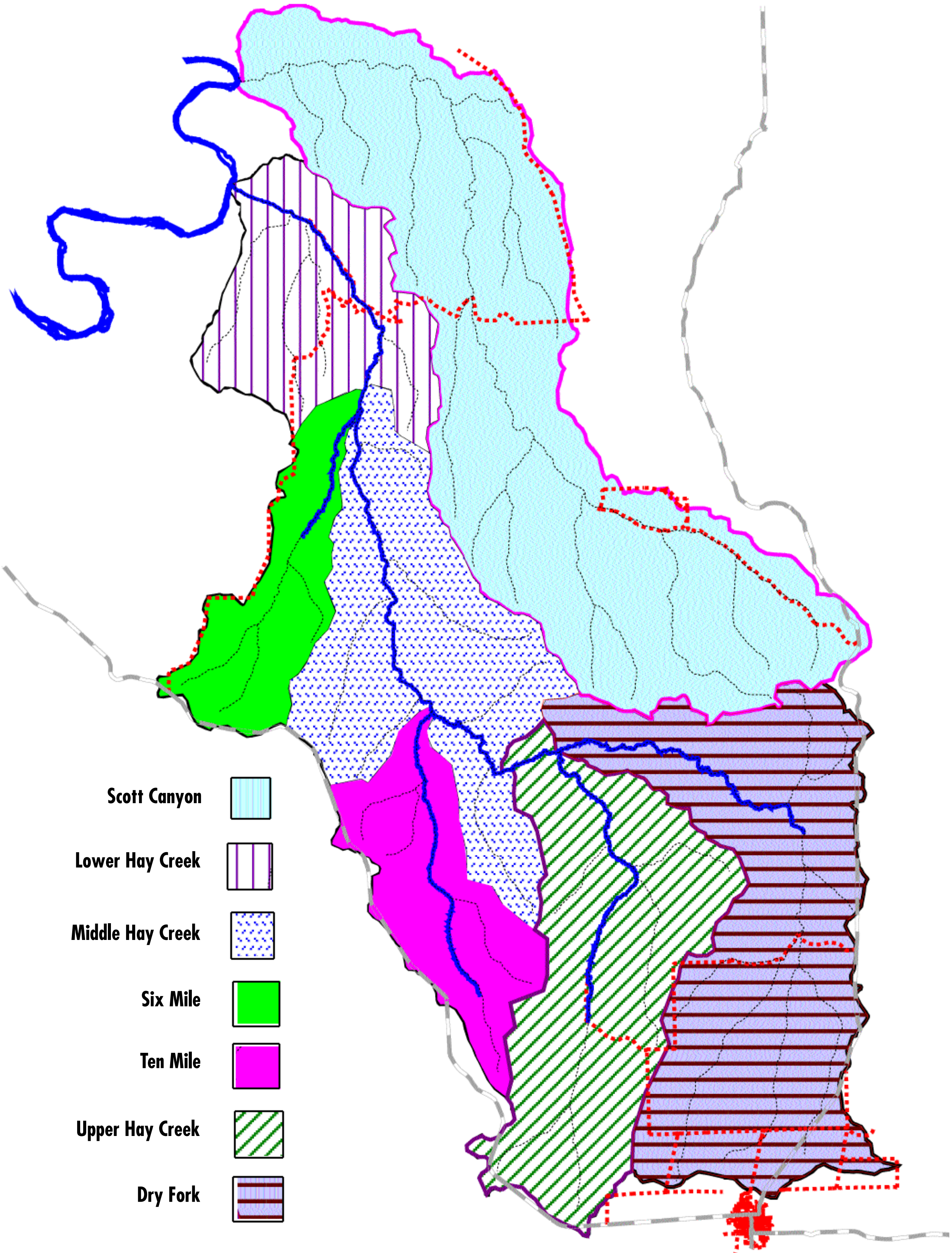
Stream Morphology – From the Greek root meaning structure or form; in stream channels, those physical features (such as gradient and confinement) that reflect the influence of processes which operate on a landscape scale (such as geology and climate).

Substrate – Mineral or organic material that forms the bed of a stream.

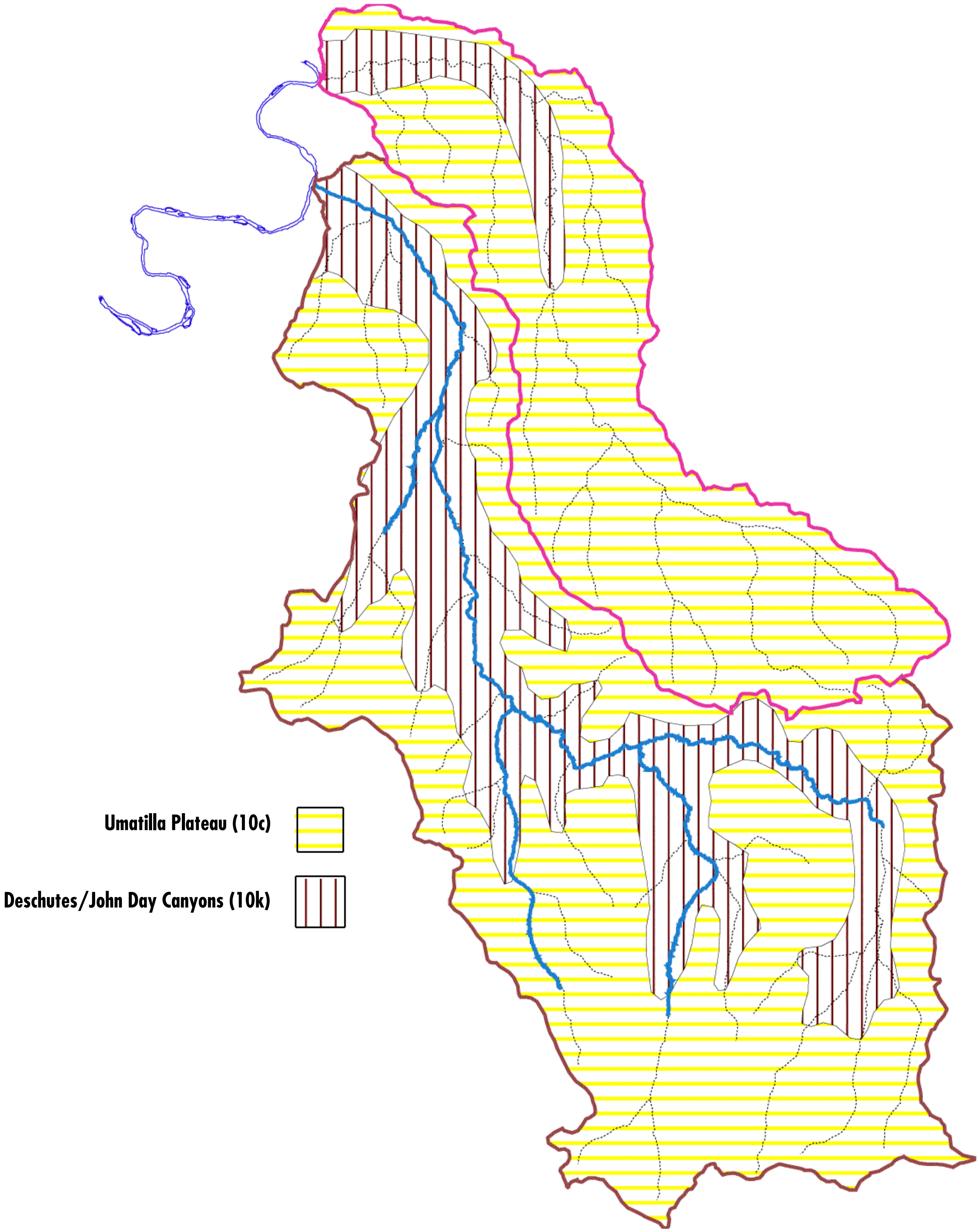
Watershed – An area drained by a river or river system.

APPENDICES

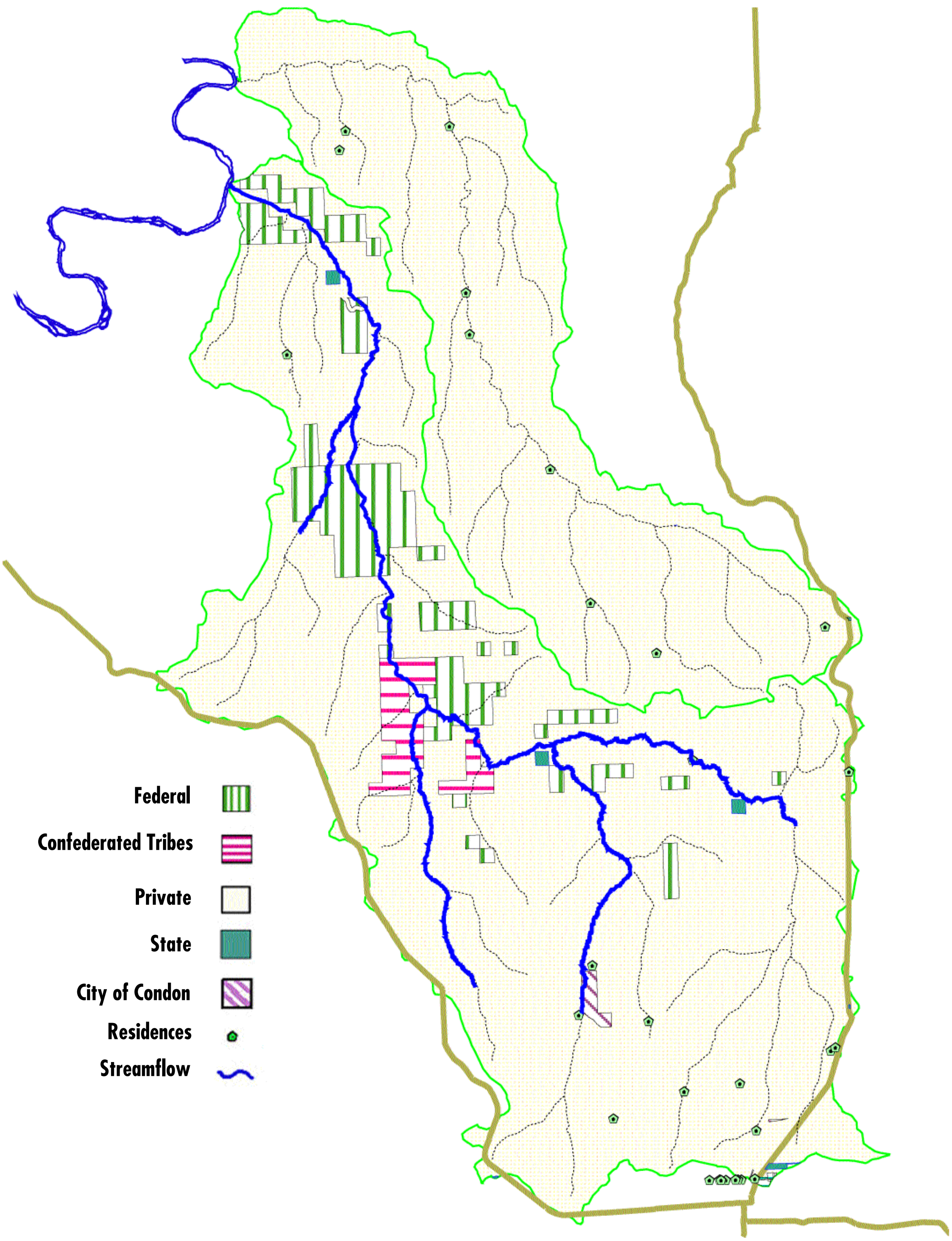
Sub-watersheds



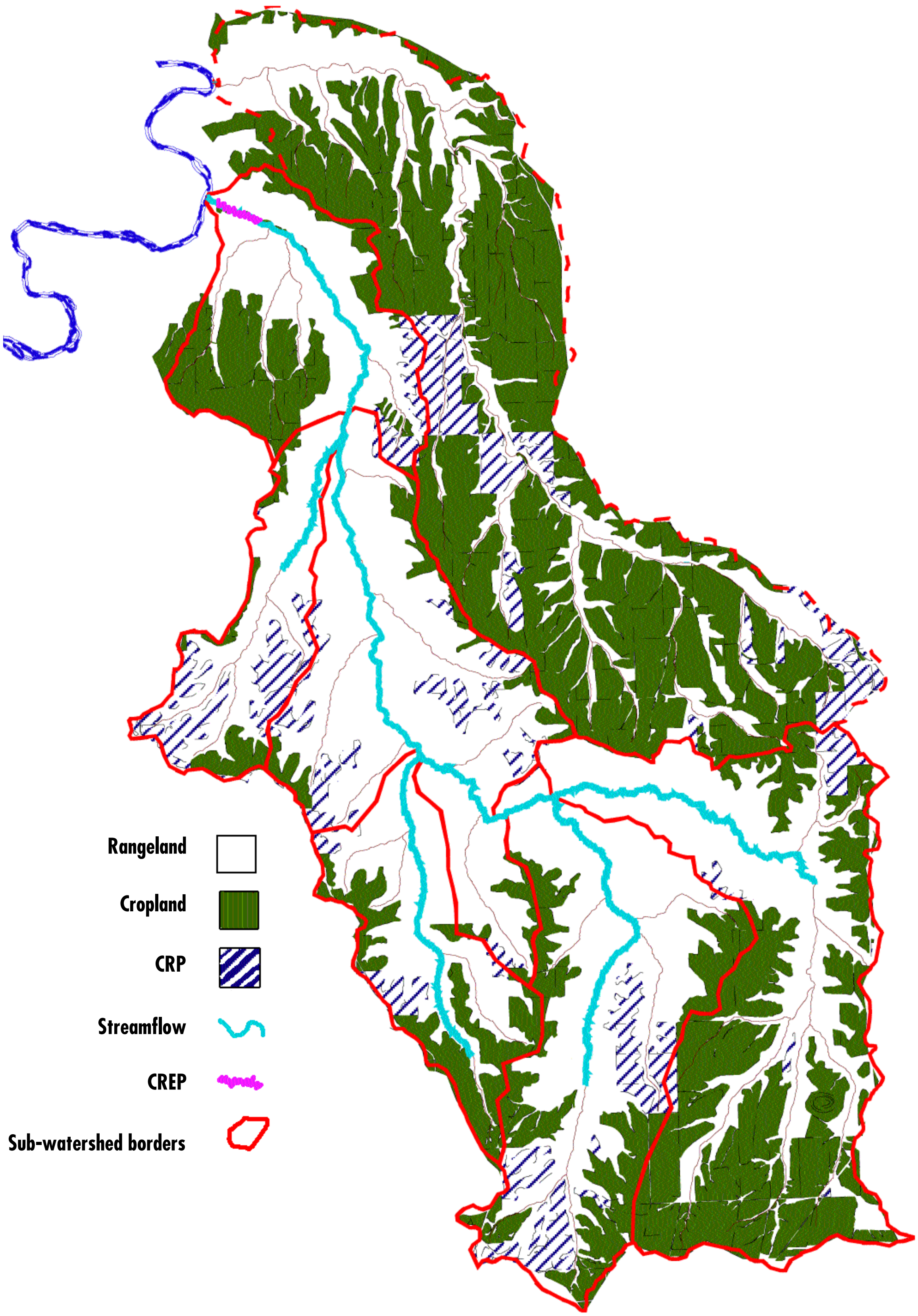
Ecoregions



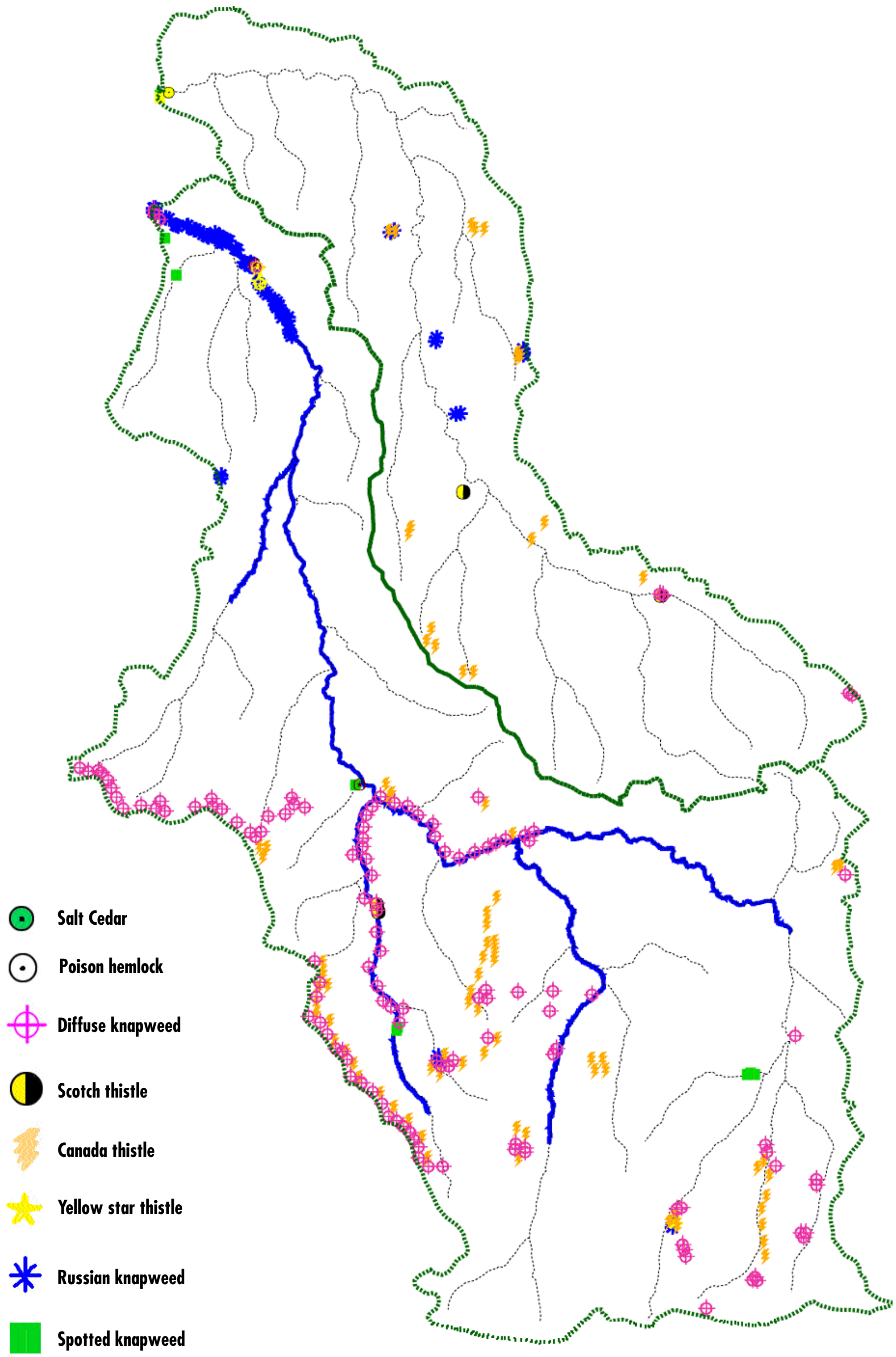
Ownership


Federal
Confederated Tribes
Private
State
City of Condon
Residences
Streamflow

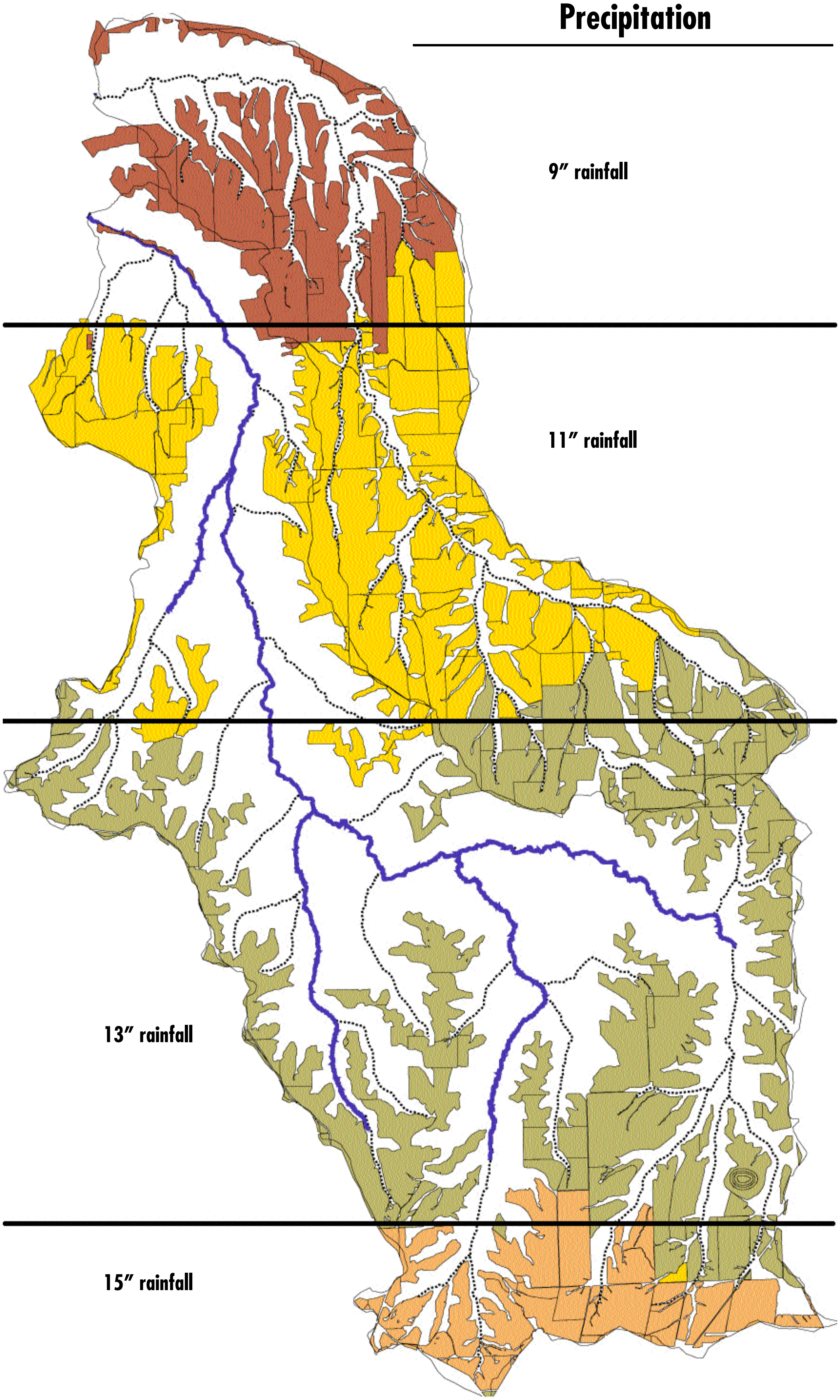
Land Use


Rangeland
Cropland
CRP
Streamflow
CREP
Sub-watershed borders

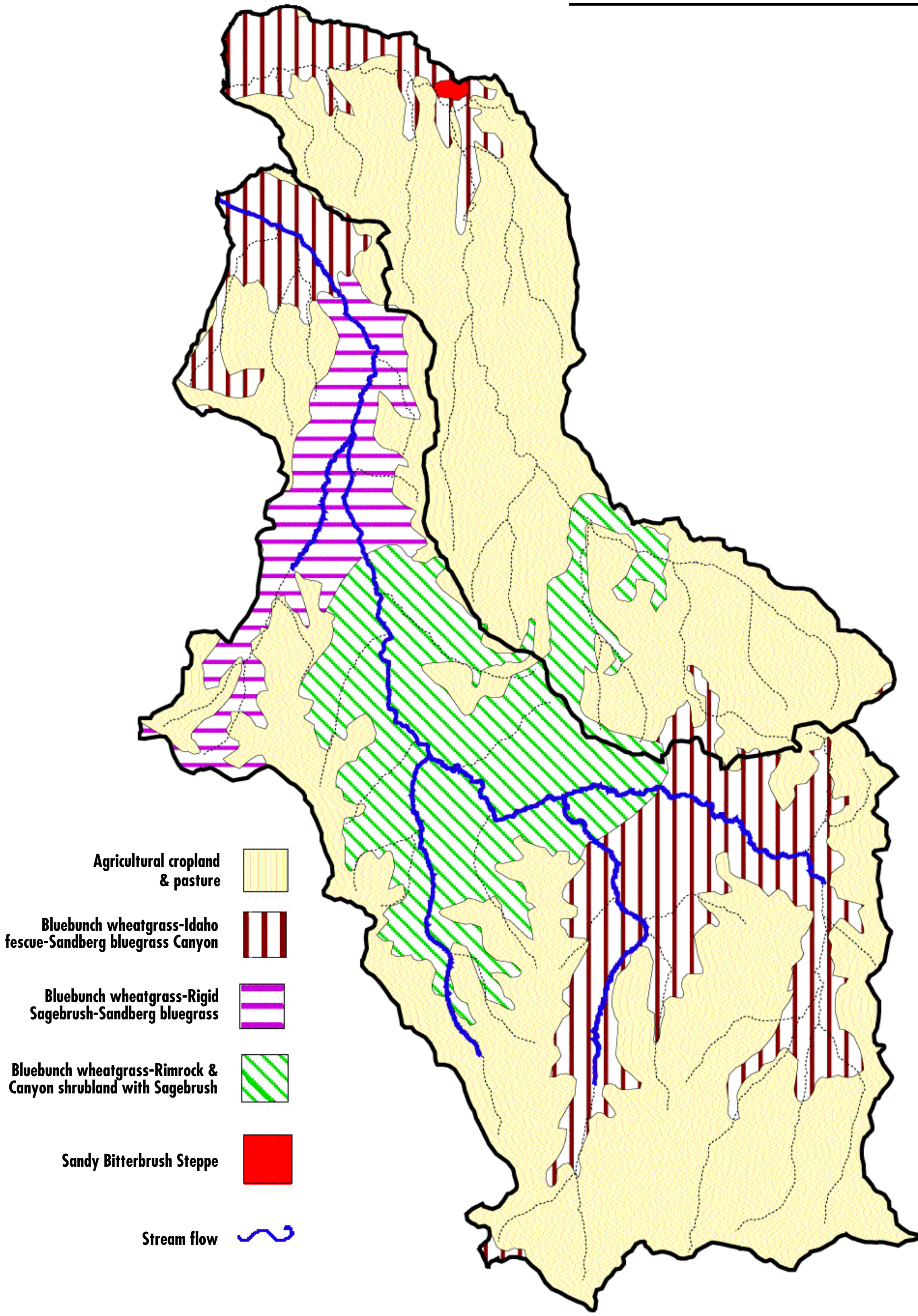
Noxious & Invasive Weeds



Precipitation

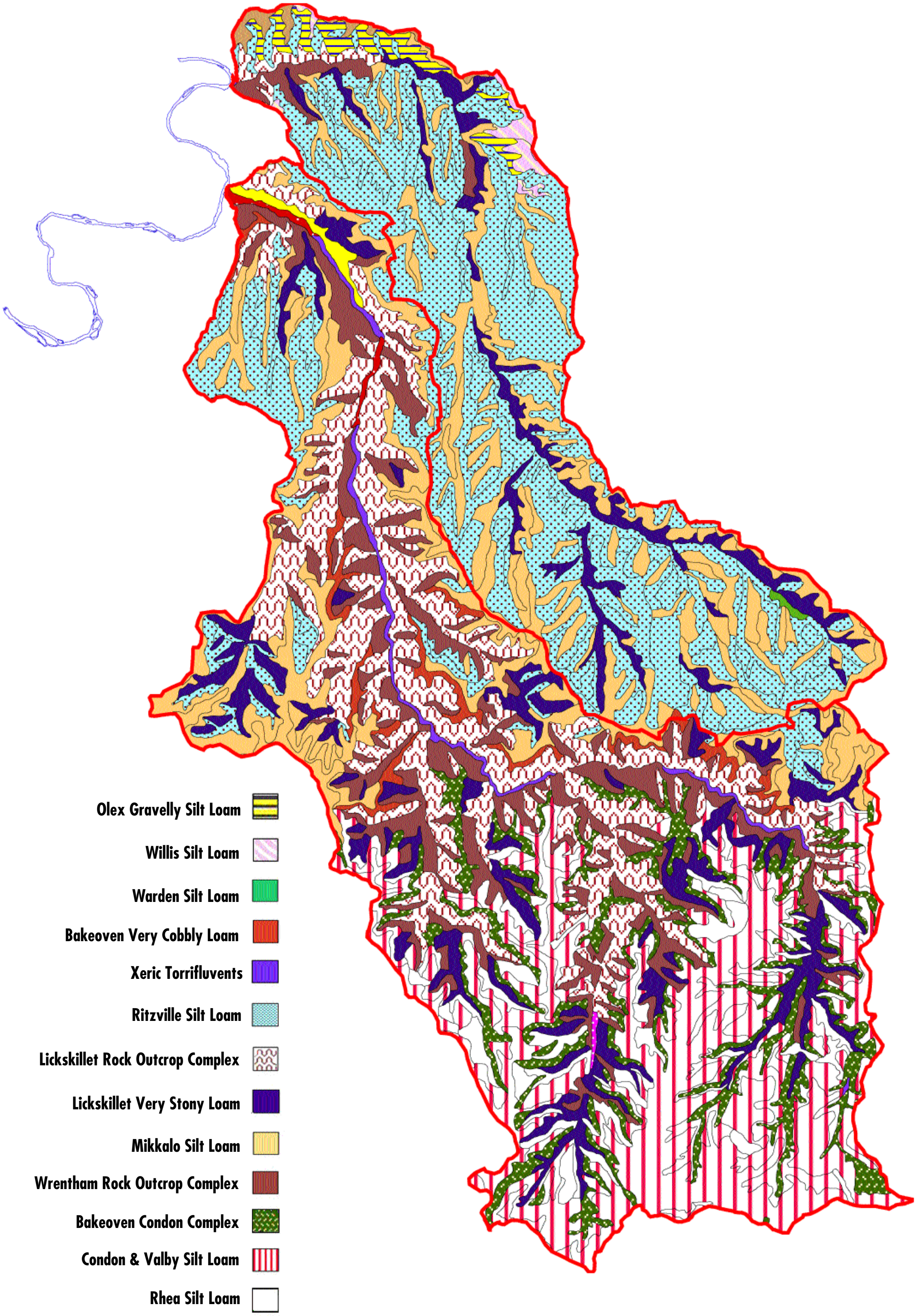


Vegetation

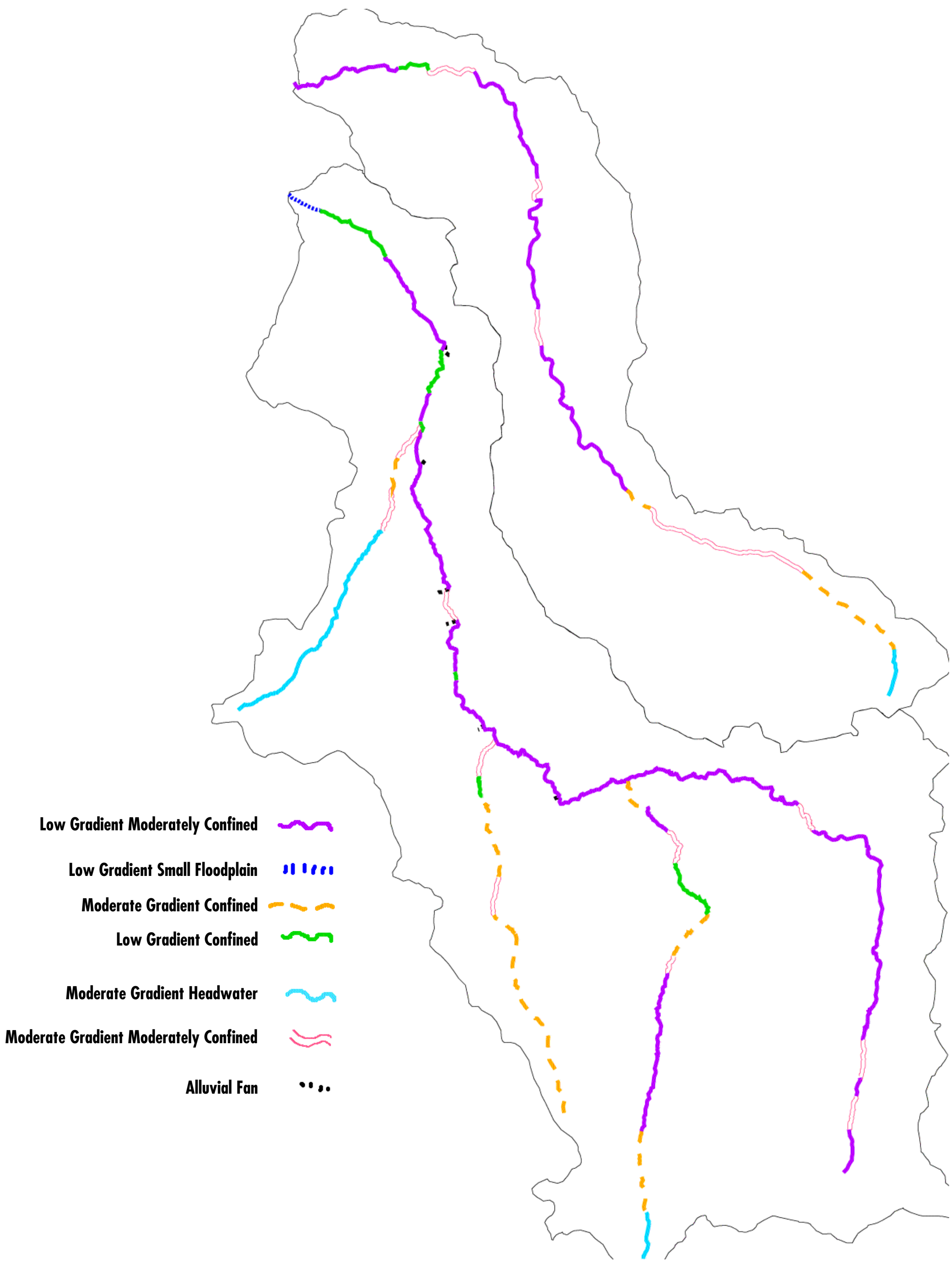


Agricultural cropland & pasture
Bluebunch wheatgrass-Idaho fescue-Sandberg bluegrass Canyon
Bluebunch wheatgrass-Rigid Sagebrush-Sandberg bluegrass
Bluebunch wheatgrass-Rimrock & Canyon shrubland with Sagebrush
Sandy Bitterbrush Steppe
Stream flow

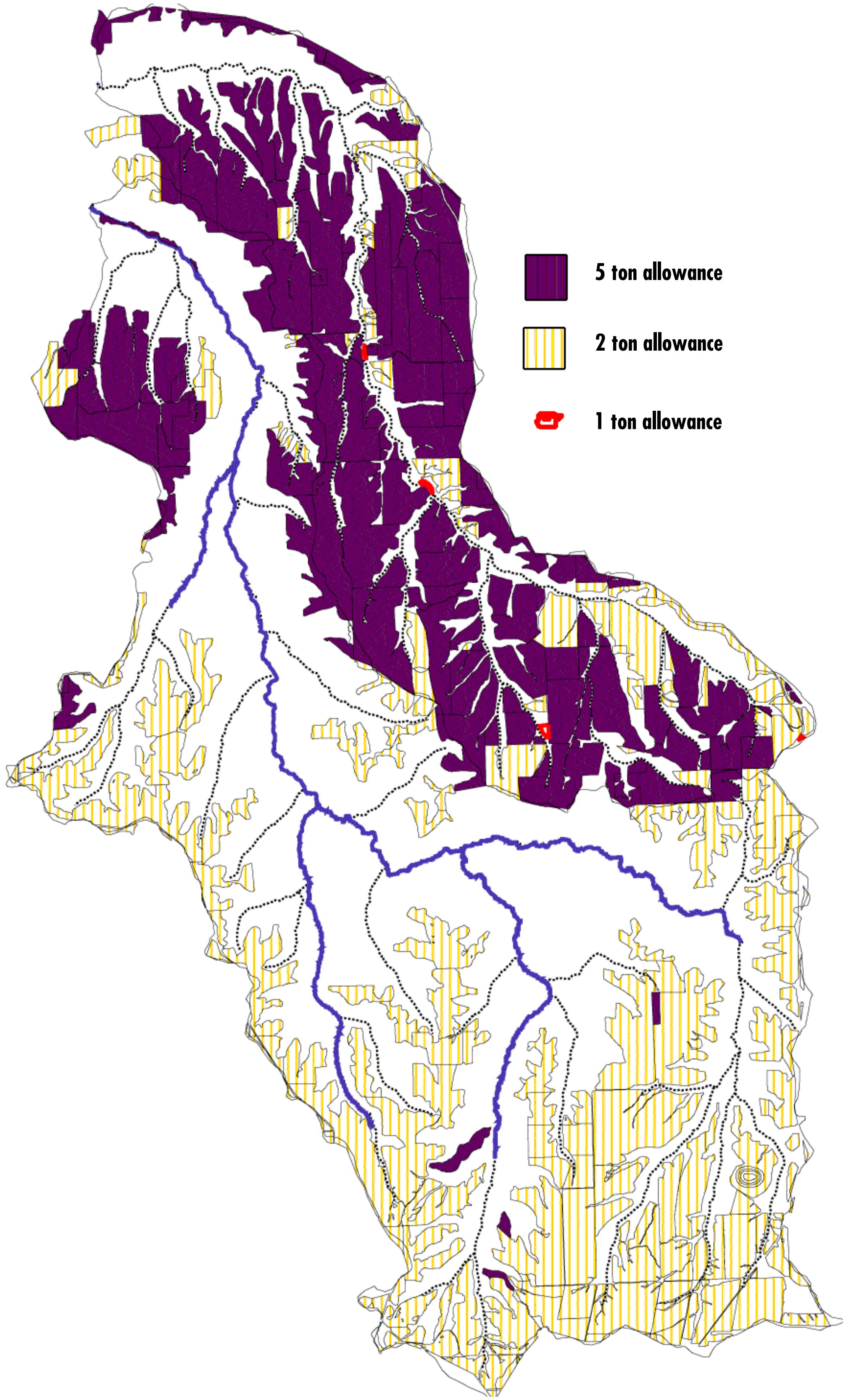
Soils


Olex Gravelly Silt Loam
Willis Silt Loam
Warden Silt Loam
Bakeoven Very Cobbly Loam
Xeric Torrifluvents
Ritzville Silt Loam
Lickskillet Rock Outcrop Complex
Lickskillet Very Stony Loam
Mikkalo Silt Loam
Wrentham Rock Outcrop Complex
Bakeoven Condon Complex
Condon & Valby Silt Loam
Rhea Silt Loam

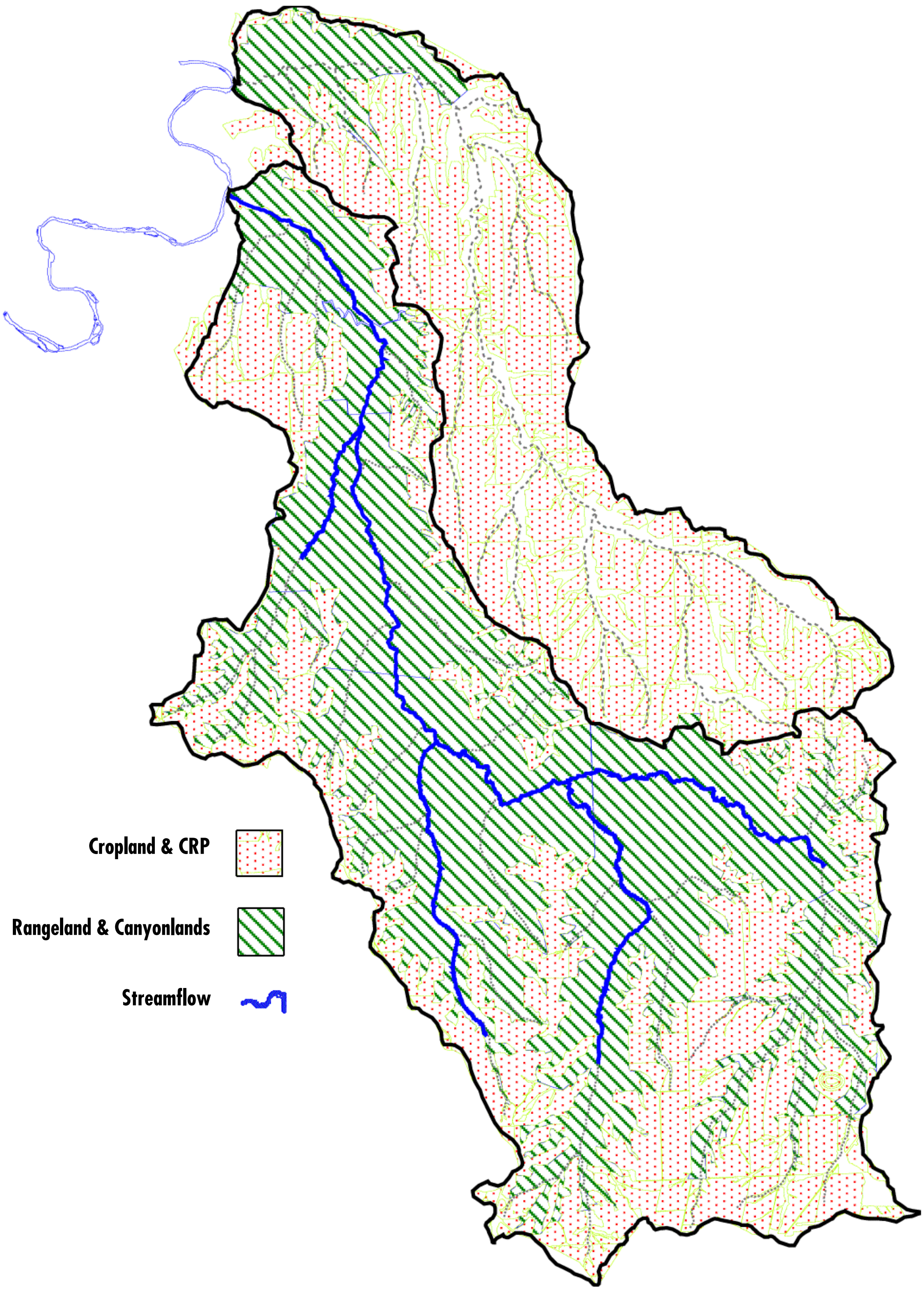
Channel Habitat Types



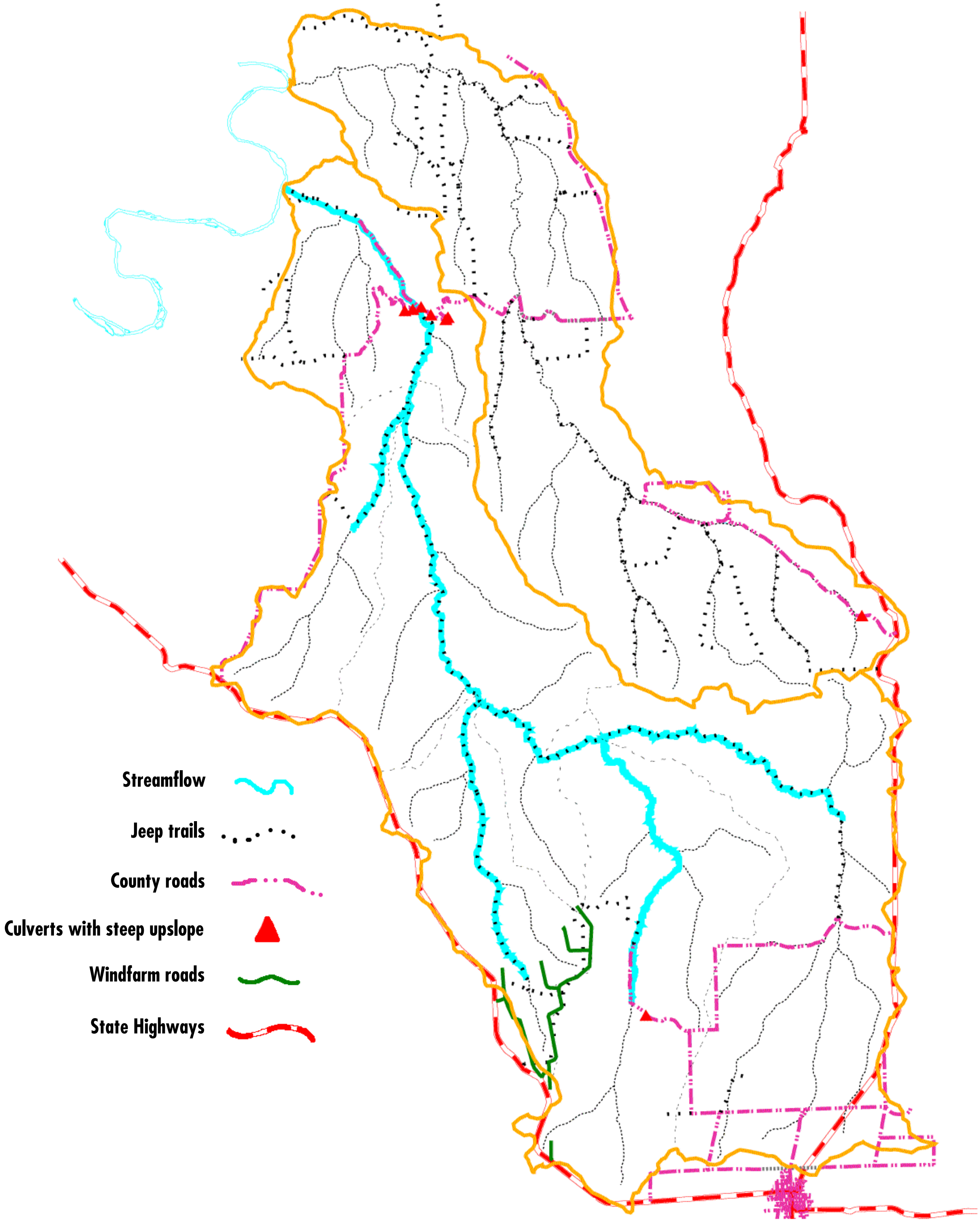
Erosion Factors (T)



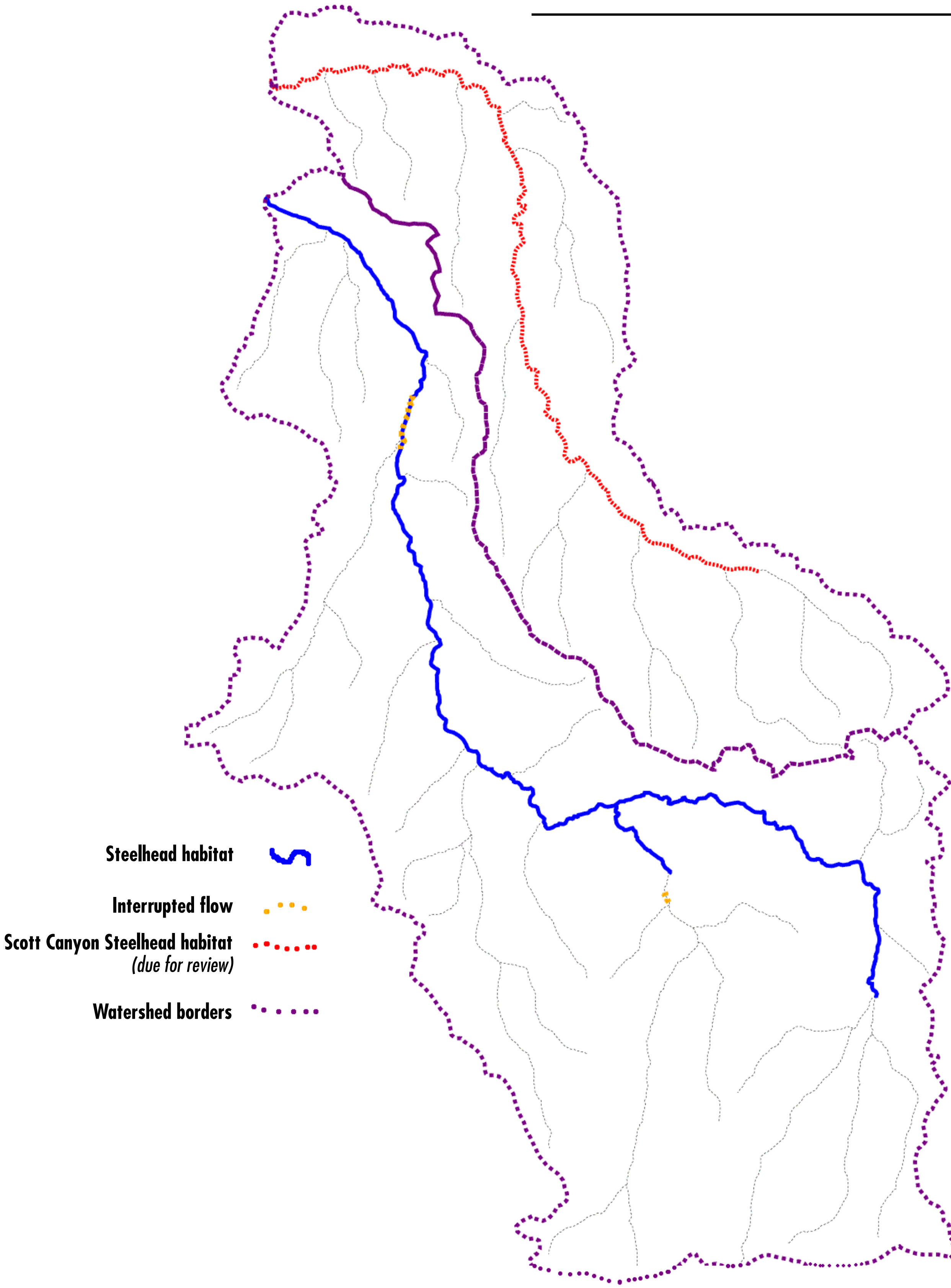
Cropland, Rangeland & Canyonlands



Roads & Culverts

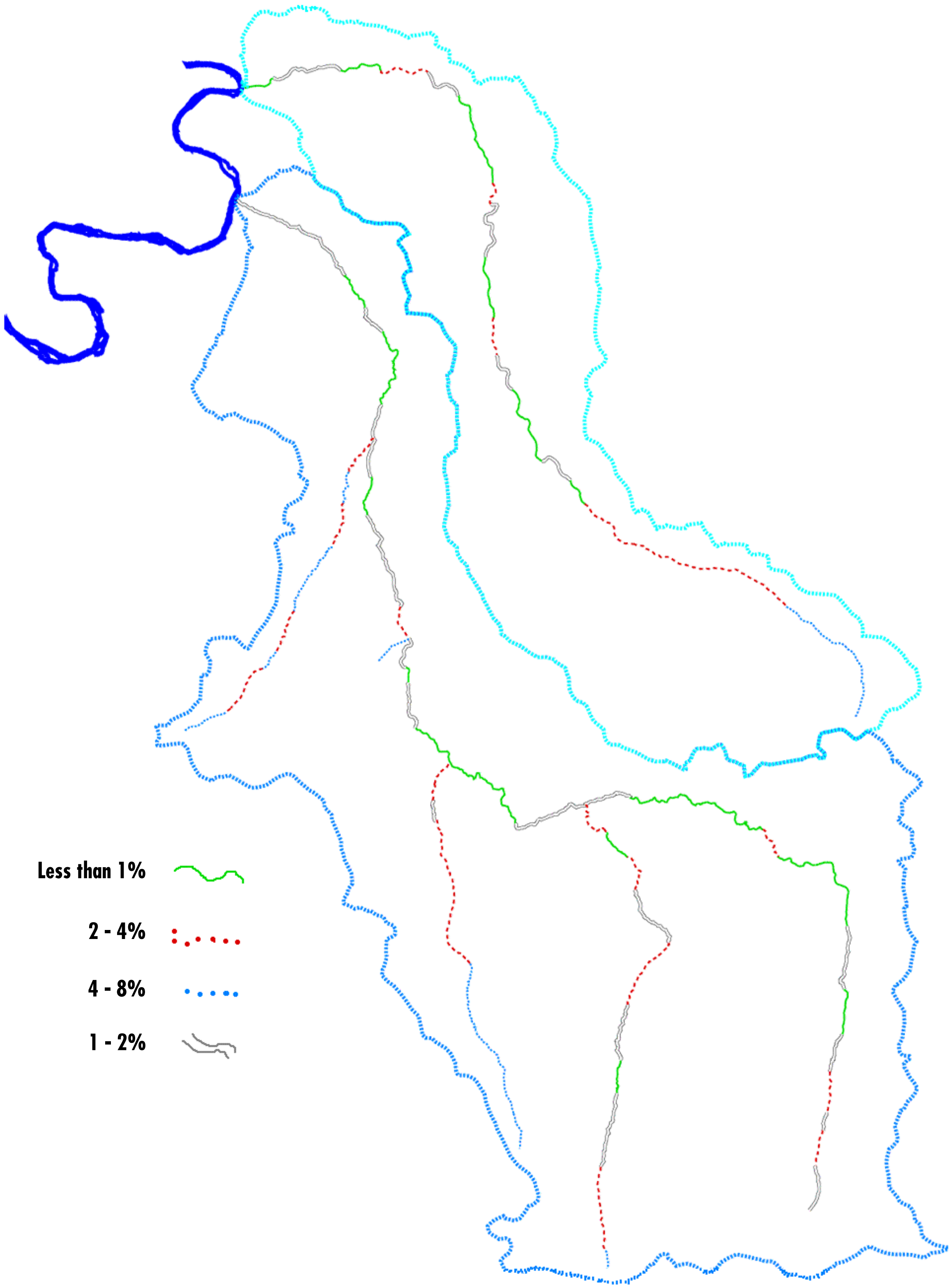


Steelhead



Steelhead habitat
Interrupted flow
Scott Canyon Steelhead habitat
(due for review)
Watershed borders

Stream Gradients



B I R D S P E C I E S

American bittern
Great blue heron
Black-crowned night heron
Canada goose
Turkey vulture
Osprey
Bald eagle
Northern harrier
Sharp-shinned hawk
Cooper's hawk
Swainson's hawk
Red-tailed hawk
Ferruginous hawk
Golden eagle
American kestrel
Prairie falcon
Gray partridge
Chukar~
Ring-necked pheasant~
California quail
Sora
American coot
Sandhill crane
Killdeer
Willet
Burrowning owl
Northern saw-whet owl
Common nighthawk
Common poorwill
Vaux's swift
White-throated swift
Black-chinned humingbird
Calliope hummingbird
Rufous hummingbird
Belted kingfisher
Lewis woodpecker
Red-naped sapsucker
Downy woodpecker
Hairy woodpecker
Spotted sandpiper
Upland sandpiper
Long-billed curlew
Common snipe
Wilson's phalarope
Ring-billed gull
California gull
Rock dove
Mourning dove
Barn owl
Flammulated owl
Western screech owl

Great horned owl
Bushtit
Rock wren
Canyon wren
Bewick's wren
House wren
Winter wren
Marsh wren
American dipper
Golden-crowned kinglet
Ruby-crowned kinglet
Western bluebird
Northern flicker
Western wood-pewee
Willow flycatcher
Least flycatcherHammond's
flycatcher
Dusky flycatcher
Gray flycatcher
Cordilleran flycatcher
Say's phoebe
Ash-throated flycatcher
Western kingbird
Eastern kingbird
Horned lark
Tree swallow
Violet-green swallow
Northern rough-winged swallow
Bank swallow
Cliff swallow
Barn swallow
Black-capped chickadee
Mountain chickadee
Mountain bluebird
Swainson's thrush
American robin
Varied thrush
Gray catbird
Sage thrasher
Cedar waxwing
Loggerhead shrike
European starling
Solitary vireo
Warbling vireo
Red-eyed vireo
Orange-crowed warbler
Nashville warbler
Yellow warbler
Black-throated gray warbler
Townsend's warbler
Macgillivray's warbler

Brewer's blackbird
Brown-headed cowbird
Cassin's finch
House finch
Lesser goldfinch
American goldfinch
Evening grosbeak
House sparrow
Bullocks Oriole
Common yellowthroat
Wilson's warbler
Yellow-breasted chat
Western tanager
Black-headed grosbeak
Lazuli bunting
Chipping sparrow
Brewer's sparrow
Vesper sparrow
Lark sparrow
Sage sparrow
Savannah sparrow
Grasshopper sparrow
Fox sparrow
Song sparrow
White-crowned sparrow
Dark-eyed junco
Red-winged blackbird
Tri-colored blackbird
Western meadowlark
Yellow-headed blackbird
Nothern shrike

Merlin*
Wood duck*
Green-winged teal*
Mallard*
Northern pintail*
Blue-winged teal*
Cinnamon teal*
Northern shoveler*
Gadwall*
American wigeon*
Cavasback*
Redhead*
Lesser scaup*
Hooded merganser*
Ruddy duck*

There are no definitive records for the Hay Creek/Scott Canyon watershed on some of these species but based on overall distribution and habitat requirements, some may potentially occur or may have occured historically.

* unknown to occur in watershed however, they are highly migratory and likely occur at some time through the year.

~ introduced species

WILDLIFE SPECIES

Preble's shrew	Common raccoon
Vagrant shrew	House mouse
Water shrew	Ermine
Merriam's shrew	Long-tailed weasel
Coast mole	Mink
Nuttall's cottontail	American badger
White-tailed jack rabbit	Western spotted skunk
Black-tailed jack rabbit	Striped skunk
Pygmy rabbit	Northern river otter
Yellow-bellied marmot	Mountain lion
Washington ground squirrel	Bobcat
Belding's ground squirrel	Elk
Golden-mantled ground squirrel	Mule deer
Northern pocket gopher	White-tailed deer
Great basin pocket mouse	Pronghorn antelope
Ord's kangaroo rat	Bighorn sheep~
American beaver	
Western harvest mouse	Little brown myotis*
Deer mouse	Yuma bat*
Canyon mouse	Long-eared bat*
Northern grasshopper mouse	Fringed bat*
Bushy-tailed woodrat	Long-legged bat*
Montane vole	California myotis*
Long-tailed vole	Western small-footed bat*
Sagebrush vole	Western pipistrelle*
Muskrat	Big brown bat*
Norway rat	Hoary bat*
Common porpupine	Spotted bat*
Coyote	Townsend's big-eared bat*
Red fox	Pallid bat*

There are no definitive records on the Hay Creek/Scott Canyon watershed for some of these species. But based on overall distribution & habitat requirements, some may potentially occur or may have occured historically.

* unknown to occur in watershed however, they are highly migratory and likely occur at some time through the year.

~ re-introduced species

FISH

- Torrent sculpin
- Mottled sculpin
- Summer steelhead
- Redband trout
- Speckled dace
- Longnose dace
- Redside shiner
- Bridgelip sucker
- Largescale sucker
- Pacific lamprey

There are no definitive records for most of these species. But based on overall distribution and habitat requirements, some may potentially occur or may have occured historically.

HERPTILES

Long-toed salamander	Western whiptail
Western toad	Rubber boa
Pacific treefrog	Racer
Great basin spadefoot	Night snake
Bullfrog	Striped whipsnake
Painted turtle	Gopher snake
Southern alligator lizard	Western terrestrial garter snake
Short-horned lizard	Common garter snake
Sagebrush lizard	Western rattlesnake
Western fence lizard	Northern leopard frog*
Side-blotched lizard	Columbia spotted frog*
Western skink	

*There are no definitive records for some of these species. But based on overall distribution and habitat requirements, some may potentially occur or may have occured historically.

FEDERALLY LISTED, PROPOSED OR SPECIES OF CONCERN THAT *MAY* OCCUR IN HAY CREEK/SCOTT CANYON WATERSHED

MAMMELS		
Washington ground squirrel	*Spermophilus washingtoni*	Candidate species
Pygmy rabbit	*Brachylagus idahoensis*	Species of concern
California wolverine	*Gulo gulo luteus*	Species of concern
Pacific fisher	*Martes pennanti pacifica*	Species of concern
California bighorn sheep	*Ovis candensis californiana*	Species of concern
Preble's shrew	*Sorex preblei*	Species of concern
Pale western big-eared bat	*Corynorhinus townsendii*	Species of concern
Spotted bat	*Euderma maculatum*	Species of concern
Small-footed myotis (bat)	*Myotis ciliolabrum*	Species of concern
Long-eared myotis (bat)	*Myotis evotis*	Species of concern
Fringed myotis (bat)	*Myotis thysanodes*	Species of concern
Long-legged myotis (bat)	*Myotis volans*	Species of concern
Yuma myotis (bat)	*Myotis yumanensis*	Species of concern
BIRDS		
Bald Eagle	*Haliaeetus leucocephalus*	Listed species
Tri-colored blackbird	*Agelaius tricolot*	Species of concern
Western burrowing owl	*Athene cunicularia hypugea*	Species of concern
Ferruginous hawk	*Buteo regalis*	Species of concern
FISH		
Steelhead (Middle Columbia)	*Oncorhynchus mykiss*	Listed species
Redband trout	*Oncorhynchus mykiss gibbsi*	State sensitive
Pacific lamprey	*Lampetra tridentata*	State sensitive
AMPHIBIANS & REPTILES		
Northern sagebrush lizard	*Sceloporus graciosus graciosus*	Species of concern
INVERTEBRATES		
California floater (mussel)	*Anodonta californiensis*	Species of concern
Great Columbia River spire snail	*Fluminicola columbianus*	Species of concern
Minor Pacific sideband (snail)	*Monadenia fidelis minor*	Species of concern

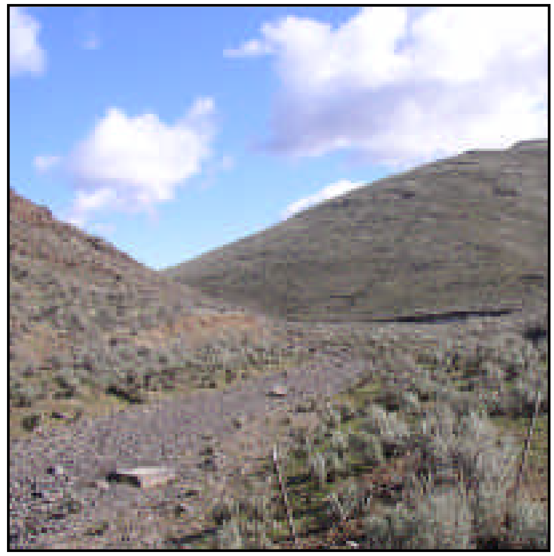
There are no definitive records relating to the Hay Creek/Scott Canyon watershed for most of these species but based on overall distribution and habitat requirements, some may potentially occur or may have occured historically.

Photo Gallery of CREP on lower Hay Creek

2002/2003

Photo Gallery of Scott Canyon

2002/2003



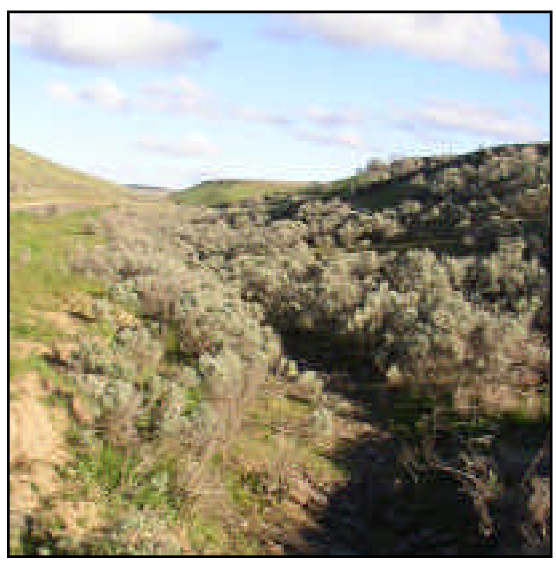


Photo Gallery of Hay Creek

2002/2003