SECTION 21 – Table of Contents

21 Spokane Subbasin Overview

21.1 Regional Context

The Spokane Subbasin shares a border with the Upper Columbia Subbasin to the north, the Pend Oreille Subbasin to the northeast, and the Coeur d' Alene Subbasin to the east (Figure 21.1). The outlet of Coeur d' Alene Lake forms the headwaters of the Spokane River, which flows westerly to its confluence with the Columbia River (Lake Roosevelt). The major river in the Subbasin is the Spokane River, which runs 111 miles from the outlet of Coeur d' Alene Lake to its confluence with the Columbia River. The major tributaries of the Spokane River listed from upstream to downstream include Hangman Creek (also known as Latah Creek), Little Spokane River, and Chamokane Creek (also known as Tshimikain Creek).

In eastern Washington and northern Idaho there are seven dams on the Spokane River. The city of Spokane Water Department owns, operates, and maintains Upriver Dam and is licensed for fifty years (FERC license 3074-WA, 1981-2031). Avista Corporation owns and operates the other six hydroelectric facilities. The six dams (from upstream to downstream) include Post Falls in Idaho, Upper Falls, Monroe Street, Nine Mile, Long Lake, and Little Falls located in Washington. Five of the six dams owned by Avista were constructed and were operating between 1906 and 1922. Monroe Street Dam was initially built in 1890 (Avista 2002; Scholz et al. 1985) and then reconstructed in 1973.

Five of the six dams (excluding Little Falls Dam, a run-of-the-river facility), owned and operated by Avista, are referred to collectively as the Spokane River Hydroelectric Project. The Spokane River Hydroelectric Project operates to maximize power generation to meet local and regional electricity demands with consideration given to flood management, natural resource protection, recreation, and other associated needs (T. Vore, Environmental Coordinator, Avista, personal communication, 2003). Post Falls Dam has the largest storage capacity of the five dams and operates to meet several interests including: 1) compliance with minimum flow requirements of the FERC license and regulating Spokane River flows, 2) maximizing the storage capacity available in Coeur d' Alene Lake during spring runoff, 3) generating electricity to meet Avista customer energy demands, and 4) considering other upstream and downstream recreational, residential, and commercial interests as well as downstream resource needs. Upper Falls and Monroe Street dams are operated as run-of-river facilities, meaning water flow into the facility is essentially equal to downstream outflow. It also means reservoir water levels change little unless under flood conditions, operation and maintenance activities, or some other unusual circumstance (T. Vore, Environmental Coordinator, Avista, personal communication, 2003). Nine Mile Dam has a limited storage capacity that may be utilized when following changes in load demand with associated pool level fluctuations rarely more than a few inches (T. Vore, Environmental Coordinator, Avista, personal communication, 2003). The most downstream facility, Long Lake Dam, has a greater storage capacity than Nine Mile Dam, but less than half of Post Falls Dam. Long Lake Dam is operated as a storage and release facility for power generation purposes (T. Vore, Environmental Coordinator, Avista, personal communication, 2003).

The lower 29 miles of the Spokane River (also referred to as the Spokane Arm of Lake Roosevelt or Spokane Arm) is inundated by Grand Coulee Dam and is considered part of Lake Roosevelt. For management purposes, however, the Spokane Arm is included in the Spokane Subbasin. Grand Coulee Dam, as well as the upriver hydro-operations, control the physical and chemical conditions of the Spokane Arm. Currently, no dam on the Spokane River has a fish passage facility and all dams create fish barriers for upstream migration.

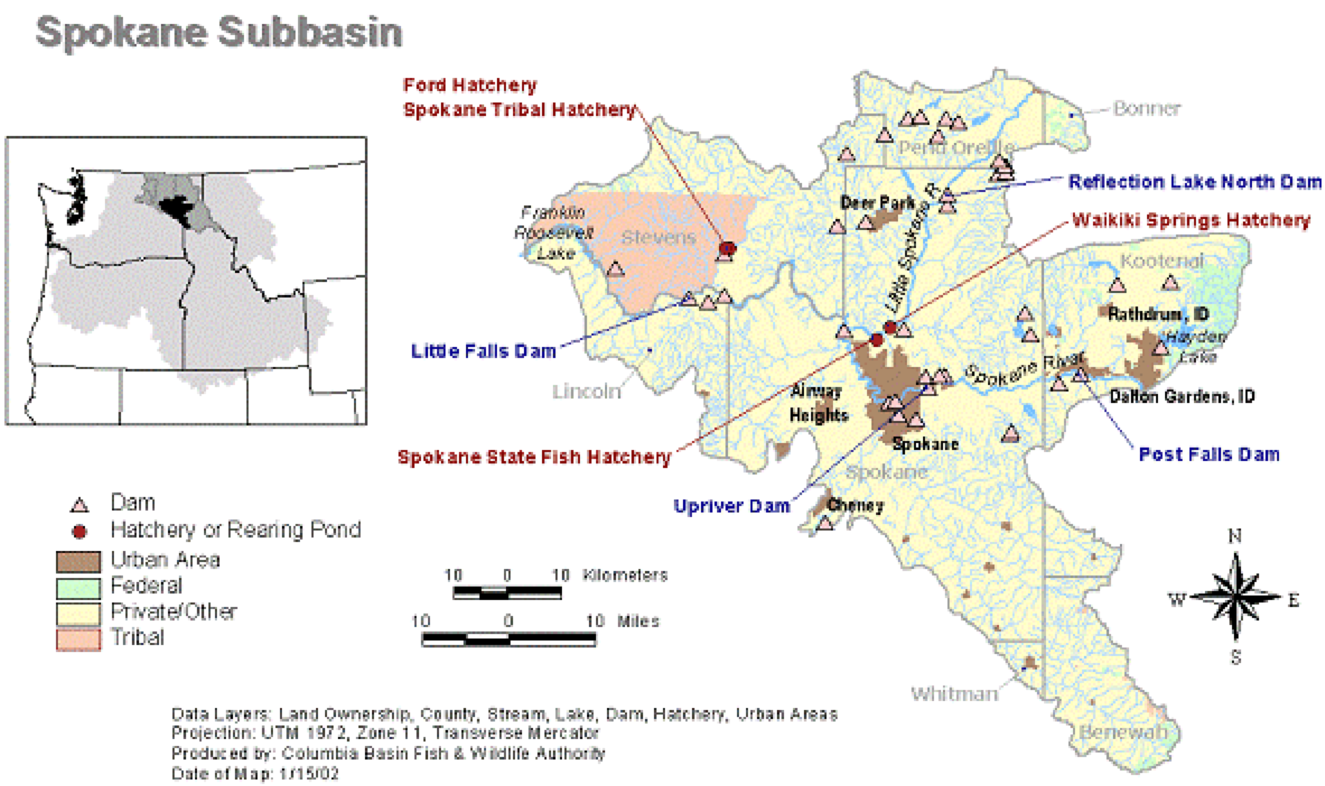


Figure 21.1. Map of Spokane Subbasin

21.2 Spokane Subbasin Description[1]

21.2.1 General Location

The Subbasin lies in five Washington counties, Pend Oreille, Stevens, Lincoln, Spokane, and Whitman and three Idaho counties, Benewah, Kootenai, and Bonner counties (Figure 21.1). The majority of the Subbasin (approximately 78 percent) lies within the state of Washington while the eastern, and generally higher elevations, portions lie within the state of Idaho. The Spokane Indian Reservation lies entirely within the Spokane Subbasin and borders the north shore of the Spokane River from Little Falls Dam west of the

[1] Large portions of Section 21.2 were contributed to by the Spokane River Subbasin Summary Report (2000) pp. 1-4.

confluence with the Columbia River. The western boundary of the Spokane Indian Reservation coincides with a portion of the western boundary of the Subbasin. The Subbasin covers approximately 43 percent of the Coeur d' Alene Indian Reservation, which is located in the southeastern portion of the Subbasin in the upper reaches of the Hangman Creek drainage. The southern boundary of the Coeur d' Alene Indian Reservation corresponds with the southern most boundary of the Subbasin. The western boundary or upstream boundary is in Idaho at Post Falls Dam.

The Spokane River flows west through the City of Spokane where it passes through three dams: Upriver Dam (RM 80.2, RM = River Mile refers to the distance from the confluence with Lake Roosevelt), Upper Falls Dam (RM 76), and the Monroe Street Dam (RM 74). Downstream of these dams, Hangman Creek is the first major tributary flowing into the Spokane River (RM 72). Continuing west, the Spokane River flows to Nine Mile Falls Dam (RM 58). As the river enters Lake Spokane (also known as Long Lake), a 24-mile long reservoir created by Long Lake Dam (RM 34), fluvial habitats change to lacustrine habitats. The Little Spokane River, the next major tributary, enters Lake Spokane (RM 56.5). From Long Lake Dam, the Spokane River continues to Little Falls Dam (RM 29), about 29 miles from the confluence with the Columbia River (Lake Roosevelt). The Spokane Indian Reservation borders the north shore of the Spokane River at the confluence of Chamokane Creek with the Spokane River (RM 32.5), 1.2 miles downstream of Long Lake Dam to the confluence with Lake Roosevelt.

21.2.2 Drainage Area

The water source for the Spokane River comes from the outlet of Coeur d' Alene Lake (RM 111) and its tributaries. The Spokane River and its tributaries are defined as waters downstream of Post Falls Dam. The Subbasin encompasses an area of approximately 2,400 square miles and incorporates the following four Water Resource Inventory Areas (WRIA) as designated by Washington Department of Ecology (WDOE):

1. WRIA 54, Lower Spokane (Figure 21.2)
2. WRIA 55, Little Spokane (Figure 21.3)
3. WRIA 56, Hangman (Latah), (Figure 21.4)
4. WRIA 57, Middle Spokane (Figure 21.5)

Lower Spokane Water Resource Inventory Area (WRIA) #54

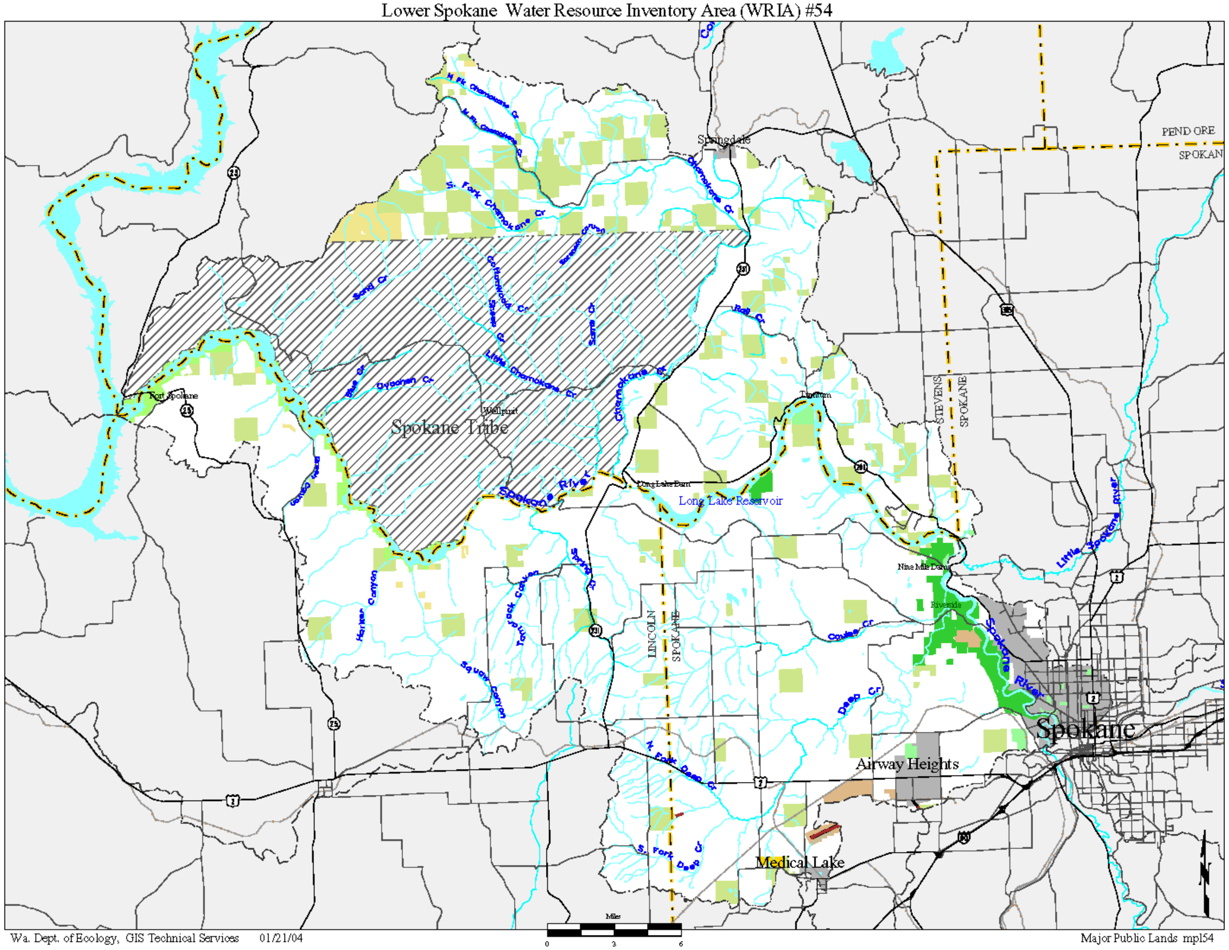


Figure 21.2. Map of WRIA 54

Little Spokane Water Resource Inventory Area (WRIA) #55

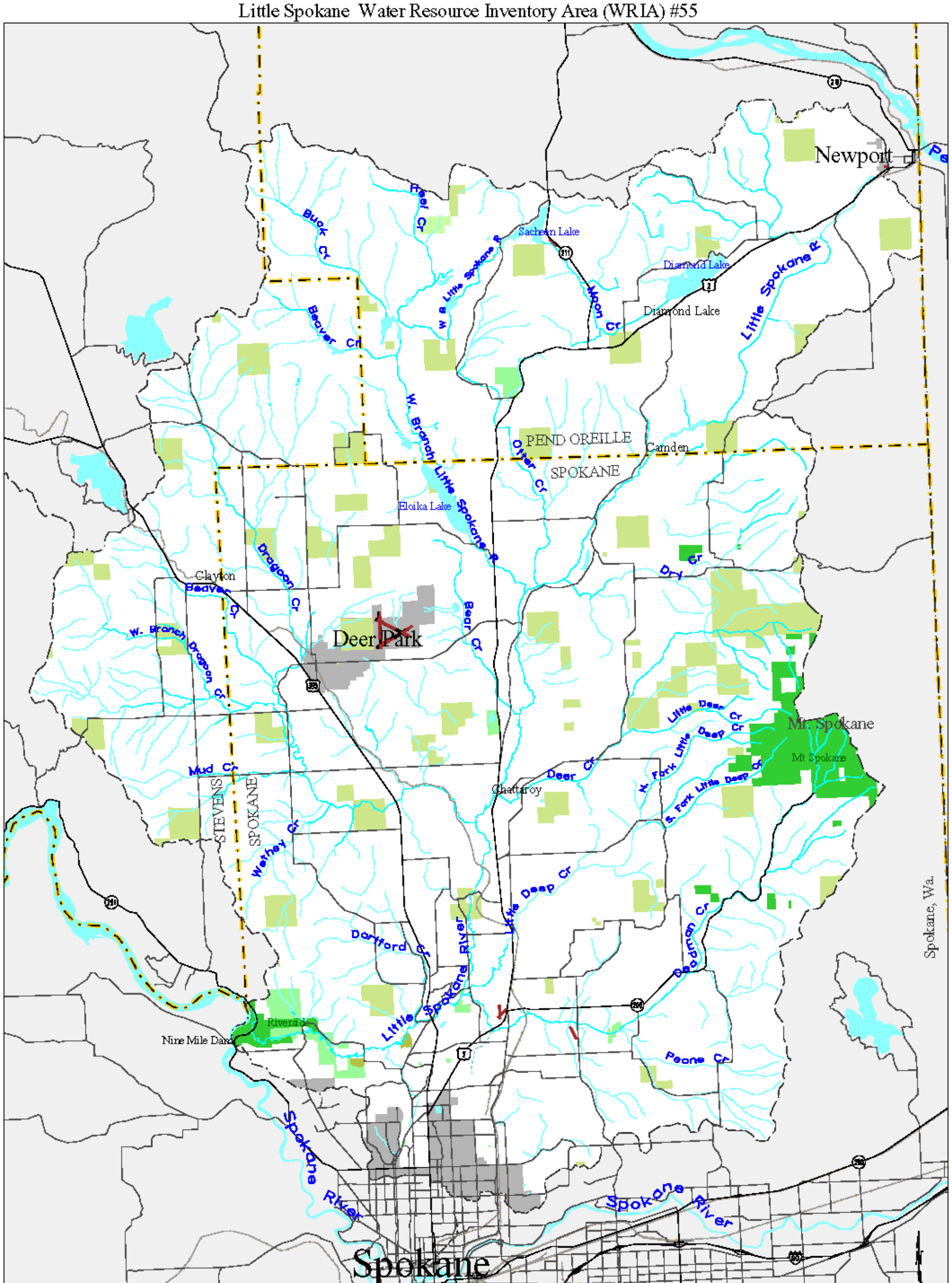


Figure 21.3. Map of WRIA 55

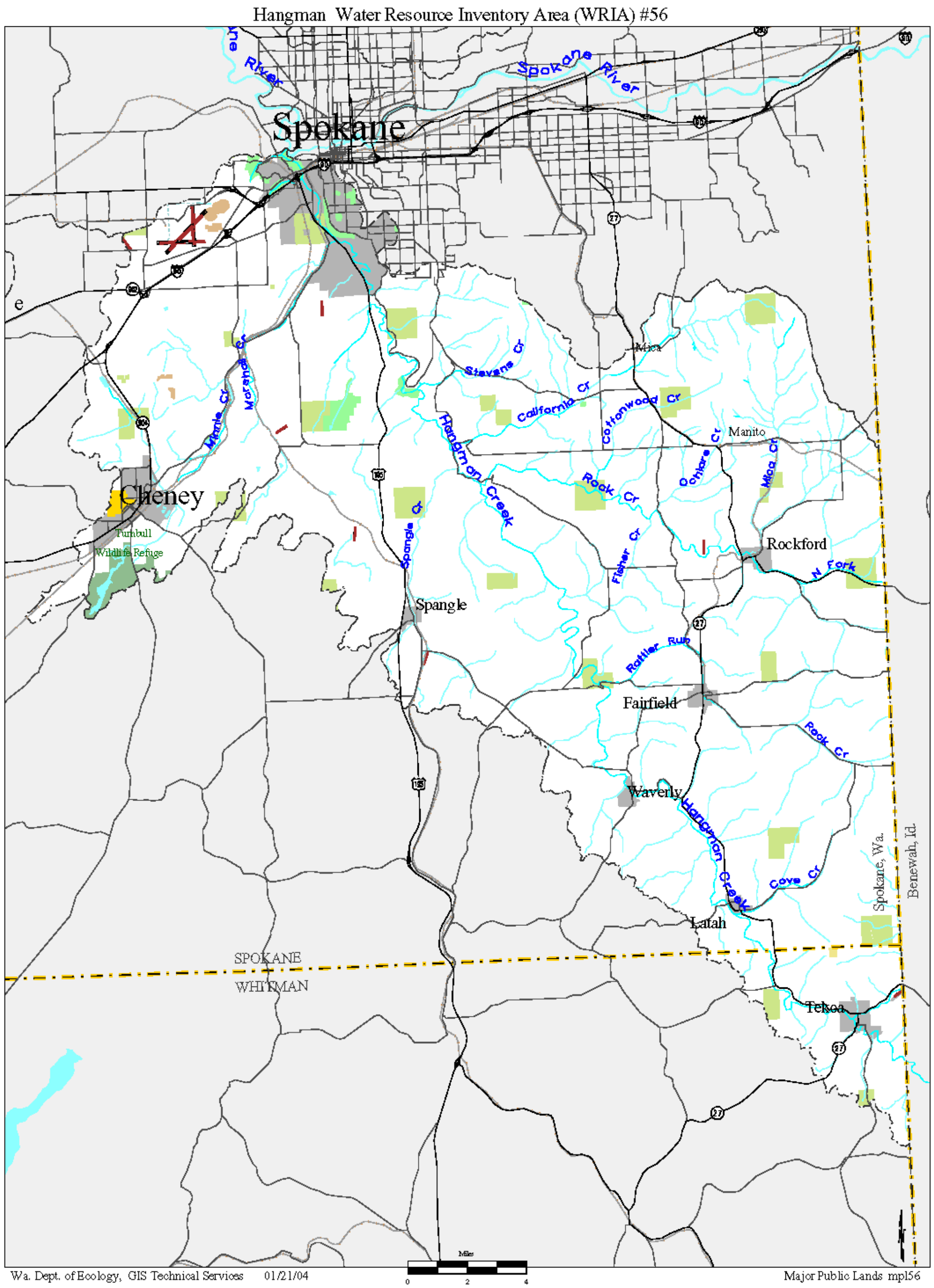
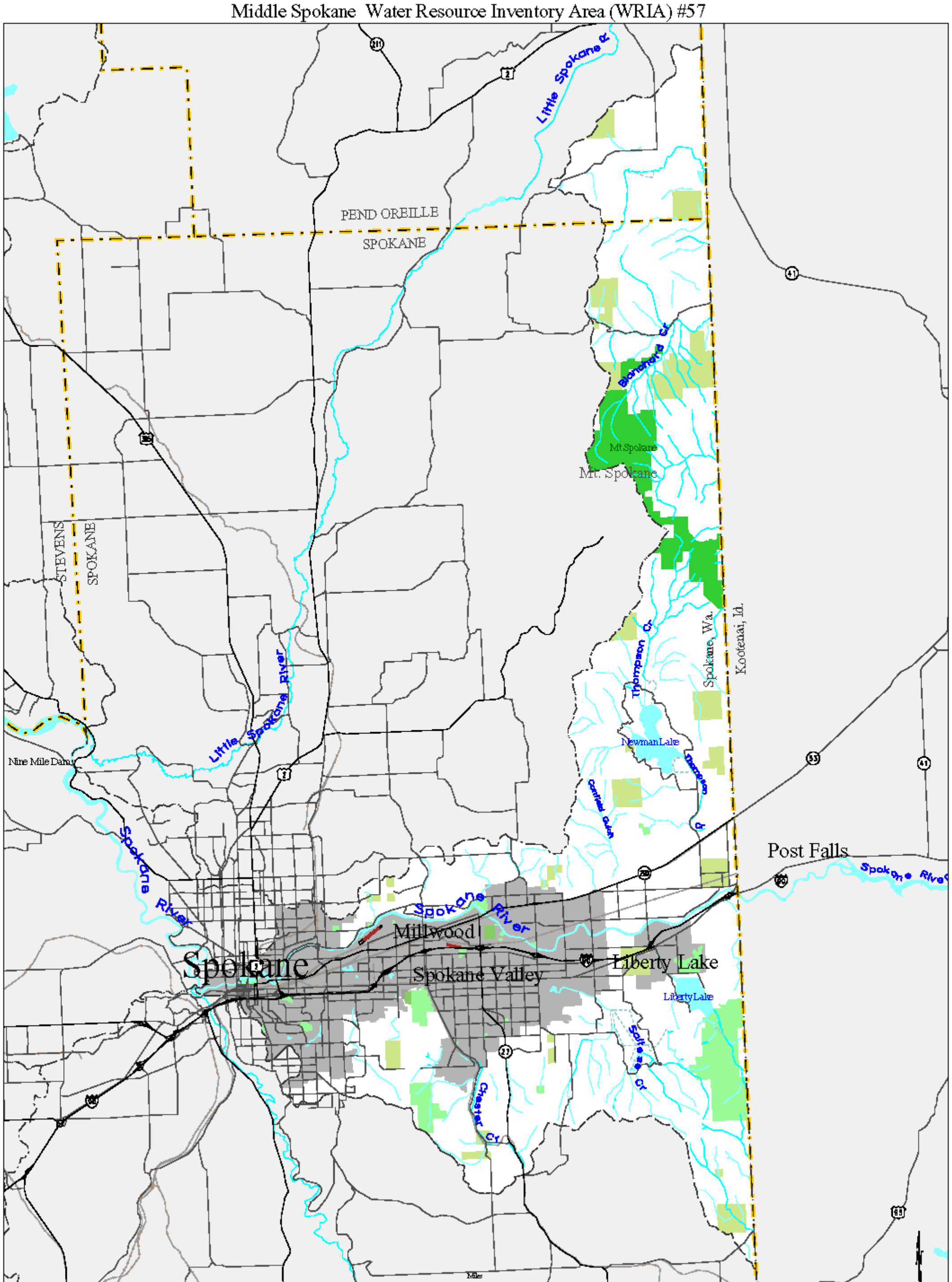


Figure 21.4. Map of WRIA 56

Middle Spokane Water Resource Inventory Area (WRIA) #57



Wa. Dept. of Ecology, GIS Technical Services 01/21/04

Major Public Lands mpl57

Figure 21.5. Map of WRIA 57

21.2.2.1 Spokane River

The Spokane River is a part of the Spokane Valley-Rathdrum Prairie Aquifer, which encompasses an area of about 320 square miles. The aquifer is bound by mountains to the north and south and extends from the east in Lake Pend Oreille and Coeur d' Alene Lake and to the west, the Little Spokane River. The aquifer flows east to west and is considered unconfined, meaning that the water table is not vertically confined and fluctuates with seasonal variation in recharge and discharge. The primary source of recharge comes from infiltration of precipitation and/or snowmelt, surface runoff (including any pollutants) from the watersheds, and inputs from the Spokane River between Post Falls Dam and Sullivan Road and from Coeur d' Alene Lake along with other lakes near the boundary of the Rathdrum Prairie. Below Spokane Falls, groundwater flows into the river from various seeps and springs, thus providing a direct connection between the river and aquifer. This is a sole source aquifer for many residents of the area in Idaho and Washington, including the city of Spokane (Available 2004: http://www.spokanecounty.org/utilities/wwfp/Nov01Rpt/BOPR%20Chapters/BOPR_Chapter_4.htm)

Flow conditions on the Spokane River fluctuate greatly between peak and base flows according to USGS records from 1891 to 2001 (USGS 12422500, Spokane River) (Figure 21.6). Historically, peak flows have occurred between December and June, with the majority occurring during May depending on the timing of rain and snow events (refer to section 21.2.3.1 for more on rain-on-snow events). Peak discharge has ranged from 7,610 to 49,000 cubic feet per second (cfs), while base flow during August and September averages approximately 1,750 cfs. The mean peak flow in May was on average 2,000 cfs lower from 1990-2001 compared to the mean discharge from 1891-2001 (Figure 21.7). Refer to Section 22.8.1 Environmental Conditions within the Subbasin, subheading Current Condition – Spokane River, for discussion comparing the Spokane River annual and seasonal hydrograph pre- and post-operation of Post Falls Dam (1906).

21.2.2.2 Little Spokane River

The Little Spokane River flows about 50 miles from the headwaters to the confluence with the Spokane River (Golder Associates 2003). The watershed is 710 square miles and drains the northeastern portion of the Spokane Subbasin. The major tributaries to the Little Spokane River include Dragoon, Deadman, Little Deep, and Deer creeks. The major lakes located in the northern half of the watershed include Eloika, Diamond, Sacheen, Horseshoe, and Chain lakes. Between 1930 and 2000 the average annual flow has been 303 cfs (USGS 12431000 Dartford). The monthly mean flow for the Little Spokane between 1929-2001 is shown in Figure 21.8. Refer to Section 22.8.1 Environmental Conditions within the Subbasin, subheading Current Condition – Little Spokane River, for discussion on the current Little Spokane River hydrograph and minimum flows.

21.2.2.3 Hangman Creek

Hangman Creek is in a low elevation watershed covering 689 square miles. The creek originates east of the Idaho-Washington border and passes through the Coeur d' Alene

Indian Reservation. Over 60 percent of the watershed is located in eastern Washington while the headwaters originate in the western foothills of the Rocky Mountains in Idaho. Approximately 20 miles of the lower creek flows through the northwest corner of the channeled scablands before joining the Spokane River (RM 72.4). The monthly mean flow in Hangman Creek at Spokane between 1948 and 2001 was 242 cfs (Figure 21.9) (USGS 12424000, Hangman Creek). The majority of the peak flow between 1948 and 2001 occurred between January and March with an occasional peak in late December or May (USGS, 2003). The average peak flow is about 7,585 cfs with the highest peak flow over 20,000 cfs in 1963 and 1997, and the lowest peak flow recorded at 395 cfs in 1994. From 1948 to 2001 summer (July-September) flows averaged 16.83 cfs but have been as low as 0.074 cfs (September 1992) (USGS, 2003). Current flow conditions are described as “flashy” and largely attributed to land use activities over the past century (agriculture, timber harvest, impervious surfaces, riparian/wetland removal, roads, stream channelization, etc.).

21.2.2.4 Chamokane Creek

Chamokane Creek drainage is 179 square miles and borders the Spokane Tribe of Indians Reservation. Data collected between 1971-2002 (USGS 12433200) below Tshimikain Falls indicate peak flows for Chamokane Creek occur in March (~175 cfs), but may vary between January and April, and base flows (~30 cfs) occur from August through November (Figure 21.10). Peak flow in Chamokane Creek (1971-2002) reached a high of 2,200 cfs in 1975 and has been greater than 1,000 cfs in 1971, 1974-75, 1995, 1997, and 1999 (USGS 2003). Between 1971 and 2002, the highest mean monthly flow for March was 626 cfs in 1997 and the lowest was 30 cfs in 1977. During the same time period (1971-2002), the highest mean base flow from August to November was 45 cfs, observed in 1997, and the lowest was approximately 19 cfs, observed between 1990 and 1992 (USGS 2003).

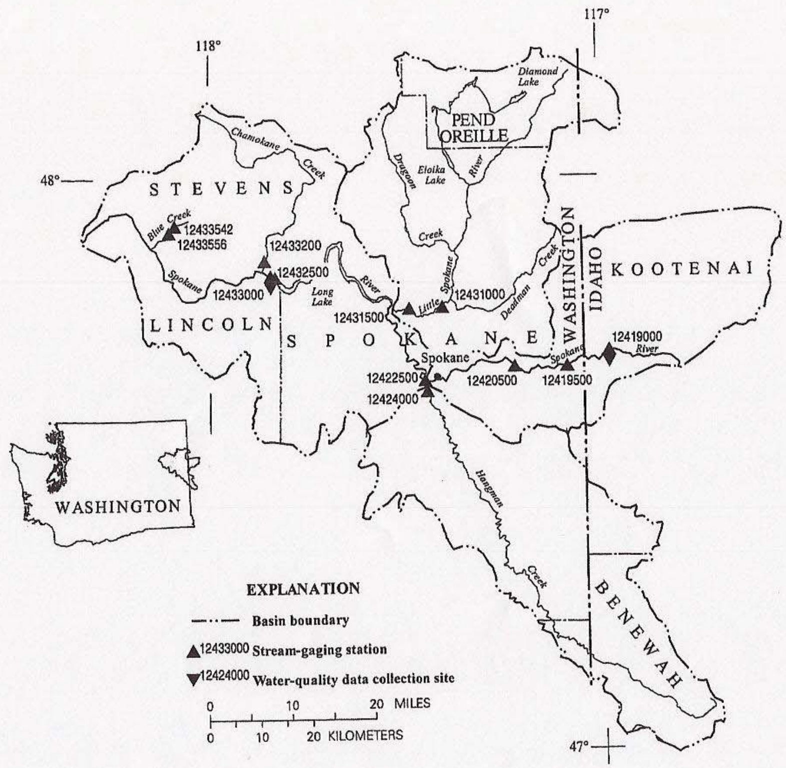


Figure 21.6. Map of the Spokane Subbasin and USGS surface water and water quality stream stations (*Source*: USGS)

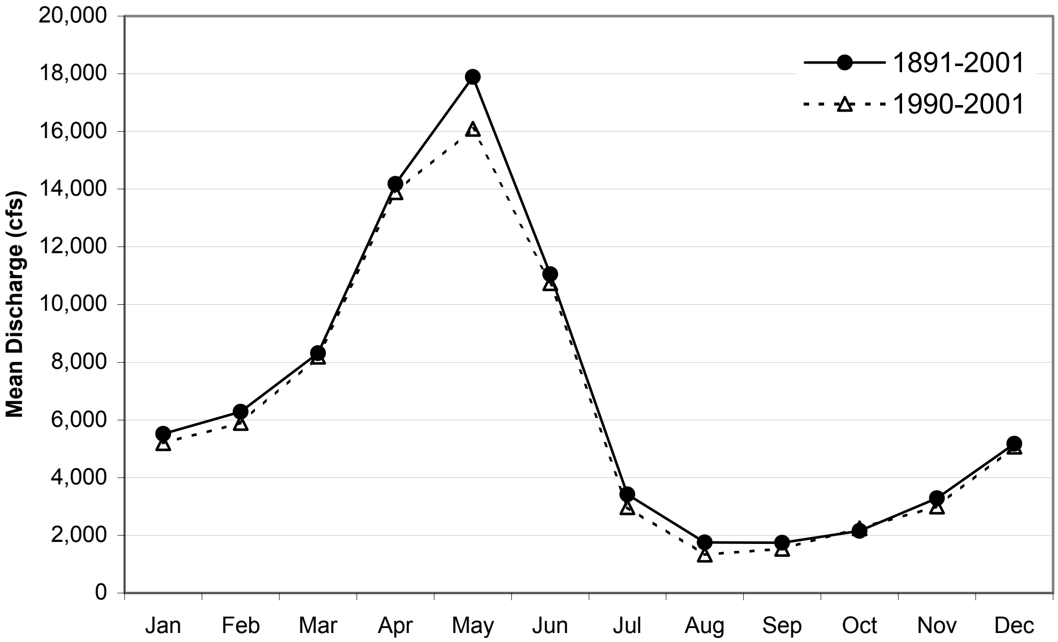


Figure 21.7. The hydrograph of the monthly mean flow between 1891-2001 and 1990-2001 for the Spokane River below the Monroe Street Dam (*Source*: USGS 12422500)

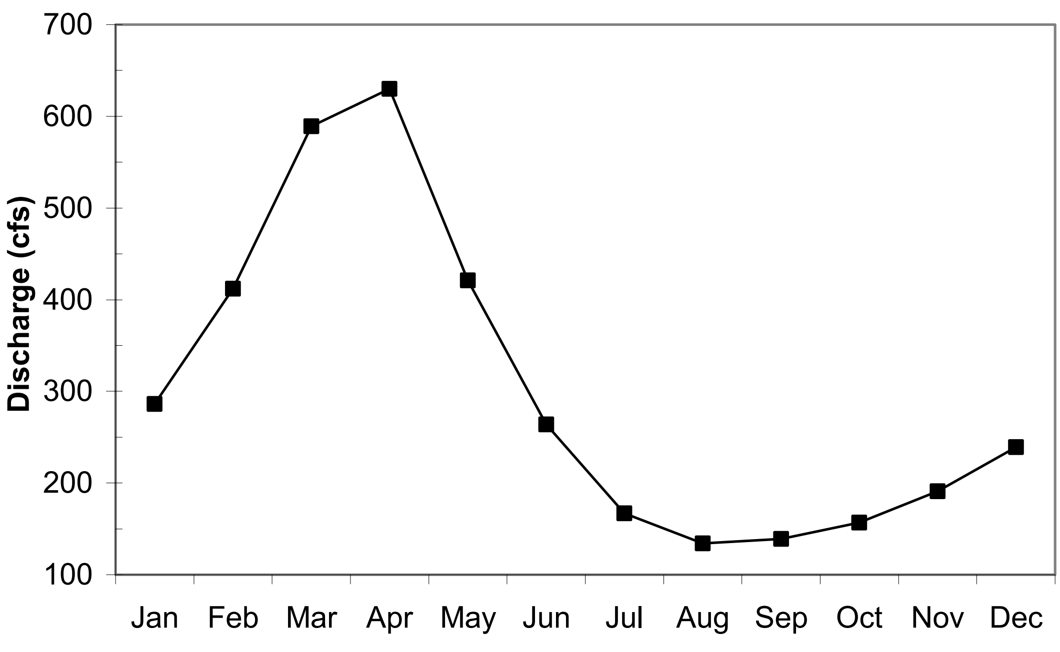


Figure 21.8. The hydrograph of the monthly mean flow between 1929-2001 for the Little Spokane River measured at Dartford, Washington (*Source*: USGS 12431000)

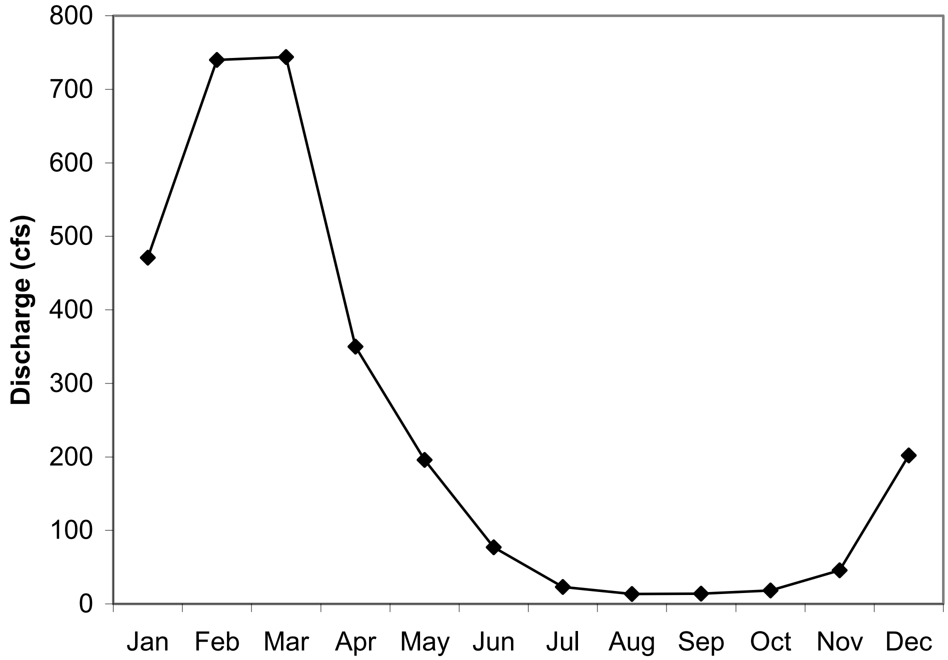


Figure 21.9. The hydrograph of the monthly mean flow between 1948-2001 at Hangman Creek at Spokane, Washington (*Source:* USGS 12424000)

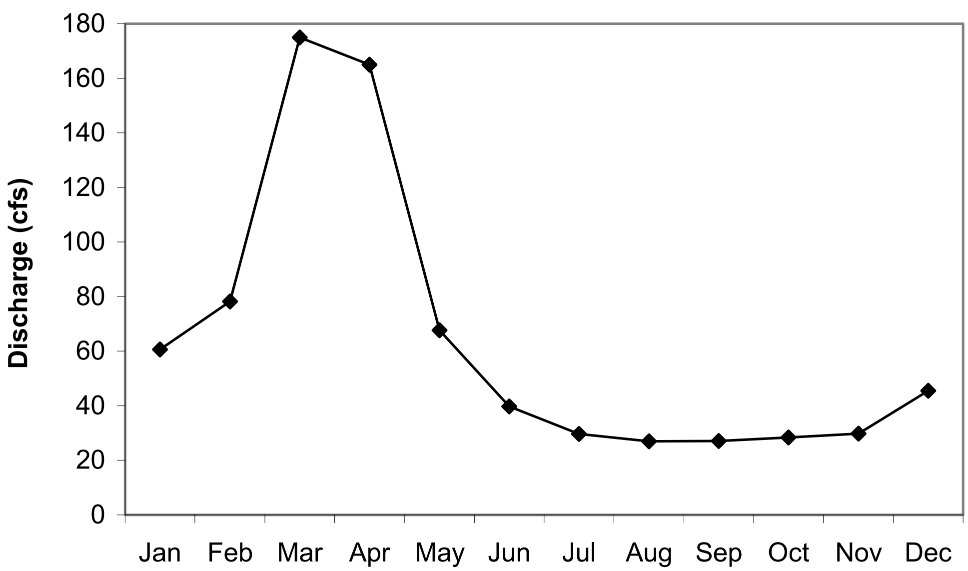


Figure 21.10. The hydrograph of the monthly mean flow between 1971-2002 for the Chamokane River measured below the falls near Long Lake (*Source*: USGS 12433200)

21.2.2.5 Lake Spokane

Lake Spokane is a 39-km (24-mile) long reservoir created when Long Lake Dam impounded the Spokane River in 1915. The reservoir has a maximum depth of 54 m, a mean depth of 15 m, and useable storage capacity of 105,000 acre-feet (Osborne et al. 2003). Lake Spokane is currently operated in the summer within one foot of full pool elevation. Under the Avista Corporation's existing FERC license, the maximum drawdown level is 7.3 m with attempts to limit fluctuations of the reservoir levels to a maximum of 4.3 m. An assessment of current habitat conditions (physical and chemical characteristics) in the reservoir is addressed in Section 22.8.1.8.

21.2.3 Climate

The Spokane Subbasin has a continental climate that is influenced by maritime air masses from the Pacific Coast. The average annual temperature between 1953 and 1983 was 9.4 °C, with July being the warmest (average 21.6 °C) and January being the coldest (average -1.5 °C). Annual precipitation from rain for the area is about 45 centimeters (cm) and for snowfall is about 27 cm (Western Regional Climate Center, http://www.wrcc.dri.edu).

21.2.3.1 Rain-on-Snow Events

Rain-on-snow (ROS) events are described as runoff from rain falling on snow. This type of weather event has been associated with mass-wasting of hill slopes, damage to river banks, downstream flooding, and associated damage and loss of life. Some of the management issues associated with ROS events include identifying the effects of land use activities that have eliminated riparian buffers and/or reduced vegetative cover in the watershed, which can result in significant flooding and increased sediment loading during a ROS event. Physical processes involving topography and ROS events indicate rain falling on snow in open areas with reduced vegetative or canopy cover that attenuates and intercepts rainfall produces more water available for surface runoff compared to rain falling in, for example, forested areas (http://wa.water.usgs.gov/projects/rosevents/summary.htm).

In 1989, the duration of ROS events within the Spokane Subbasin extended between zero to nine days with the average lasting between two and three days (Figure 21.11). The occurrence of ROS events was based on an average year of precipitation. The greatest number of days of ROS events occurred in the eastern portion of the Subbasin, east of the Idaho-Washington state line. Data estimating the increase in water availability for surface runoff during the ROS events was not available and is not reflected in Figure 21.11.

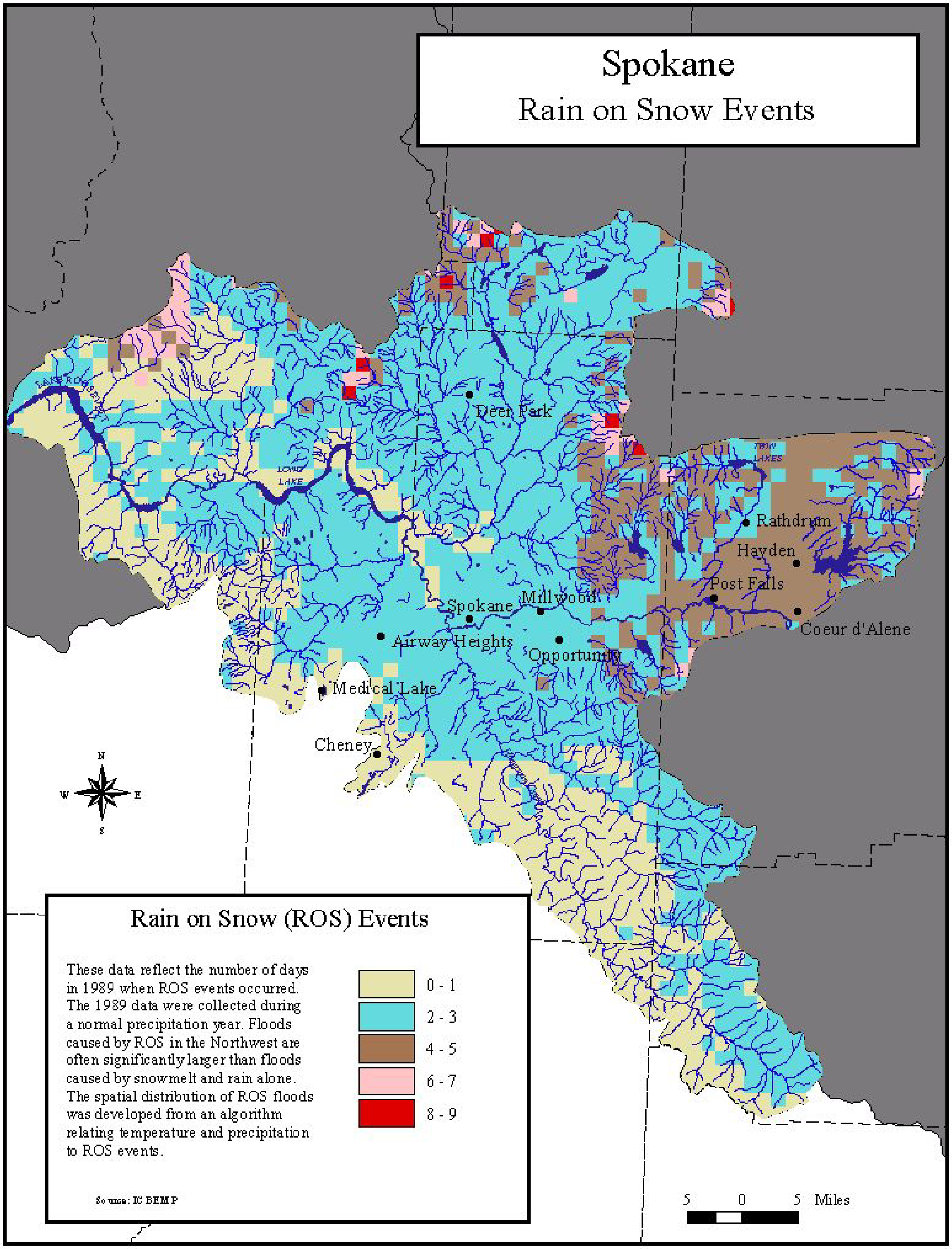


Figure 21.11. Rain-on-Snow (ROS) events during 1989 (a normal precipitation year) shown as the number of days of occurrence within the Spokane Subbasin (*Source*: Interior Columbia Basin Ecosystem Management Project, ICBEMP)

21.2.4 Geology and Soils

21.2.4.1 Geology

The Spokane Subbasin is represented by the Okanogan Highlands to the north and Columbia Basin, also known as the Columbia Plateau, to the south. Basalt flows during the Miocene period and glacial activity during the Pleistocene define the land formation and geological characteristics of the Columbia Plateau. Land formation and sculpting in the Okanogan Highlands was largely associated with glacial covering and activity during the Pleistocene.

Two geologic provinces, the old North American Continent and the Columbia Plateau characterized the Spokane Subbasin. The old North American Continent is represented by a small part of the Rocky Mountains in northeastern Washington. The ancient rock from the continental crust is more than two billion years old and consists of a combination of metamorphic rocks such as granite and gneiss (Alt and Hyndman 1984). Geologically, the Columbia Plateau comprises the Columbia Basalt Group that is differentiated into four formations that consisted of 61 different basalt flows that covered a total of 4,120 square miles (Mueller and Mueller 1987). In the Spokane Subbasin, the Columbia Plateau was formed by a series of black basalt lava flows from the Wanapum (Priest Rapids Member) and Grand Ronde formations 14-16 million years ago (Miocene period), which are visible in the current landscape (Alt 2001; Mueller and Mueller 1997; Alt and Hyndman 1984). In between these eruptive flow events, erosional and depositional processes occurred leaving material such as sands, gravels, glaciolacustrine clays, and Palouse loess either within the basalt layers or overlying some basalt flows (Derkey and Hamilton 2003). One of the sedimentary horizons, referred to as the Latah Formation, is visible in the Hangman Creek watershed.

Most recent glacial activity occurred during the Pleistocene period. Glacial Lake Columbia and Glacial Lake Missoula had the most significant impacts on the formation and shaping of the scablands characteristic of the Spokane Subbasin. Glacial Lake Columbia was a large lake impounded by an ice dam and filled the Rathdrum Prairie, Spokane Valley, and the Spokane River valley extending from the east above today's Coeur d' Alene Lake to the west of Grand Coulee (Alt 2001). Although Glacial Lake Missoula was located outside of the Spokane Subbasin, massive flood events from the lake scoured the floor of the Spokane Valley (Alt 2001). Glacial Lake Missoula was impounded by an ice dam and covered an area of 7,770 square kilometers (3,000 square miles) (Alt 2001). The lake was 300 km (186 miles) long and 105 km (65 miles) wide (Alt 2001), with a lake volume comparable to Lake Erie or Lake Ontario today. Flood deposits in the Spokane Subbasin (also in Idaho, Oregon, and other regions of Washington) indicate that between 40-70 massive flooding events originating from Glacial Lake Missoula occurred over a 10,000-year period or more (Alt 2001). The flooding transported and deposited large amounts of glacial out-wash onto the floor of the Spokane Valley, filling old river channels, and impounding some of today's lakes (Alt 2001). The intense floods also removed Palouse loess soil from top of the basalt, cut into the basalt forming the channeled scablands, and left fine-grained sediment deposits in slackwater areas (Alt and Hyndman 1984), such as today's Hangman Valley (Alt 2001). Some flood deposits in Hangman Valley range in thickness from 3 to 17 feet (Alt 2001).

21.2.4.2 Soils

Soils in the Spokane Subbasin are closely tied with elevation. Areas of high elevation have soils derived from a granite parent material. The texture is usually gravelly sandy loam or silt loam and has a depth of one meter or less. A substantial amount of these high elevation soils have a considerable amount of volcanic ash. Surface layers of these soils usually have a silt loam texture while subsoils are generally gravelly loam. At lower elevations in the margins of river valleys, the most abundant parent material is glacial till. Textures of these soils are usually sandy loam to loam, and are moderately dark. At the lowest elevations, along major rivers, soils are coarse in texture and well drained to excessively well drained. Glacial out-wash sands and gravels are the most abundant parent materials. Palouse loess deposits, yellowish brown sand and silt, are also found within the Spokane Subbasin and are more characteristic of the Hangman watershed. Some of the loess deposits in the Columbia Basin can be 150 ft (46 m) or more thick.

21.2.4.3 Spokane Arm, Lake Roosevelt Shoreline Erosion

The Lake Roosevelt shoreline extends approximately 530 miles, and about 70 percent of the shoreline consists of easily eroded unconsolidated sediments (USBR 2000). The sediments are alternately exposed, during winter reservoir (Grand Coulee Dam) drawdowns, and inundated during full pool operation. The combination of wave action and water fluctuations has contributed to slope failures of these inherently unstable soils at many locations around the reservoir. Figure 21.12 shows the portion of Lake Roosevelt located within the Spokane Subbasin, referred to as the Spokane Arm, and highlights the areas of high erosion potential along the shoreline. Analysis of a 300-foot wide band, extending upslope from the full pool reservoir elevation of 1,290 feet, shows that 23 percent of the area within the band is classified as high erosion potential, while 7 percent of the area is bedrock.

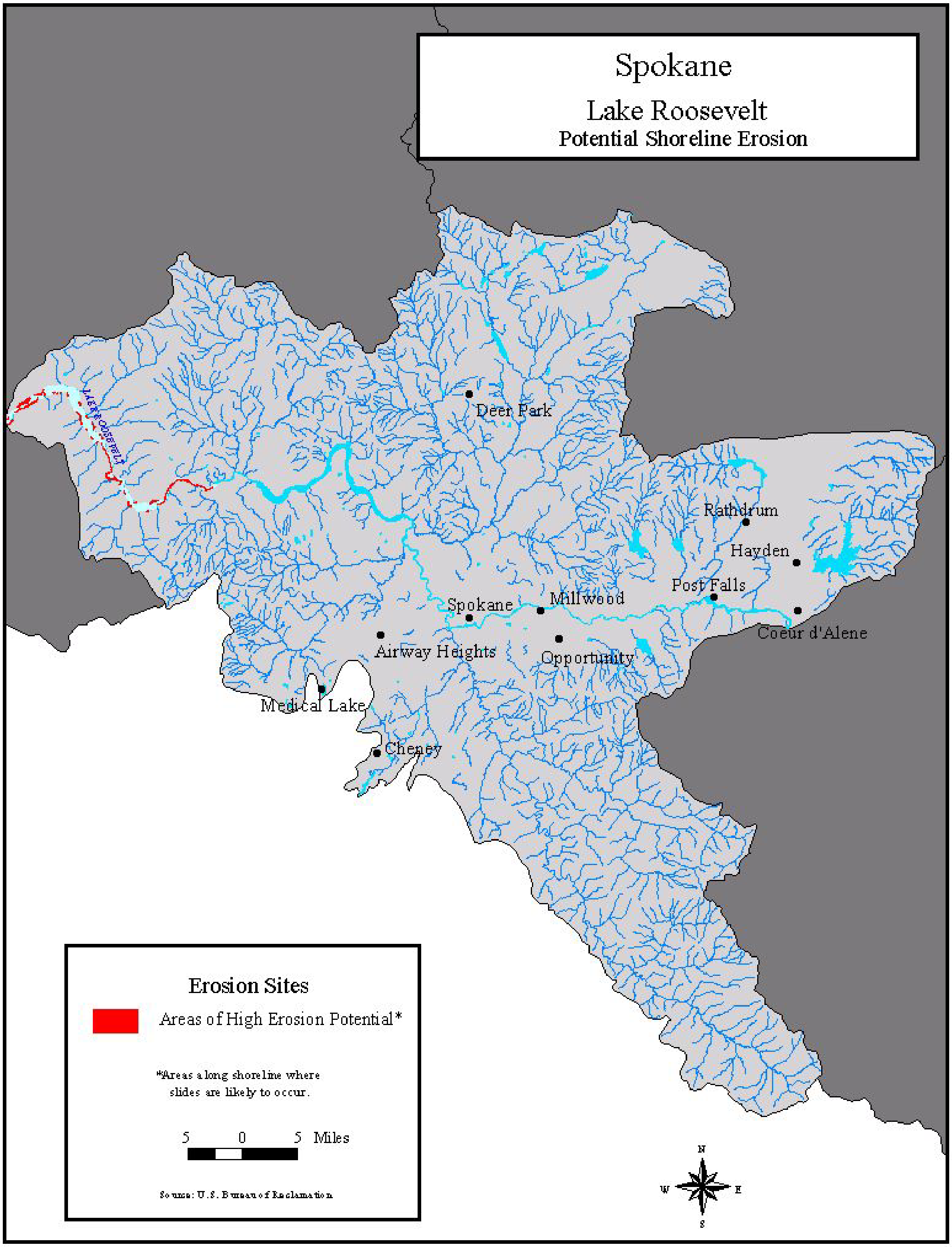


Figure 21.12. Areas of high erosion potential in the Spokane Arm, emphasized for display purposes, not to scale

21.2.5 Topography/Geomorphology

The upper Spokane River, between Post Falls and Upper Falls dams is a relatively low gradient river characterized by a wide valley and marginal channel entrenchment. Channel characteristics consist of unembedded boulder substrate, stable banks, and direct connections with the Spokane Valley-Rathdrum Prairie Aquifer. Spokane Falls marks a "nick point" (a point where the stream gradient changes) and is comprised of Miocene basalt flows. The channel is highly entrenched and bedrock is the dominant substrate. Below Spokane Falls the channel is deeply entrenched with a relatively narrow valley floor dominated by unembedded cobble to boulder substrate in areas not affected by reservoir conditions.

The Little Spokane River drainage is located in the northern portion of the Subbasin where the headwaters originate in Pend Oreille County. The majority of the drainage consists of forests (~68 percent, Golder Associates 2003) and mountainous terrain. The geology within the watershed is largely comprised of granitic formations, thus the presence of fines in the channel is increased as a result of disintegrated granite (grus) from chemical processes such as hydrolysis. Elevations in the drainage range from the highest areas in the north and east sides at 5,300 feet to 1,540 feet amsl at the confluence with the Spokane River. The drainage is represented by both the Columbia Plateau Province and North Rocky Mountain Province (Golder Associates 2003). The Columbia Plateau Province has relatively broad and flat topographic features with incised stream channels and is descriptive of the southern portion of the drainage. In contrast, the Rocky Mountain Province where the stream channels have a lower degree of sinuosity and the channels are confined by steep-sided canyons characterizes the northern portion of the drainage.

The Hangman Creek watershed represents the southern portion of the Spokane Subbasin. The headwaters of Hangman Creek lie above 3,600 feet above mean sea level in the western foothills of the Clearwater Mountains. These foothills are part of the Rocky Mountains of the old North American Continent. Slopes are steep, largely forested, and stream courses are set in deep mountainous drainages. Water flowing northwesterly in Hangman Creek from the Mountain foothills passes through the rolling Palouse Hills, were valley bottoms are broad with low gradients. The streams in the upper portions of the rolling Palouse Hills within the Coeur d'Alene Indian Reservation are perched well above the water table due to the thick layers of basalt under the deep Palouse loess soils (Ko et al., 1974). The water table and the stream elevations converge near the current border between the states of Washington and Idaho (Buchanan and Brown, 2003). The stream enters deep and narrow basalt canyons as it leaves the rolling Palouse Hills and ultimately flows into a broad alleviated valley as it joins the Spokane River (SCCD, 1994).

Matt and Buchanan (1993) and Howard et al. (1989) describe the topography and geomorphology in the Chamokane Creek (see Section 53 References). Refer to Section 22.8.1 regarding the current environmental conditions of Chamokane Creek.

21.2.6 Vegetation

Historically vegetation in the Subbasin ranges from shrub-steppe in the far west to open grass prairies in the rolling Palouse Hills. The grasslands transition with increased elevation into mountainous Douglas fir/ponderosa pine/larch/grand fir coniferous communities (refer to Figure 4.1 in Section 4.2 Historic Focal Habitat Conditions). Limited high elevation areas with moist soil conditions exhibit cedar/hemlock communities. Dryland crops such as wheat, turfgrass, alfalfa, and legumes dominate the Palouse soils of the southern portion of the Subbasin. Land use activities such as agriculture and logging, as well as the urban setting of much of the Subbasin has resulted in displacement of native vegetation with landscaping and ornamental vegetation. Figure 21.13 shows the current distribution of wildlife-habitat types in the Spokane Subbasin based on IBIS (2003).

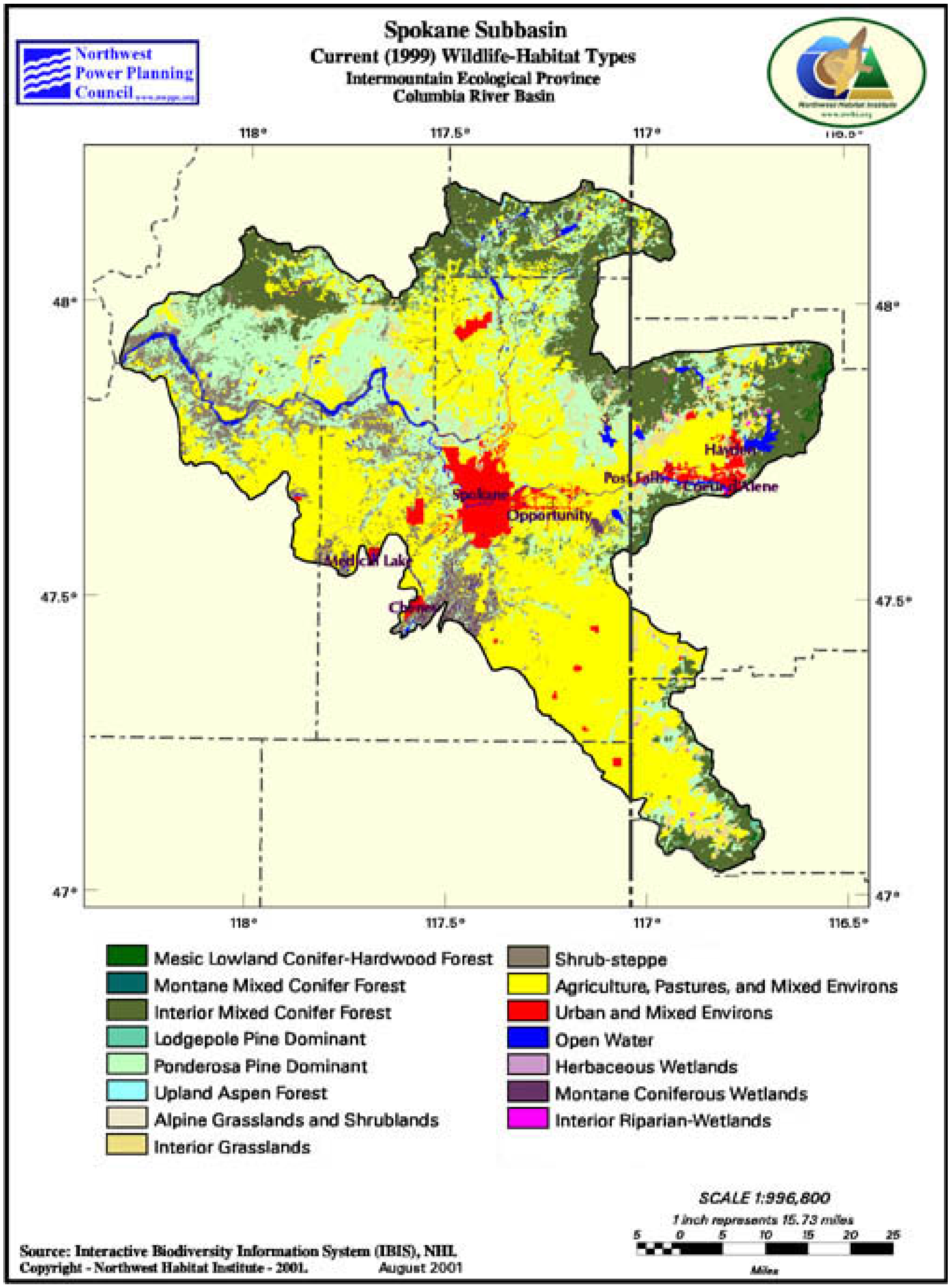


Figure 21.13. Current vegetation cover and major land use within the Spokane Subbasin

21.2.7 Major Land Uses

A map of land ownership is presented in Figure 21.1, and provides an indication of broad categories of land use in the Spokane Subbasin. Land use is heavily impacted from anthropogenic activities such as agriculture (fruit crops, cultivated crops, livestock rearing) and increasing development throughout the Spokane Subbasin. The Subbasin is broadly affected by both concentrated and diffused residential growth, which is intensifying stress on natural resources. A large part of the Subbasin is affected by urbanization from the City of Spokane and surrounding suburbs. Agricultural land uses are also widespread. Cattle graze extensively throughout the Subbasin, while dryland crops generally dominate the southern portion of the Subbasin. Livestock trample riparian areas and stream banks and contribute to fecal coliform, temperature, and dissolved oxygen water quality issues. Poor riparian condition reduces natural filtration processes and allows for increased sedimentation into streams negatively impacting channel morphology and aquatic habitat. Timber harvest is also an important land use in the Little Spokane River drainage and the headwaters of Hangman Creek.

Current watershed conditions and limiting factors with respect to the smaller drainages (Little Spokane River, Hangman Creek, etc.) are presented in Section 22.8 Environmental Conditions and Section 22.9 Limiting Factors and Conditions.

21.2.7.1 Road Density

Road densities in the Spokane Subbasin vary from low to very high, with the majority of the basin ranked as moderate. Figure 21.14 displays road density by density class in sixth order watersheds of the Spokane Subbasin. Very high road densities (4.7-16.4 miles per square mile) are present in the urban center consisting of Spokane and Spokane Valley, as well as on the Spokane Indian Reservation.

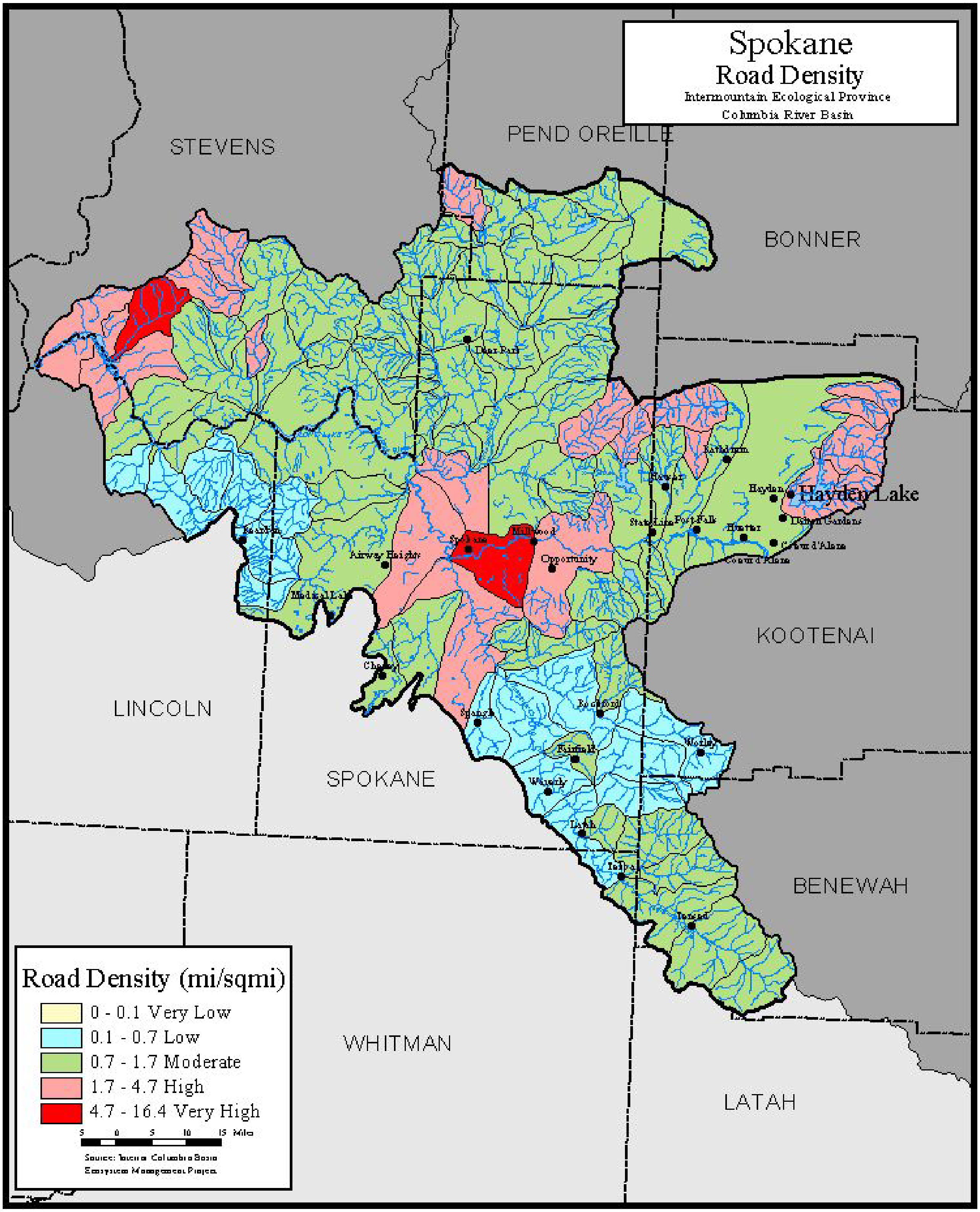


Figure 21.14. Road density within the Spokane Subbasin ranges between low (0.1-0.7 miles/square mile) to very high (4.7 to 16.4 miles/square mile)

21.3 Logic Path

The logic path starts with an overall physical description of the Subbasin, followed by an assessment of aquatic and terrestrial resources from which a management plan was created with specific strategies and objectives to address limiting factors and management goals. In the next section, Section 22: Aquatic Assessment Spokane Subbasin, aquatic resources regarding the historic and current status of selected focal species are described in detail. An analysis based on the QHA technique (described in Section 3) identifies specific habitat attributes that have been altered the most over time relative to the entire Subbasin and which areas in the Subbasin are categorized as having poor or good habitat for the respective focal species. Based on the current status of the focal species, limiting habitat attributes, and management goals recognized in the Subbasin, strategies and objectives were identified and are presented in Section 26: Spokane Subbasin Management Plan. The terrestrial assessment, presented in Section 24, provides a description of the historic and current status of wildlife species and condition of terrestrial habitat types within the Subbasin. Based on the terrestrial assessment and key findings, strategies and objectives were developed and are defined in Section 26: Spokane Subbasin Management Plan.