4 Subbasin Description

4.1 Subbasin Location

The Clearwater River subbasin is located in northcentral Idaho between the 46th and 47th latitudes in the northwestern portion of the continental United States. It is a region of mountains, plateaus, and deep canyons within the Northern Rocky Mountain geographic province. The subbasin is bracketed by the Salmon River subbasin to the south and St. Joe River subbasin to the north. The Clearwater River drains approximately a 9,645 square mile (24,980 km^2) area. The subbasin extends approximately 100 miles (161 km) north to south and 120 miles (193 km) east to west (Maughan 1972). Four major tributaries drain into the mainstem Clearwater River: the Lochsa, Selway, South Fork Clearwater, and North Fork Clearwater rivers. The Idaho–Montana border follows the upper watershed boundaries of the Lochsa, Selway, and eastern portion of the North Fork Clearwater rivers in the Bitterroot Mountains. The North Fork Clearwater then drains the Clearwater Mountains to the north, while the South Fork Clearwater River drains the divide along the Selway and Salmon Rivers. Dworshak Dam, located two miles above the mouth of the North Fork Clearwater River, is the only major water regulating facility in the subbasin. Dworshak Dam was constructed in 1972 and eliminated access to one of the most productive systems for anadromous fish in the subbasin. The mouth of the Clearwater is located on the Washington–Idaho border at the town of Lewiston, Idaho where it enters the Snake River 139 river miles (224 km) upstream of the Columbia River.

4.2 Climate

The Clearwater subbasin experiences a wide variety of climates. Warm, moist maritime air masses from the Pacific strongly influence the climate across the Clearwater subbasin (Lipscomb 1998; Stapp et al. 1984), except for the southernmost and high elevation eastern portions of the subbasin, which experience dryer and colder climatic conditions more typical of the northern Rocky Mountains (Bugosh 1999; Finklin 1977; N. Gerhardt, Nez Perce National Forest, personal communication February 2000).

A general increase in precipitation occurs from west to east across the subbasin coincident with increasing elevation (Stapp et al. 1984), resulting in greater precipitation in the mountainous terrain in the eastern half of the subbasin compared to the low elevation canyons and plateaus to the west. Mean annual precipitation ranges from 12 inches (310 mm) at the Clearwater River's confluence with the Snake River to greater than 90 inches (2,000 mm) in the highest elevations. Precipitation also varies seasonally, with little occurring during the summer months (Stapp et al. 1984; Bugosh 1999). Due to colder average temperatures, winter precipitation above 4,000 feet (1,219 m) falls largely as snow (McClelland et al. 1997; Paradis et al. 1999b; Bugosh 1999), where it may remain through late spring to early summer. Below 4,000 feet, a higher probability of winter precipitation falling as rain occurs with subsequently reduced storage duration. The area below the 4,000-foot elevation band also defines the rain-on-snow zone in the subbasin, an area susceptible to rapid melting and extreme runoff events. Rain-on-snow events can occur from November through March (Thomas et al. 1963). The highest precipitation areas tend to be in the northeastern portion of the subbasin, with the Upper North Fork Clearwater AU averaging nearly 60 inches (152 cm) per year. The Lower Clearwater AU has the lowest annual precipitation, averaging 25.7 inches (65 cm; Figure 3; Table 5).

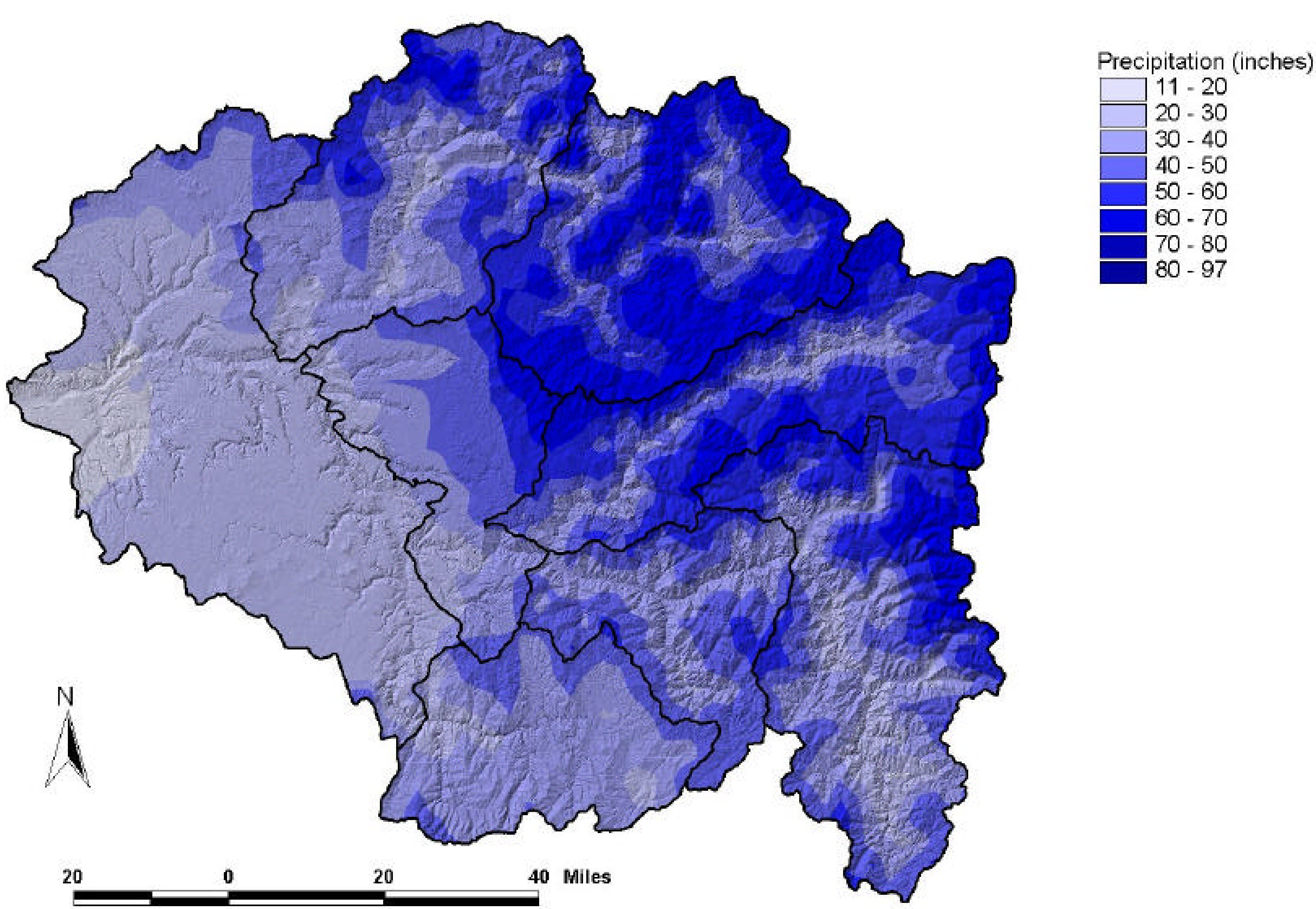

Figure 3. Precipitation levels in the Clearwater subbasin

Table 5. Minimum, maximum, and mean annual precipitation

Assessment Unit	Min. Precipitation (inches/cm)	Max. Precipitation (inches/cm)	Mean Precipitation (inches/cm)
Lower Clearwater	11.0/28.0	57.0/144.8	25.7/65.3
S. F. Clearwater	25.0/63.5	53.0/134.6	36.0/91.4
Lolo/Middle Fork	23.0/58.4	75.0/190.5	40.2/102.1
Lower Selway	27.0/68.6	61.0/154.9	41.6/105.7
Lower North Fork	23.0/58.4	87.0/221.0	43.1/109.5
Upper Selway	19.0/48.3	71.0/180.3	43.7/111.0
Lochsa	27.0/68.6	81.0/205.7	53.0/134.6
Upper North Fork	31.0/78.7	97.0/246.4	59.0/150.0

Mean annual temperature throughout the Clearwater subbasin ranges from 50–55^{0}F (10–13^{0}C) at lower elevations to 25-32^{0}F (-3–0^{0}C) in the upper elevations (Figure 4). Temperatures are generally below freezing in higher elevations of the subbasin during the winter and can be in excess of 90°F (32^{0}C) in the lower elevation canyons during the summer (Bugosh 1999; Maughan 1972). The highest temperatures recorded in Idaho occurred at Orofino and Lewiston, Idaho (118° and 117°, respectively; Stapp et al. 1984). Both towns are located at low elevation at the bottom of the main Clearwater canyon, with Lewiston having the lowest elevation of any location in Idaho (679 feet (207 m) above MSL).

Based on a statewide classification of climate, the National Climatic Data Center (NCDC) has defined three distinct climatic zones in the Clearwater drainage. These areas are roughly characterized as the North Central Prairies (zone #2), North Central Canyons (zone #3), and Central Mountains (zone #4). Combined, the North Central Prairie and Canyons encompass the vast majority of privately owned and agricultural lands found within the Clearwater subbasin. More specifically, the North Central Prairies encompass areas surrounding the mainstem Clearwater River upstream to its confluence with the Middle Fork Clearwater River. The North Central Canyons include mid-elevation areas surrounding the North Central Prairies, and also include lands surrounding Dworshak Reservoir. The Central Mountains division encompasses primarily mid to high elevation, forested areas, primarily owned by the U.S. Forest Service.

The NCDC classification allows for a characterization of drought regimes in the subbasin. Since 1895, these have been computed for each climatic division. As drought patterns have been similar between zones, only the North Central Prairies are presented here using the Modified Palmer Drought Severity Index (Figure 5). The Palmer Drought Severity Index (PDSI) is a meteorological index used to assess the severity of dry or wet weather periods. The index is calculated monthly and is based on the principles of a balance between moisture supply and demand. The index generally ranges from –6 to +6, although values to $\pm$7 may occur. Negative index values indicate dry periods (drought), and positive values indicate wet periods.

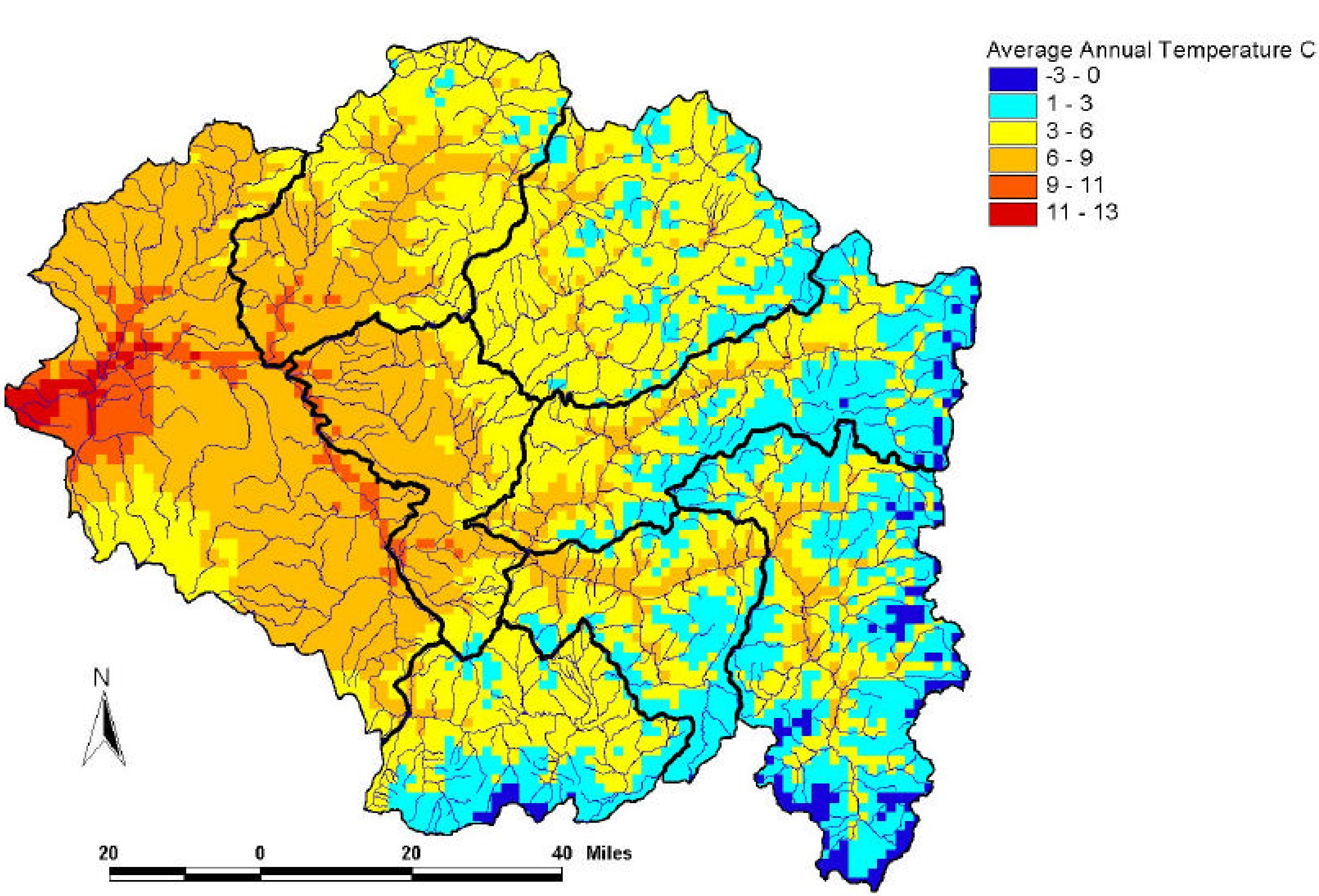

Figure 4. Average annual temperature in the Clearwater subbasin

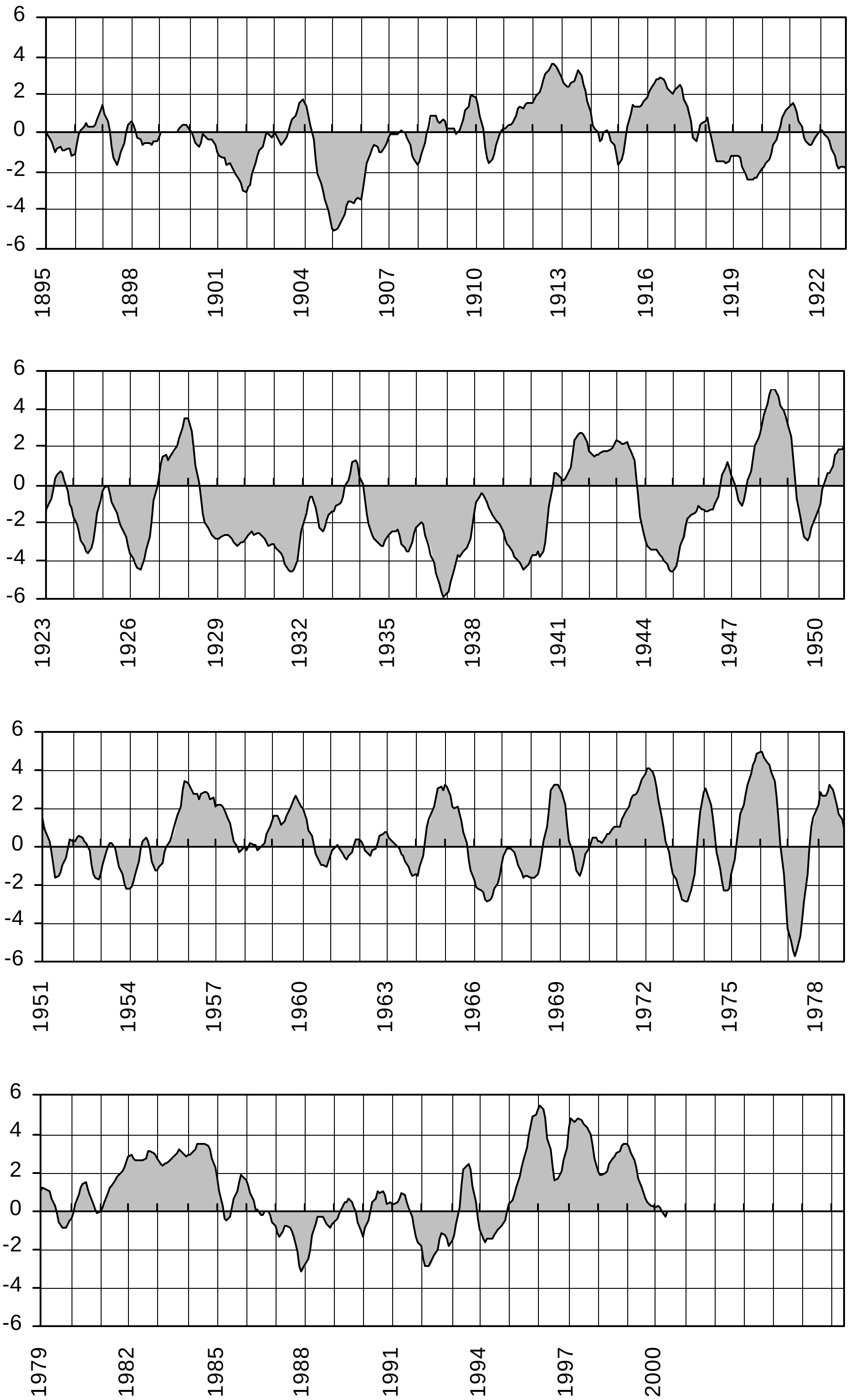

Figure 5. Modified Palmer Drought Index for Clearwater subbasin areas within the North Central Prairies. Data has been smoothed using a 6 month rolling average

4.3 Geology

4.3.1 General Geologic History

The following geologic history is supplied by Idaho Geologic Survey (Lewis, personal communication, September 25, 2003).

The geologic record in the Clearwater Subbasin extends back an estimated 1.5 billion years. Marine sediments were deposited between 1470 mya and 1400 mya in a fairly shallow portion of a basin that may have formed as the result of a rifting event. This deposition became the Precambrian Belt Supergroup, the oldest rocks known to have originated in the Clearwater area. This rock unit consists primarily of quartzites, siltites, argillites and carbonate sequences.

Metamorphic rocks of similar or greater age, the Syringa sequence, are also present within the Clearwater Subbasin. It has not been determined whether these rocks were deposited in another basin and later positioned adjacent to Belt rock sequences during a subsequent tectonic event or are actually basement rocks for the Belt Supergroup.

About 1370 mya, granitic plutons were emplaced and intruded the Belt rocks. Metamorphism and structural deformation of the overlying and adjacent Belt rocks may have been associated with this event. Rifting of the western continental margin somewhat later led to additional faulting of the Belt rocks. The present edge of the Precambrian continental margin is believed to exist in the vicinity of Dworshak Dam.

More than 100 mya, late Paleozoic to early Mesozoic-aged volcanic and sedimentary rocks were accreted to the western edge of the existing continental margin. These rocks were part of the Blue Mountains island-arc complex and form the Seven Devils greenstone terrane along the western edge of the Clearwater Subbasin.

Magmatic activity which began late in the Jurassic period and continued through the Cretaceous period led to further deformation and metamorphism of existing rock units and continued until the emplacement of the Idaho batholith 90 to 60 mya. Granitic rocks associated with the Idaho batholith are the backbone of mountain ranges within the Clearwater Subbasin. A few younger plutonic or volcanic sequences were emplaced during the Eocene period 50 to 45 mya (ex. Beaver Creek plutonic rocks and Potato Hill volcanics). Some magmatic activity occurred about 25 mya during the Oligocene (ex. Onaway and Kamiah volcanics).

Uplift and extension slowed substantially by Miocene time (about 16 mya) when drainages in the area were invaded by Columbia River basalt. Within the Clearwater Subbasin, a large irregular prism of basalt covering over 4000 square miles was created and is referred to as the Clearwater Embayment. Basalt flows covered the valleys and foothills of the Clearwater Mountains, disrupted drainages and established a new base level at a minimum altitude of 2800 feet (Bond, 1963).

During the Miocene, sediment that had previously been transported out of upland areas was now deposited at the margins of basalt flows. Stream gradients were inadequate to transport much sediment across the relatively flat basalt terrain. Sediments eroded off highlands made up interbeds between individual basalt flows. Laterally, the sediment grades into weathered rock, soil and colluvium developed on basalt and older rocks. These sediments are relatively widespread throughout the Clearwater subbasin; deposition is typically controlled by lava-damming of drainages and local subsidence which created deformational basins during the period of basalt accumulation.

Climate was humid during the Miocene period as demonstrated by the fossil record at several localities. Deeply weathered Columbia River basalt exists at higher elevations above Orofino and drainages are slowly cutting back into the canyons away from the mainstem of the

Clearwater River. Deeply weathered basalts can be confused with sedimentary units; they can be 100 feet thick in some areas. Columbia River Basalt units on the Camas Prairie show less weathering; this is likely due to a more moderate climatic history.

During and after volcanism, the Clearwater Plateau remained relatively undeformed through most of the Pliocene. A major cycle of folding and faulting, accompanied by the spreading of local basalt flows, began in late Pliocene or early Pleistocene time and created structural relief of over 4000 feet. The new erosion cycle is in a youthful stage (Bond,1963). During the Pleistocene period, alpine glaciation in the Clearwater and Selway-Bitteroot mountain ranges resulted in minor till deposition associated with isolated moraines.

4.3.2 General Geomorphic History

The oldest landforms in the Clearwater subbasin date back 58 – 25 mya during the Eocene and Miocene epochs (respectively). These are the low gradient, low relief portions of the subbasin, such as those occurring in the lower Clearwater AU. The climate during this period was subtropical and was dominated by processes of chemical weathering (Wilson et al. 1983). Intense weathering of the underlying granitics, gneisses, and schists resulted in a landscape that was highly dissected, with accordant ridges and low stream gradients.

Differential erosion of the Miocene basalt flows eventually created the current stair-step appearance characteristic of many low elevation watersheds in the subbasin (BLM 2000). The higher elevation portions of the subbasin to the east were simultaneously changing into broad convex ridges through processes of erosion and uplift. Streams draining these regions consequently flooded over the lower basalt floors creating a low relief alluvial landscape (Wilson et al. 1983).

A general cooling trend occurred from 13 million to about 1 mya, during which there was a gradual uplift in the east and gentle tilting to the west (Wilson et al. 1983). The change in elevation was estimated to be around 4,000 feet, which greatly increased stream gradients, and consequently, stream competence. Due to their higher energy, Clearwater streams rapidly dissected the basalt creating an oversteepened, high relief series of landforms with unstable slopes adjacent to river canyons. These areas are often referred to as the breaklands, or 'breaks.' The steep-sided slopes of breakland landforms play an important role in erosion from both landslides and surface runoff (Jones et al. 1997; McGreer 1981).

Coincident with the period of atmospheric cooling (during the early Wisconsin glaciation epoch, 75,000 years before present) was elevational cooling, initiated by processes of geologic uplift. This brought on mountain glaciation in the Selway-Bitterroot and Clearwater Ranges. More recent Pleistocene glaciation (approximately 11,000 years ago) caused alpine glaciers to form in the upper elevations around the rim of the subbasin in the Lower and Upper North Fork, Lochsa and Upper and Lower Selway AUs. The glacial activity during this time was primarily restricted to elevations above 5,000 feet (Anderson 1930).

Also during the early Wisconsin period, several ash falls occurred beginning about 12,000 years ago and ending about 6,600 years ago. Since the end of glaciation, the primary land forming processes in the Clearwater subbasin have been fluvial, eolian, and mass wasting erosion. Portions of the old surface remain exposed between major canyons.

4.3.3 Characterization of Geologic Parent Materials

A coarse characterization of the primary geologic parent materials in the Clearwater subbasin are shown in Figure 6. NRCS geologists and soil scientists summarized ICBEMP lithology maps to derive utilitarian parent material classifications (Table 6). When stratified by assessment unit, many of the parent materials emerge as dominating a given landscape, such as basalt in the Lower Clearwater, schist in the Lower North Fork, or granite in the Upper Selway (Table 7). Granite and schist are the dominant parent materials in the subbasin (Figure 6), both of which are widespread throughout most assessment units. Combined, these materials occur on almost 4 million acres of land in the Clearwater.

Table 6. Summarization of ICBEMP Lithology maps to local geologic parent materials

ICBEMP Lithology	Geologic Parent Material Summarization
Alluvium; glacial drift	Alluvium
Mafic volcanic flow; mafic meta-volcanic	Basalt
Granitic gneiss; mafic gneiss	Gneiss
Calc-alkaline intrusive; granite	Granite
Loess	Loess
Metamorphosed carbonate and shale; interlayered meta-sedimentary	Schist
Argillite and slate; meta-siltstone; siltstone; meta-siltstone; mixed miogeosynclinal; shale and mudstone; sandstone	Sitltite
Felsic volcanic flow; calc-alkaline volcanoclastic; felsic pyroclastic; mixed eugeosynclinal; tuff; calc-alkaline meta-volcanic	Volcanic

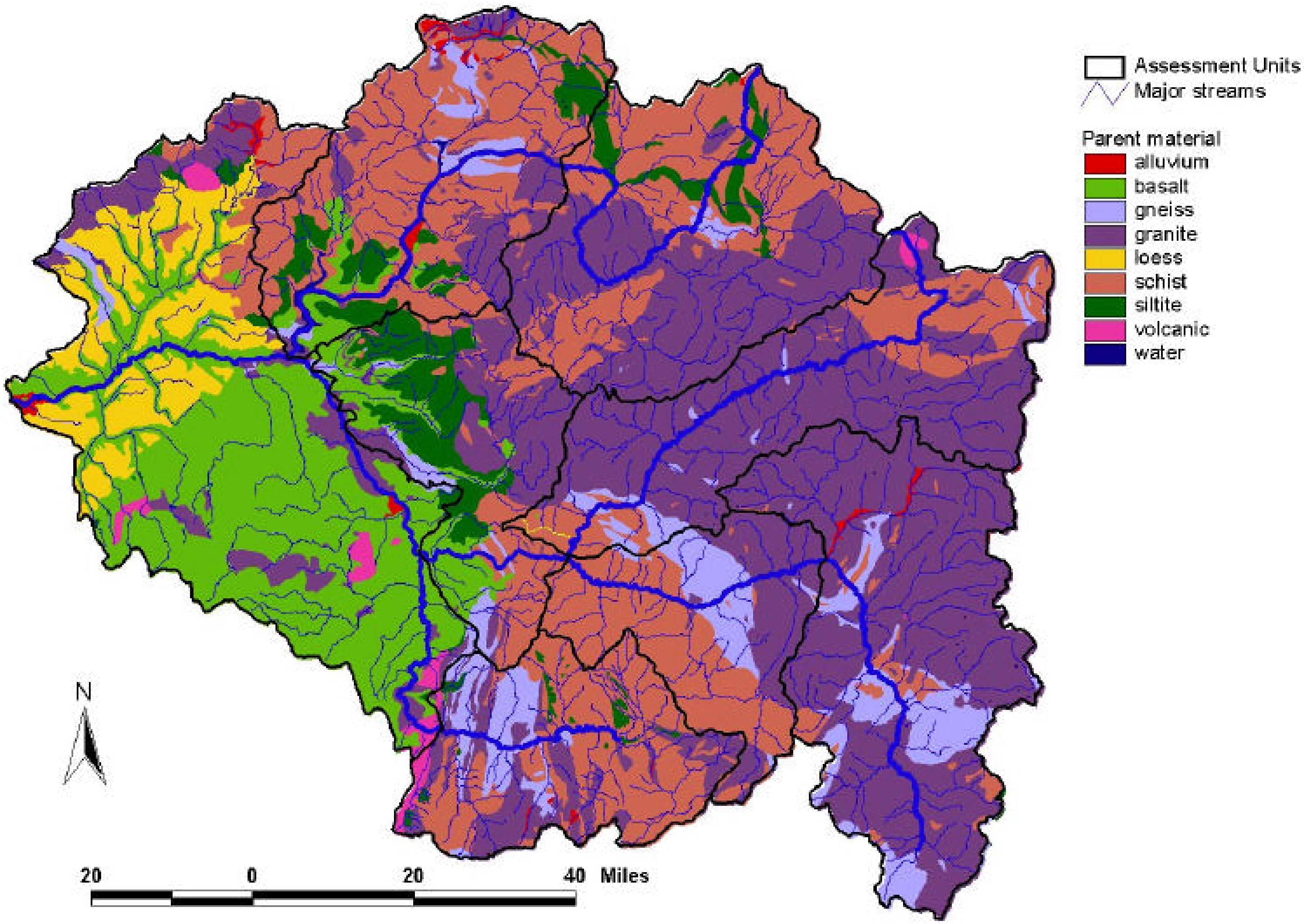

Figure 6. Geologic parent materials occurring in the Clearwater subbasin. Parent material classes were defined and summarized from ICBEMP lithology maps by NRCS personnel (J. Hohle, Nez Perce County NRCS, personal communication 2001)

Table 7. Percentage of geologic parent materials by assessment unit in the Clearwater subbasin

AU Name	Schist	Siltite	Granite	Alluvium	Water	Gneiss	Loess	Volcanic	Basalt
L. Clearwater	6.06	1.23	11.74	1.10	0.07	1.47	19.6	2.79	55.91
L. North Fork	58.19	11.86	14.36	1.52	3.14	5.45	0.01	0.00	5.48
Up. North Fork	40.60	6.51	51.64	0.04	0.02	1.20	0.00	0.00	0.00
Lolo/MF	21.26	24.34	29.64	0.03	0.00	5.74	0.00	0.00	18.99
Lochsa	22.21	0.00	72.01	0.00	0.07	4.89	0.00	0.82	0.02
Lower Selway	53.22	0.00	30.16	0.01	0.01	16.61	0.00	0.00	0.00
Upper Selway	4.90	0.02	79.58	0.80	0.08	14.61	0.00	0.02	0.00
South Fork	53.27	2.90	25.82	0.45	0.01	15.20	0.00	2.15	0.19

The term "granitics" refers to all light colored intrusive rocks of any age (Ford et al. 1997). Granitic parent material is comprised of coarse-equagranular rock made up of minerals with different properties. Because granitics typically occur as a large, homogenous mass, their relative abundance and distribution throughout the Clearwater subbasin should not be surprising. Site-specific differences do, however, exist when comparing erosivity, which is commonly classified along a 'weathering' spectrum ranging from unweathered to highly weathered. For example, when occurring in moist and acidic environments, granitic parent materials are highly prone to processes of chemical weathering, often resulting in gentle, yet erodible landforms (Ford et al. 1997). Conversely, when occurring on dry, non-acidic environments, granitics tend to be very resistant to weathering and form a more rugged or jagged landscape. The weathered product of granitics, called grus, is prone to movement due to its structure, and may be transported to stream channels via processes of surface and/or mass wasting erosion.

Metamorphic schists, which in this document also pertain to metasedimentary (belt) bedrock, are widespread throughout north and southcentral portions of the subbasin. Due to their abusive processes of formation, schist parent materials contain numerous planes of failure and uncohesive mica minerals making them highly erodible (Ford et al. 1997; Cvancara 1995). The distinct foliations in schist are readily split through processes of physical or chemical weathering, commonly resulting in a highly mobile grus or micaceous sand. These products are readily delivered to stream channels or floodplains via landslides and/or slumps (see *sedimentation* section 4.6 below), and are considered to represent among the least stable of all geologic materials in the subbasin (McClelland et al 1997; G. Hoffman, NRCS, personal communication February 27, 2001). The predominance of granite and schist in the Clearwater ultimately creates a landscape actively changing through destructive (i.e. erosion) and constructive (i.e. deposition) geologic processes.

Basalt parent materials are predominant in the lower Clearwater assessment unit, and define the lower mainstem Clearwater and many of its tributaries. This igneous rock type marks the easternmost border of the Columbia Plateau volcanic flows. Basalt parent materials typically have the flat upper surface of a fluid lava flow (Ford et al. 1997). Processes of fluvial erosion by trunk streams, such as the mainstem Clearwater, create deep dissections in basalt, forming the characteristic stepped breaks controlled by resistant flows (Ford et al. 1997). Knickpoints, or those areas of slope interruption along the longitudinal profile of a stream channel, are common in basalt-dominated tributaries, such as Lapwai, Big Canyon, and Lawyers creeks.

Much of the basalt parent material, in the Palouse and Camas Prairie regions of the Lower Clearwater AU, is mantled by loess. Loess, and other ash-derived soils, occurs in the assessment unit as a result of volcanic and windborne transport processes from Washington and Oregon (Busacca and McDonald 1994). The ash cap, which was initially laid down over the area

6,700 years before people (BP) to depths of 4–5 m, has since been mostly eroded away on steeper and/or burned slopes (Falter and Rabe 1997). This deep, silt-sized material plays an important role in soil formation and stream channel structure since it is easily transported through mechanical (i.e. fluvial and eolian) processes of erosion.

Associated with the granitic batholith and metamorphosed belt rocks are various forms of gneiss, a coarse-grained metamorphic rock type with poor foliation and rock cleavage (Cvancara 1995). Gneiss parent materials often occur in combination with the intrusion of the granitic batholith as small inselbergs (island hills) in the Upper and Lower Selway, Lochsa and Upper and Lower North Fork AUs. Gneiss plays a similar role in influencing erosion and sedimentation processes as do granitics (Megahan and Kidd 1972; McGreer 1981; Jones et al. 1997; Ries et al. 1991).

Sedimentary rock types, such as siltites and alluvium are most common along the old continental margin (i.e. Middle Fork and Lower North Fork AUs) and near historic glacial moraines or stream terraces. Siltites, which are common in the Middle Fork and Lower/Upper North Fork AUs, define the remnants of old, high terraces and glacio-fluvial areas (Wilson et al. 1983). Siltite particle size is typically <0.002 inches (0.005 cm) and has clay minerals or quartz as its primary constituents. Alluvium parent material is the least common of those defined in the subbasin. This depositional rock is weakly weathered, has a coarse texture, and is most commonly associated with stream terraces, floodplains, or glacial moraines. Rounded gravels, cobbles, and stones are generally characteristic of alluvium parent material.

4.4 Topography/Landforms

The Clearwater subbasin is well known for its rugged mountainous terrain and deep canyon-walled rivers and streams. The topographic relief, slope percent, and aspect of the subbasin vary greatly from the river valley near Lewiston, Idaho to the crest of the mountains along the Idaho/Montana border to the east. Two subsections are used below to discuss topography and landforms throughout the subbasin. The first provides a general overview of the topography and landforms found throughout the subbasin, and the second provides a more detailed look at the landform distribution and its relationship to vegetative and wildlife species.

4.4.1 Overview of Topography and Landforms

The westernmost portion of the subbasin is characterized by plateaus and foothills, which are divided by breaklands (Figure 7). The plateau region, in the southern lobe of the Lower Clearwater AU and parts of the Lolo/Middle Fork AU, has moderately sloping terrain, with local elevations ranging from 2,500 to 3,500 feet (762 – 1,067 m) above msl (Figure 8). Hill slopes are greatest in areas dissected by streams (15 to > 60%), while in other areas range from 0 to 15% (Figure 9). The isolated buttes in the western part of the plateau reach elevations to 5,000 feet (msl) and have slopes ranging from 30 to 60%. The valleys that have been eroded into the plateau have bench topography from the multiple underlying lava layers forming a series of stepped, cliff-faced outcrops of basalt up the steep slopes (BLM 2000).

Breakland landforms typify the central portion of the lower Clearwater AU and closely border the mainstem Clearwater and most associated tributaries. Slope gradients in the breaklands average between 60 to 80 percent, an attribute that greatly contributes to sediment transport efficiency.

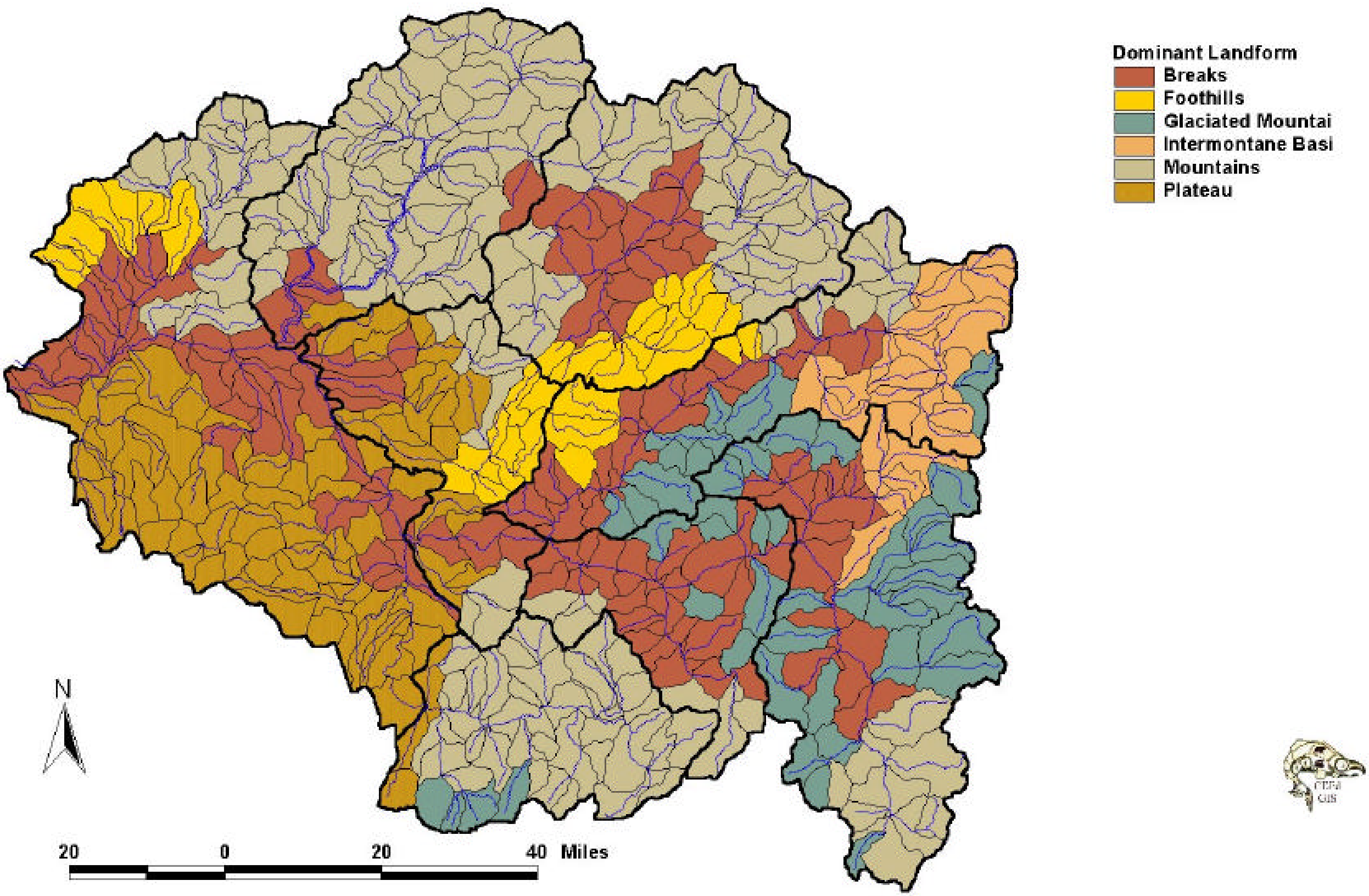

Figure 7. Dominant landforms in the Clearwater subbasin, stratified by sixth-field HUC

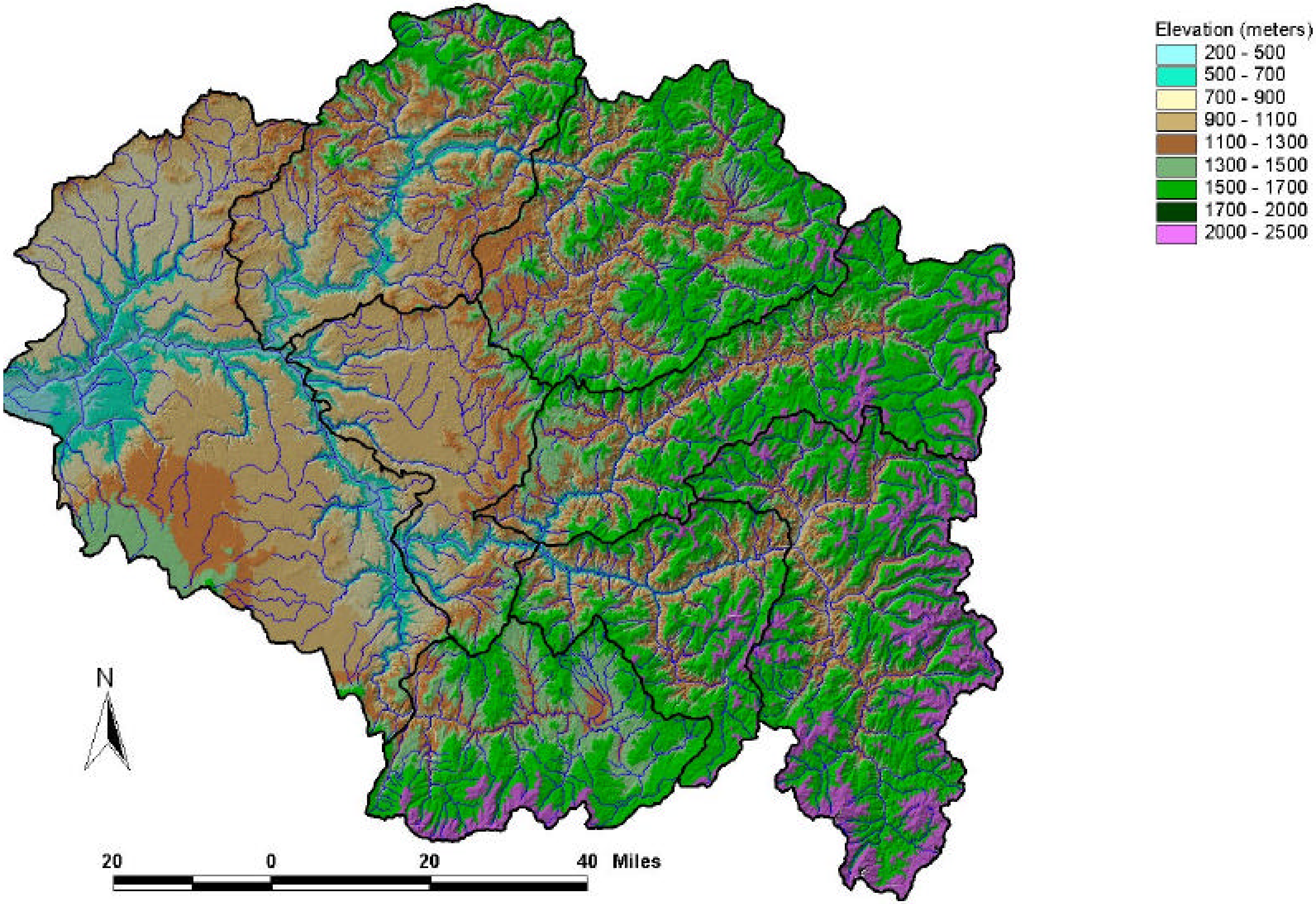

Figure 8. Elevation and topography of the Clearwater subbasin

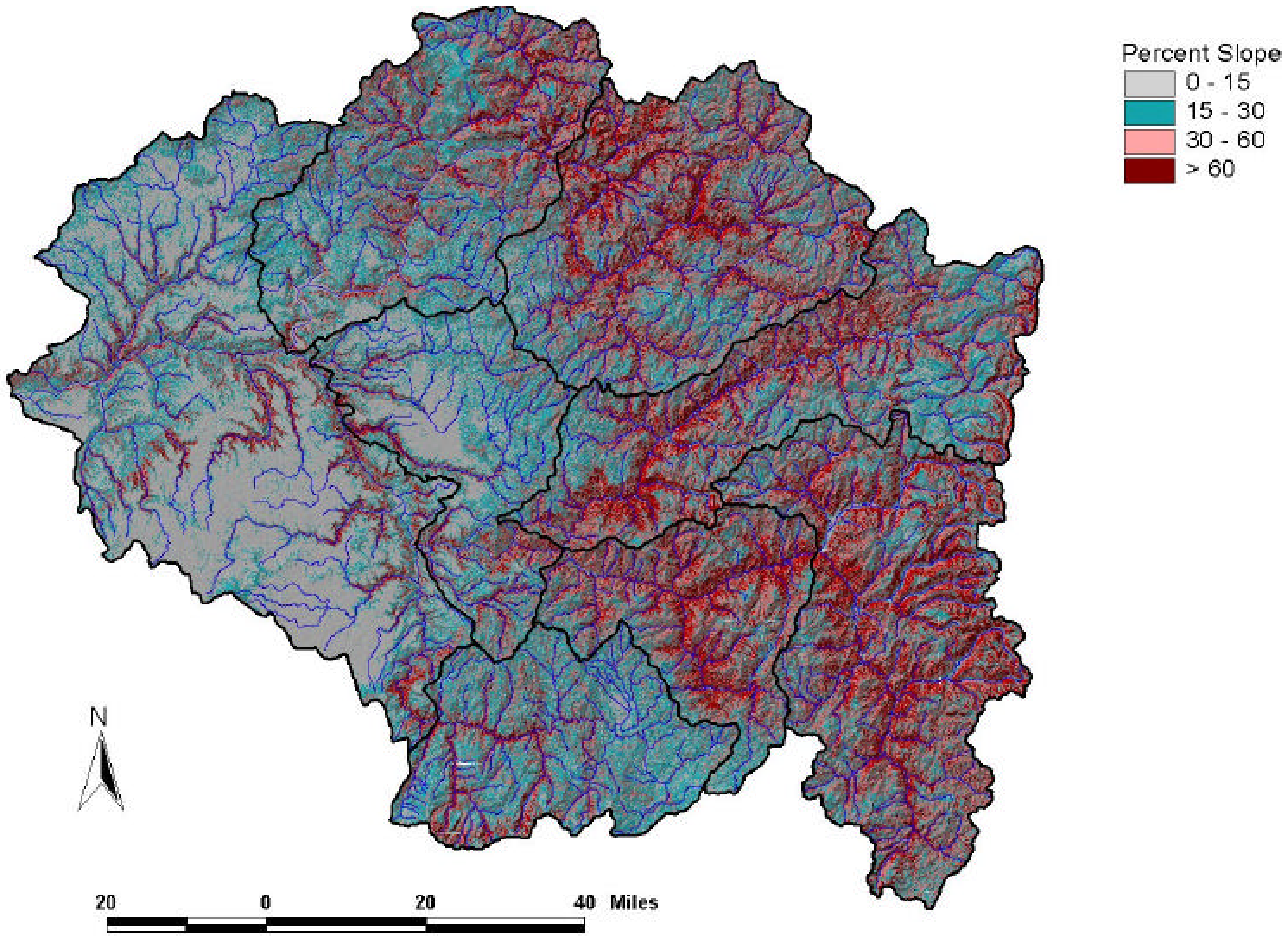

Figure 9. Relative distribution of land slope classes throughout the Clearwater subbasin

The northern lobe of the Lower Clearwater AU is characterized by low relief rolling hills and mountain landforms. The dune-like formations, which are typical throughout the Palouse Prairie, range in elevation from 1,000 to 3,000 feet (305–914 m), with slope gradients of 0 to 30 percent. Mountain landforms, which are common throughout the uppermost portions of the assessment unit (i.e. upper Potlatch River drainage), range in elevation from 3,000 to 4,500 feet (914–1,372 m), with slope gradients between 30 to 60 percent.

Moving east, the topography of the Clearwater subbasin undergoes a notable increase in relief, especially in the southern and northern portions of the drainage. Topography in the lower North Fork, upper North Fork, Lochsa, and South Fork AUs is dominated by mountain landforms, with mean elevations ranging from 3,800 to 7,100 feet (1,158–2,164 m) above msl. The Clearwater Mountains, which rise from the Salmon River breaks to the south, extend northward through the South Fork and into the North Fork Clearwater. The ridges of the Clearwater range are often frost-shattered, with convex or straight sideslopes (Ford et al. 1997). Slope gradients vary by aspect, but average 35 to 60 percent and are greatest at stream dissections. Infrequent, small basins occur throughout the higher elevations of mountain landforms, such as those in the Gospel Hump Wilderness Area. Many of the alpine lakes in the subbasin form in the cirques at the head of these snow-formed basins and provide flow to perennial Clearwater River tributaries (Hubbard 1956). Because of their rounded formation, steep (>65%) side slopes, and erodible and mobile geologic parent materials (i.e. schist), the Clearwater Mountains supply a continual source of sediment to the lower elevation streams and rivers.

Similar to the western portion of the subbasin, breakland landforms divide the southern and northern hemispheres of the mid-Clearwater drainage area, and effectively demarcate landform differences throughout the central and eastern assessment units. The confluence of the Lochsa and Selway Rivers delineate some of the most extensive of the breakland landforms in the subbasin. The Lochsa River proper is entirely bordered by breaks, which separate the glaciated mountain landforms to the south and foothills/mountain landforms to the north (refer to Figure 7).

Breakland landforms in the Lower Selway AU comprise approximately 60% of those identified (Thompson 1999), while those in the Upper Selway AU account for an estimated 29% of the landform types. In general, southerly aspects of the inherently unstable breakland landforms may experience intensified rates of erosion and retardation of soil development due to their exposure to prevailing northwesterly storm patterns (refer to *soils/sedimentation* section 4.5 and 4.6 below). Dominant geologic parent materials differ between and within assessment units but are most commonly either schist or highly weathered granite. Breakland elevations range from 2,500 to 7,500 feet (Ford et al. 1997) and relief of several thousand feet is common (Wilson et al. 1983). Breakland landscapes are deeply eroded and are typically composed of stream or structural breaks. Streams tend to be highly incised, with moderate to steep gradients and boulder substrate.

The Selway-Bitterroot mountain range dominates the landscape of the eastern portion of the subbasin, and in effect forms the Idaho/Montana border. In general, the Bitterroots are comprised of glaciated mountains to the south (upper Selway AU), intermontane basin in the central portion (upper Lochsa AU), and mountain landforms to the north (upper North Fork and portions of the lower North Fork AUs).

In the Selway AU, mean elevations range from about 5,100 feet to 7,100 feet (1,554–2,164 m) with slopes generally in excess of 50%. The glaciated mountain landforms that characterize much of the Bitterroot range in the upper Selway unit are defined by cirque headwalls, glacial troughwalls, alpine ridges and cirque basins (Ford et al. 1997). These landforms are predominantly formed by alpine glacial erosion. Slope shape tends to be straight to concave in glacial troughs, convex to concave in cirque headwall areas, and convex on alpine ridges. Wetlands (wet sidehills and avalanche chutes), lakes, and ponds are also common in the AU (Ford et al. 1997).

The intermontane basin in the eastern portion of the Lochsa AU separates the glaciated and non-glaciated portions of the Selway Bitterroot mountains to the south and north, respectively. These areas have largely been formed through glacial meltwater and fluvial action and have developed a gently rolling surface shape. Mean elevation ranges between 5,700 feet and 7,100 feet (1,737-2,164 m) while slope gradients are generally between 10-30 percent.

Topography of the Bitterroots again changes in the upper North Fork AU with the transition from intermontane basin to non-glaciated mountains. Although mean elevations (4,650–5,700 feet) are not as great as those to the south (upper Selway AU), relief tends to be high with slopes commonly in excess of 50%. The ridges and sideslopes in this area are frost shattered, convex and straight (respectively), and have been formed by fluvial and colluvial processes (Ford et al. 1997). The schist parent material, which dominates much of the landform, is erodible and considered a likely sediment source to downstream areas (Wilson et al. 1983).

4.4.2 Relationship of Landforms to Upland Biota

A detailed analysis (Ford et al. 1997) of landforms within the Clearwater subbasin resulted in a classification containing15 different landforms (Figure 8; Table 8). The three landforms that cover the greatest amount of the subbasin are mountain slopes and ridges, breaks, and low relief hills. The following information describes the major vegetative cover classes associated with each landform type in the subbasin. The reader is referred to Ford et al. (1997) for a complete description of the landform classification used.

Mountain Slopes and Ridges

The most common vegetation types on mountain slopes and ridges are mixed mesic forests, Douglas-fir (*Pseudotsuga meziesii*) forests, and warm mesic shrublands. Douglas-fir stands with multiple canopies provide habitat for flammulated owl (Groves et al. 1997a). The mountain slopes and ridges landform contains one of the larger amounts of ponderosa pine habitat in the subbasin. The 242 square kilometers of ponderosa pine habitat on mountain slopes and ridges are important for focal species such as flammulated owl, white-headed woodpecker, and black-backed woodpecker.

Breaks

Mixed mesic forests and warm mesic shrublands each occupy about 15% of the breaks in the subbasin. Douglas-fir forest, which is used by flammulated owls, is the only other vegetation type that occurs on more than 10% of the breaks. Although riparian areas only cover 2% of this landform, the breaks landform has the largest area of land in riparian zones. This landform has 85 square kilometers of riparian habitat. Riparian habitat is extremely important for many wildlife species. Another important kind of habitat in this landform is ponderosa pine habitat. The breaks landform has 255 square kilometers classified as the ponderosa pine vegetation type. Ponderosa pine communities are important for three terrestrial focal species, the flammulated owl, the white-headed woodpecker, and the black-backed woodpecker.

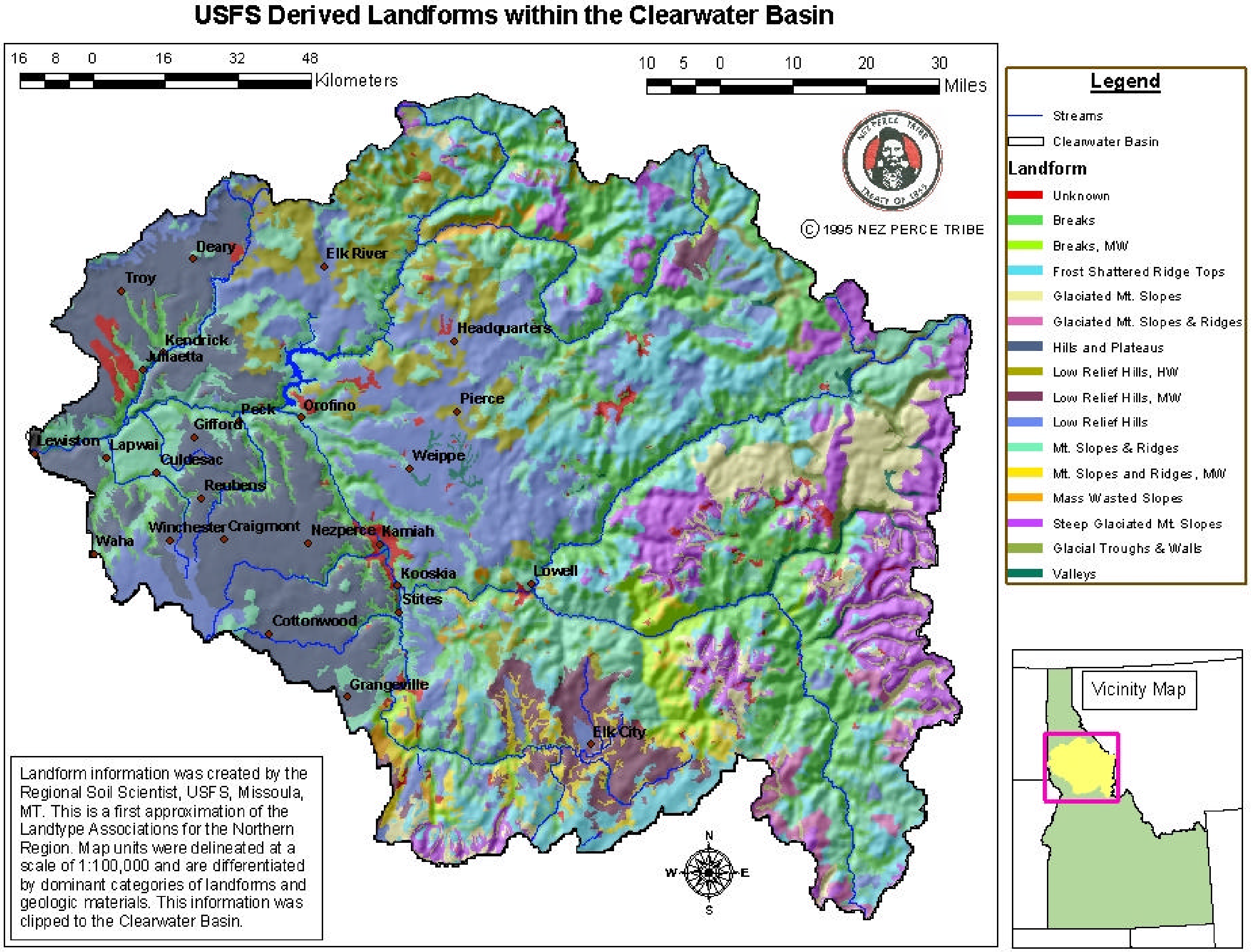

Figure 10. Detailed landform map of the Clearwater subbasin (from Ford et al. 1997)

Table 8. The landforms contained within the Clearwater subbasin

Landform	% Area
Breaks	17.1%
Breaks, Moderately Weathered	2.1%
Frost Shattered Mountain Ridge Tops	10.0%
Glaciated Mountain Slopes	4.7%
Glaciated Mountain Slopes and Ridges	1.0%
Hills and Plateaus	12.5%
Low Relief Hills, Highly Weathered	5.2%
Low Relief Hills, Moderately Weathered	3.0%
Low Relief Hills	14.2%
Mountain Slopes and Ridges	17.8%
Mountain Slopes and Ridges, Moderately Weathered	1.8%
Mass Wasted Slopes	0.6%
Steep Glaciated Mountain Slopes	7.8%
Alpine Troughs and Trough Walls	1.4%
Valleys	0.8%

Low Relief Hills

Forests cover the majority of low relief hills in the subbasin. The most common forested vegetation types are mixed mesic forest, western red cedar/grand fir (*Thuja plicata/Abies grandis*), grand fir, and Douglas fir/grand fir. Cedar forests provide habitat for two focal plant species: crenulated moonwort (*Botrychium crenulatum*) and mountain moonwort (*B. montanum*). Warm mesic shrublands are the next most common cover type; they cover 9% of low relief hills in the subbasin. The low relief hill landform contains the largest amount of ponderosa pine habitat in the subbasin with 259 square kilometers in the ponderosa pine vegetation type. Ponderosa pine habitat is very important for three of the subbasin's terrestrial focal species, flammulated owl, white-headed woodpecker, and black-backed woodpecker.

Hills and Plateaus

Over 65% of this landform is now agricultural land. The only other vegetation type covering more than 5% of this landform is the foothill grasslands vegetation type which occupies 8% of the landform. These remnant grasslands provide habitat for two focal plant species: Jessica's aster (*Aster jessicae*) and Palouse goldenweed (*Haplopappus liatriformis*). Spalding's catchfly (*Silene spaldingii*), a proposed Threatened species also inhabitats these habitats . Hills and plateaus contain the greatest amount of urban area in the subbasin: 16 square kilometers of this landform is now in urban areas.

Frost Shattered Mountain Ridge Tops

This landform provides subalpine habitat. Mixed subalpine forests make up 22% of this landform. The two other most prevalent vegetation types are mixed mesic forests and lodgepole pine forests (*Pinus contorta*). Lodgepole pine covers 17% of the landform. Old growth lodgepole pine stands provide habitat for black-backed woodpeckers. This landform contains 223 square kilometers of the Engelmann spruce and subalpine fir vegetation types. Areas containing a mixture of early and late seral stages of these vegetation types can provide lynx habitat. Lynx need old growth areas for denning and young seral areas for foraging.

Steep Glaciated Mountain Slopes

This landform contains a variety of subalpine habitats, including mixed subalpine forests (19% of landform), subalpine fir forests (9% of landform), and montane parkland/subalpine meadows (9% of landform). Other common cover types are lodgepole pine forests, mixed mesic forests, and exposed rock. Lodgepole pine forests cover 15% of the landform; old growth stands of this type provide habitat for black-backed woodpeckers. The subalpine fir and Engelmann spruce vegetation types that occur on these steep glaciated mountain slopes cover 206 square kilometers of the landform. These two vegetation types provide lynx habitat if a matrix of young and old stands exists. Also found in these high elevation sites is white-barked pine (*Pinus albicaulis*), an important wildlife food species suffering declines from blister rust.

Low Relief Hills, Highly Weathered

Mixed mesic forests covers 20% of the low relief hills, highly weathered landform. Grand fir forests, western red cedar/grand fir forests, Douglas fir/grand fir forests, and Douglas fir forests each cover approximately another 10% of the landform throughout the subbasin. Douglas fir stands provide potential habitat for flammulated owls. Mature and old growth forested stands provide nesting habitat for goshawks. Not all the habitat in this landform is forested though, the warm mesic shrubland vegetation type alone covers 12% of the landform.

Glaciated Mountain Slopes

Glaciated mountain slopes contain 25% lodgepole pine, 24% mixed subalpine forest, and 11% mixed mesic forest. Two other vegetation types found in the landform are subalpine fir and Douglas fir. Old growth lodgepole pine stands provide habitat for black-backed woodpeckers. Glaciated mountain slopes contain 115 square kilometers of Engelmann spruce and subalpine fir, important components of lynx habitat.

Low Relief Hills, Moderately Weathered

The three most common vegetation types in this landform are mixed mesic forest, grand fir, and lodgepole pine. Mixed mesic forest and grand fir each occupy over 20% of the area designated to this landform.

Breaks, Moderately Weathered

Mixed mesic forest is the vegetation type that covers the most area on moderately weathered breaks. Warm mesic shrubland and Douglas-fir are the only other two vegetation types that cover more than 10% of the landform. Douglas-fir can provide habitat for flammulated owl.

Mountain Slopes and Ridges, Moderately Weathered

Mixed mesic forest covers almost a fourth of this landform. Other types of forests commonly found include grand fir and lodgepole pine.

Glacial Troughs and Trough Walls

Mixed mesic forest covers 25% of this landform. Lodgepole pine is the next most common vegetation type, covering 16% of the landform. Douglas fir and mixed subalpine forest vegetation types each cover approximately 10% of the landform.

Glaciated Mountain Slopes and Ridges
Over 80% of glaciated mountain slopes and ridges are covered by four vegetation types. The most common vegetation types in this landform, in decreasing areas of land covered, are mixed subalpine forest, Douglas fir, lodgepole pine, and subalpine fir.

Valleys
Valleys contain a variety of vegetation types. Only two vegetation types, mixed mesic forest and foothills grassland, cover 10% or more of the landform. Six other vegetation types, including warm mesic shrubs, ponderosa pine, and western red cedar/grand fir, cover between 5% and 10% of the landform. The valleys landform has the largest proportion of its land in riparian vegetation types, with 6% of its land classified in a riparian vegetation type.

Mass Wasted Slopes
Douglas fir is the most common vegetation type in this landform, covering 16% of mass wasted slopes. Western red cedar/grand fir and mixed mesic forest each cover 13% of this landform.

4.5 Soils

The Clearwater subbasin provides a unique and diverse area for soil development due to varying climatic conditions, the diversity of geologic parent materials, and differing topographic features. In turn, soils occurring throughout the subbasin have locally unique properties of fertility, porosity, mobility, and erosivity, each with important implications to the movement and storage of energy, water, and nutrients (Nez Perce National Forest 1998).

For the purposes of this assessment, a less detailed soils characterization was conducted to facilitate ease of interpretation and relation to aquatic issues. For a more detailed discussion regarding landtype/soil associations for National Forest land in the Northern Region, the reader should refer to Ford et al. (1997), or to the Natural Resource Conservation Service website (http://www.statlab.iastate.edu/cgi-bin/osd/osdname.cgi) for a site-specific characterization of individual soil series. Additional information is available from the State Soils Geographic Database (STATSGO; http://www.il.nrcs.usda.gov/soils/statsgo_inf.html).

STATSGO data, Land Remote Sensing Satellite (LANDSAT) images, and literature review were used in the following discussion. Soils sharing similar primary and secondary characteristics are discussed based on their Great Group taxonomic classification. Descriptors were based in part on soil orders and their general area of occurrence for ease of discussion.

In general, soils in the Clearwater subbasin can be characterized as having a volcanic ash horizon over weakly developed subsoil (Wilson et al. 1983). The primary ash cap was laid down 6,700 years ago by volcanic eruptions from Mt. Mazama (Crater Lake, Oregon), and to a lesser degree recent eruptions from Mt. St. Helens (Washington) and Glacier Peak. The original deposition appears to have been between one and two feet thick, with greatest depths occurring in depressions or areas protected from redeposition and erosion (Wilson et al. 1983). Much of the ash has since been eroded away or mixed with the original soil on many steep southerly aspects or on high elevation areas that have experienced historic, high intensity wildfires (Wilson et al. 1983). Where present, volcanic ash has increased soil productivity due to its moisture retentiveness and erosion resistant properties. However, because of its poor replacement frequency (i.e. volcanic eruptions) and increasing levels of disturbance, volcanic ash is currently considered to be an irreplaceable resource and spatially limited (Nez Perce National Forest 2000).

The primary soils in the Lower and Middle Fork Clearwater AUs are deep to very deep with silt loam surface textures and silt loam to silty clay loam subsurface textures (Ford et al. 1997). These highly developed, fertile grassland soils, collectively referred to as Mollisols, occur on warm, dry, low relief slopes with parent material dominated by a thick layer (6 to 300 feet/1.8 – 91.4 m) of wind-blown loess underlain by Columbia flood basalts. The dominant potential natural vegetation is bluebunch wheatgrass and Idaho fescue in the prairie grasslands (Camas and Palouse), ponderosa pine, and Douglas fir in forested areas. Agricultural crops currently are the dominant vegetation type in prairie areas (R. Spencer, NRCS, personal communication February 28, 2001). Soils occurring along breakland landforms are shallow to moderately deep with textures ranging from silt loams to very cobbly loams, while those occurring on mountain slopes and ridges are moderately deep to deep with silt loam to loam surface textures and very gravelly to cobbly loam subsurface layers. (Ford et al. 1997).

The Mollisols grade into forest soils (Alfisols) in higher elevation portions of the plateau, and the division is discernable by stringers of ponderosa pine forest extending into grasslands. Soil types occurring in these upland areas have developed under a cooler, moister climatic regime and have thinner topsoil horizons than those commonly found lower on the plateau (Barker 1982). Alfisols do, however, have a protective organic litter layer of decomposing needles, branches and twigs, which adds to their fertility, water and nutrient transmissivity, and soil development. Forest soils can have clay hardpan subsurface horizons which, if they lie directly on crystalline bedrock on steep terrain, are prone to slope failure and mass wasting, particularly when their topsoil is disturbed or removed (Jones et al. 1997; McGreer 1981). This occurs in the lower/upper North Fork AUs and Lolo/Middle Fork AUs in the central and eastern parts of the subbasin. Unstable Alfisols are also noted on the western part of the plateau in the area of Winchester State Park at the head of Lolo creek and in the northern part of the Potlatch River drainage in the Lower Clearwater AU.

Soils that have developed from volcanic ash become more abundant with an eastward progression through the subbasin, and in some areas are considered to represent the parent material. These soil types, also referred to as Andisols, are less homogenous than those on the plateau, and vary widely in terms of their productivity and erosivity (Soil Survey Staff 1975). Ash-derived soils are common in the upper and lower North Fork AUs, and, when combined with topographic and climatic features, contribute to high levels of vegetative productivity (Wilson et al. 1983). The erosive resistant properties of these soils may, however, be compromised where the topsoil is disturbed or where little cohesiveness exists in subsurface horizons (G. Hoffman, NRCS, personal communication February 27, 2001).

Characteristics of structural or stream breakland soils, common throughout the central and eastern portions of the subbasin, differ spatially, but share a common theme of being among the most erodible of soils found in the subbasin. Their erosivity results largely from the high porosity caused by extensive gravel, cobble, or sand content. In the South Fork AU, where schist, granite, and gneiss comprise the dominant parent materials, primary soils vary in depth and texture (Ford et al. 1997). Soils occurring on breaklands in the Lower Selway AU, such as those in the Meadow Creek HUC, are similar to those in the South Fork AU: they vary in depth and have textures ranging from silt loams to very gravelly loams (Ford et al. 1997). Where granite is the dominant parent material in breakland landforms, such as in the Upper Selway AU and along the mainstem Lochsa River, breakland soils tend to be weakly developed, vary in depth, and maintain porous surface and subsurface textures due to silt, gravel, sand, and cobble content (Ford et al. 1997). Many of these soil types may be classified as Mollisols, which grade into volcanic ash in areas of increased relief.

High elevation, subsurface soil forming environments in the Idaho batholith portion of the Clearwater and Bitterroot mountains are typically moist and cold. The soils in these areas are considered to be submature, or Inceptisols, based on their retarded state of development. A thin layer of organic matter covered by a weak layer of topsoil is typical of surface components, while noncohesive coarse sand and gravels intermixed with volcanic ash form subsurface horizons. Where granitic parent material occurs on these landscapes, such as in the Lochsa, upper Selway and upper North Fork AUs, soil types are often characterized by grus. This chemically weathered granitic product is noncohesive, coarse-grained, and highly mobile. Where schist is the dominant high elevation parent material, such as in the lower Selway AU and lower/upper North Fork AUs, soil textures are finer, consisting of silt loam on the surface and silty clay loam in the subsurface.

4.6 Sedimentation

Movement of soils from hillslopes or streambanks into stream channels is a natural process with which aquatic species have evolved. Addition of sediment to the channel may occur through surface erosion, gully erosion, soil mass movement and stream channel erosion (Brooks 1991). In the Clearwater, these processes differ both spatially and temporally and influence aquatic and terrestrial habitats in different ways. Processes of sedimentation in the Clearwater also change along an elevational gradient. Within the subbasin, variations in geology, topography, climate, soil character and soil cover characteristics are influenced by elevation, and act singularly or collectively to drive the frequency, magnitude, and process of sedimentation in streams and rivers.

When factoring in the different biophysical characteristics and processes, the characterization of sedimentation at the scale of the Clearwater subbasin becomes a modeling exercise. Various modeling approaches were used to examine different forms of sedimentation, based on their ability to provide accurate information for the subbasin at a level of detail appropriate for use in the assessment. Models which could not be used across the entire subbasin were not considered for this assessment. Due to the limitations of modeling sedimentation across broad scales, results presented provide only comparative indices for general planning purposes. The resolution of these data is not sufficient to support site specific prescriptions.

Surface erosion processes are discussed using models derived during the Interior Columbia Basin Ecosystem Management Project since they were the only models found to describe surface erosion in a scientifically defensible manner across the entire subbasin. To provide an overview of mass wasting potential, a locally developed landslide hazard model developed by the University of Idaho and Potlatch Corporation was used. In addition, a third model developed by the WSU Center for Environmental Education was used to examine the likelihood that sediment, once mobilized, would enter a stream channel.

Surface Erosion

Surface erosion, also referred to as overland flow, occurs when water or wind detachs sediment particles and small aggregates (Dunne and Leopold 1978). This type of erosion is induced by rainsplash, sheetwash, rill, concentrated overland flow and wind transport. Surface erosion tends to be greatest in non-forested environments.

An examination of the base (inherent) surface erosion hazard data for the subbasin shows that the hazard is highest in the central and easternmost portions of the subbasin (Figure 11). This analysis ignores the role of vegetation cover, and is based only on the Modified Soil Loss Equation (MSLE), slope, rainfall intensity, and surficial geology. The lowest base surface erosion hazard ratings occur in the Lower Clearwater AU, the Lolo/Middle Fork AU and the South Fork AU. Inclusion of the variable 'vegetation cover' yields a much different picture of expected surface erosion hazard ratings in the Clearwater subbasin. Ratings are highest in the Lower Clearwater, Lolo/Middle Fork and Lower North Fork AUs, and lowest in the South Fork and Lochsa AUs (Figure 12). It is widely accepted that realized surface erosion within the Clearwater subbasin is greatest in the agricultural areas in the western portions of the subbasin, consistent with Figure 12.

Comparison of information presented in Figure 11 and Figure 12 is critical for future planning efforts. The relative impact of land management activities on surface erosion processes is expected to be most substantial in the agricultural lands in the western portion of the subbasin, and in the mountainous eastern portions of the subbasin, where soil and topographic conditions lead to a high likelihood of surface erosion following devegetation through timber harvest, roading, or other activities.

Mass Wasting Erosion Hazard

The Clearwater subbasin's inherently high erosion hazard is largely due to its steep slopes and unstable border or batholith parent material. These conditions, combined with high intensity storm events and soil disturbance, favor mass wasting processes throughout the central and eastern portions of the subbasin.

Several classifications of mass movements are distinguishable based on their mechanisms of movement. Among the most prevalent in the Clearwater subbasin are slides, planar failures (debris slides), rotational failures (slumps), flows, debris avalanches, debris flows, and soil creep. Cursory analyses of ICBEMP data suggest that slides, planar failures, avalanches, and debris flows are most common in the high-relief, eastern portion of the subbasin, while slumps and soil creep are more prevalent throughout central regions. The predominance of clay rich soils, which converge with steep slopes, may account for the occurrence of slumping types of mass wasting in the central subbasin, while the dominance of granular, noncohesive soils on steep slopes may relate to the preponderance of slides, flows, and avalanche sedimentation in the eastern subbasin.

While documentation of the cause (e.g. McClelland et al 1997; 1998; Huntington 1998), occurrence (e.g. Megahan et al. 1978), and effects (e.g. Pipp et al. 1997; Falter and Rabe 1997; Huntington 1998), of mass wasting has been made throughout portions of the subbasin, efforts often were limited in their treatment of the entire Clearwater drainage. Mass wasting hazard models developed for the Clearwater subbasin by the University of Idaho and Potlatch Corporation (Miller et al. 2001) provides a subbasin-wide hazard analysis of mass wasting.

The UI/Potlatch landslide hazard model was developed more recently than available ICBEMP data regarding mass wasting, and used data collected primarily within the boundaries of the Clearwater subbasin. The model incorporates aerial photo interpretation and field identification of 3,046 landslide scars. Although the majority of these landslides were associated with the severe rainstorms that occurred in late 1995 and early 1996, the survey also assessed scars predating the 1995/1996 events. Geologic parent material, slope, aspect, elevation and land use attributes were related to landslide occurrence through a logistical regression analysis. High slopes, rain-on-snow elevations, and the presence of older roads or bare ground were landscape attributes found to be the most highly correlated with landslide occurrence. Schist and quartzite parent materials and southern aspects were also positively correlated with landslide

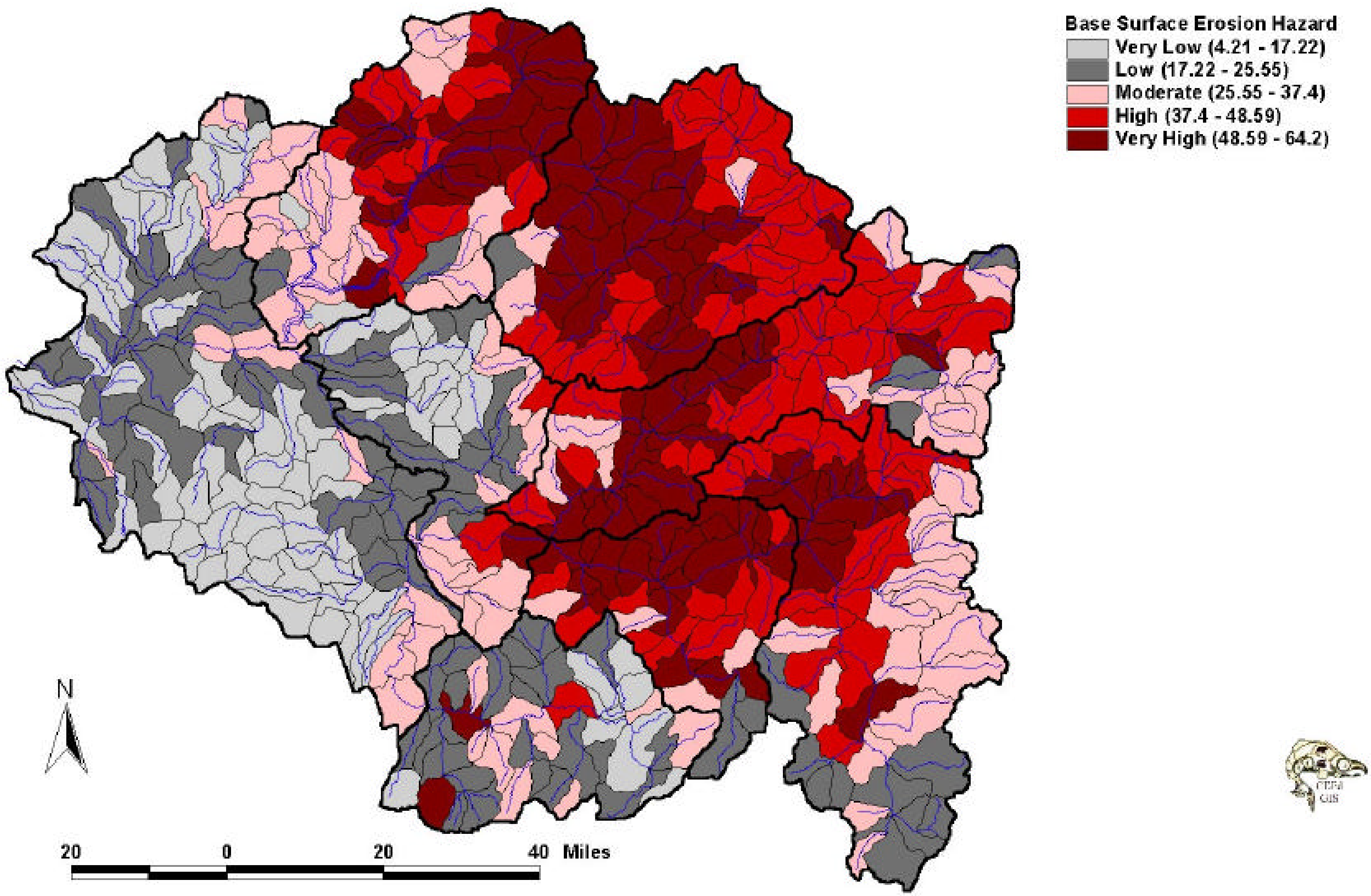

Figure 11. Base surface erosion hazard in the Clearwater subbasin. Data is taken from ICBEMP and incorporates the Modified Soil Loss Equation (MSLE), slope, rainfall intensity, and surficial geology in its derivation

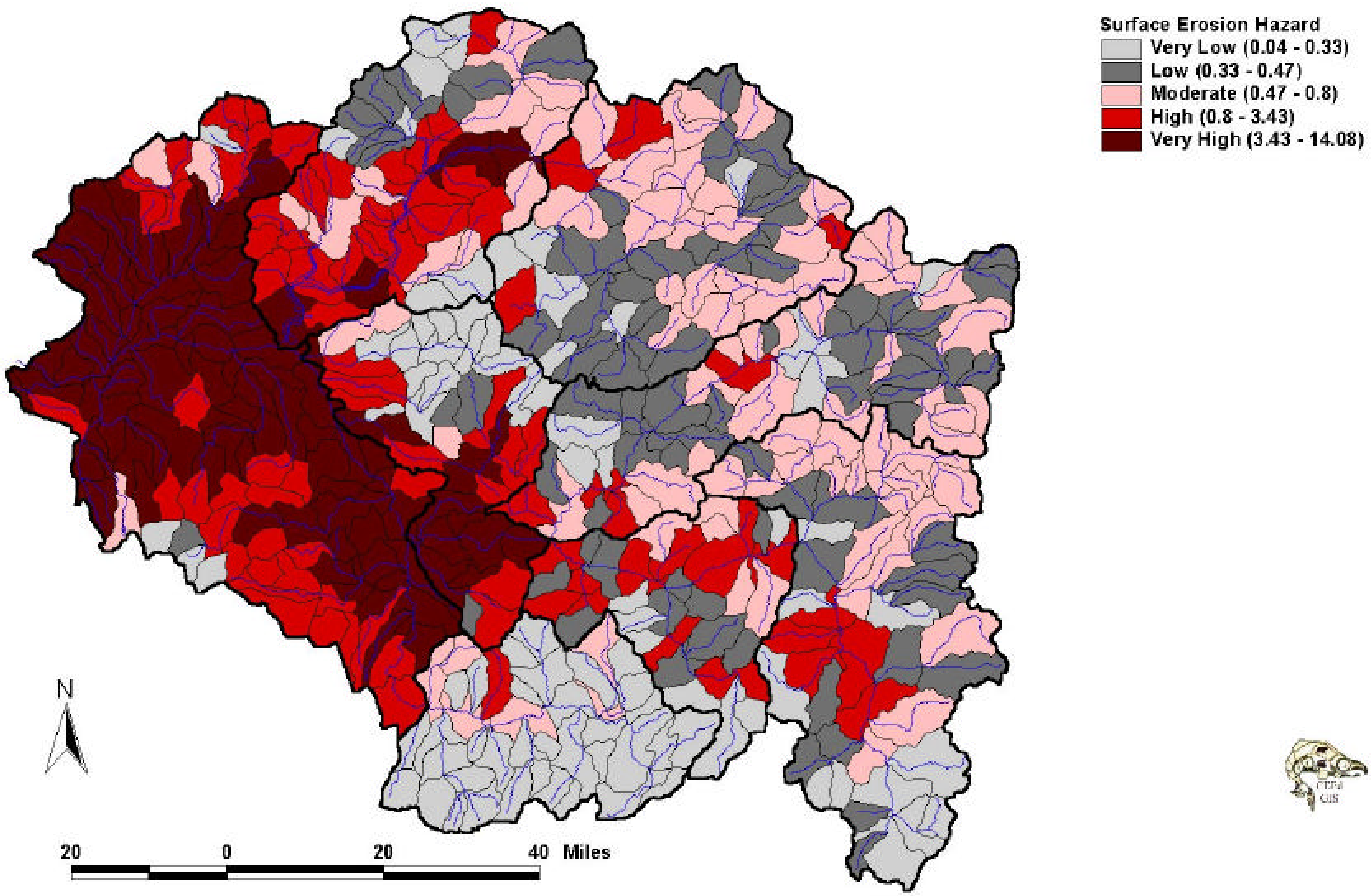

Figure 12. Surface erosion hazard in the Clearwater subbasin. Data is taken from ICBEMP and incorporates the Modified Soil Loss Equation (MSLE), vegetation cover types, slope, rainfall intensity, and surficial geology in its derivation

occurrence, though to a lesser degree (for an indepth discussion of assumptions, equations, and other quantitative data used in the UI/Potlatch model, refer to Miller et al. 2001).

To apply the UI/Potlatch model at a subbasin scale, we used data on geologic parent material, slope, aspect and elevation, since these variables were available at an appropriate resolution across the subbasin. Although road age information was a primary land use variable factored in the UI/Potlatch model, it was not uniformly available across the subbasin, and therefore prohibited inclusion of roading impacts in the modeling exercise. Model outputs therefore represent natural landslide potential, without the influence of road building activity.

Figure 13 depicts relative landslide hazard throughout the subbasin by measuring the percentage of a given 6th field HUC with moderate to high landslide potential. Generally, inherent landslide hazard is rated low throughout many of the upland portions of the subbasin, and highest along primary tributaries or trunk streams. Sixth field HUCs with the greatest percentage of their area classified as moderate to highly susceptible to landslides are clustered around the confluence of the Lochsa and Selway Rivers, the Middle Fork AU, and throughout the lower portions of the upper North Fork Clearwater AUs. Sixth-field HUCs not considered to be at high or moderate risk of landslide are clustered along glaciated and mountainous landforms bordering the Lochsa, upland portions of the Selway and South Fork AUs, and in the Camas and Weippe prairie regions.

Potential Sediment Source Zone

The influence of topography on sedimentation processes is significant, and when considered at a landscape scale, may effectively define inherent risks of various management actions. Definition of the topographic features immediately adjacent to floodplain areas and/or active channels may provide further resolution to the inherent risk of sediment entering a stream. For example, the rough, noncontinuous slopes typical of breakland landforms (high relief) in the subbasin influence sediment transport by decelerating rill and gully erosion and storing eroded material in benchlike depressions proximal to channels (BLM 2000). Conversely, streamside slope gradients in hill and plateau landforms (low relief) are often excessive due to channel incision, and may readily convey sediment to the active channel.

To determine areas throughout the subbasin most likely to transport sediment to a channel following upland soil movement, the potential sediment source zone (PSSZ) model was developed. The model provides an index of vulnerability to sediment entering the active channel or floodplain area. The PSSZ is essentially a variable-width hazard zone around streams defined by the surrounding topography (Figure 14). The intent of the PSSZ model is similar to the "sediment transport efficiency" layer developed by ICBEMP (Quigley and Arbelbide 1997).

The PSSZ index is a cell-based GIS model, using non-linear transformation of slope percent as an impedance cost. Land slope, based on a USGS 30m digital elevation model (DEM), creates an impedance that restricts the width of the source zone on flatter areas (higher impedance) and broadens the width of the zone (lower impedance) on steeper terrain. Arc-Grid command pathdistance was used to determine the distance from the stream over the impedance zone described above. A total impedance cost threshold, or buffer zone width threshold, was used to limit the impedance width of the PSSZ. This creates the variable width PSSZ along the length of the river based on the cross sectional shape of the river valley immediately adjacent to a measured stream. One value of the PSSZ is in determining variable-width buffer zones for protecting streams from sediment inputs.

Figure 15 depicts the percentage of any given 6th field HUC comprised by the PSSZ. Overall, most 6th field HUCs have less than 11% of their total area contained within the PSSZ.

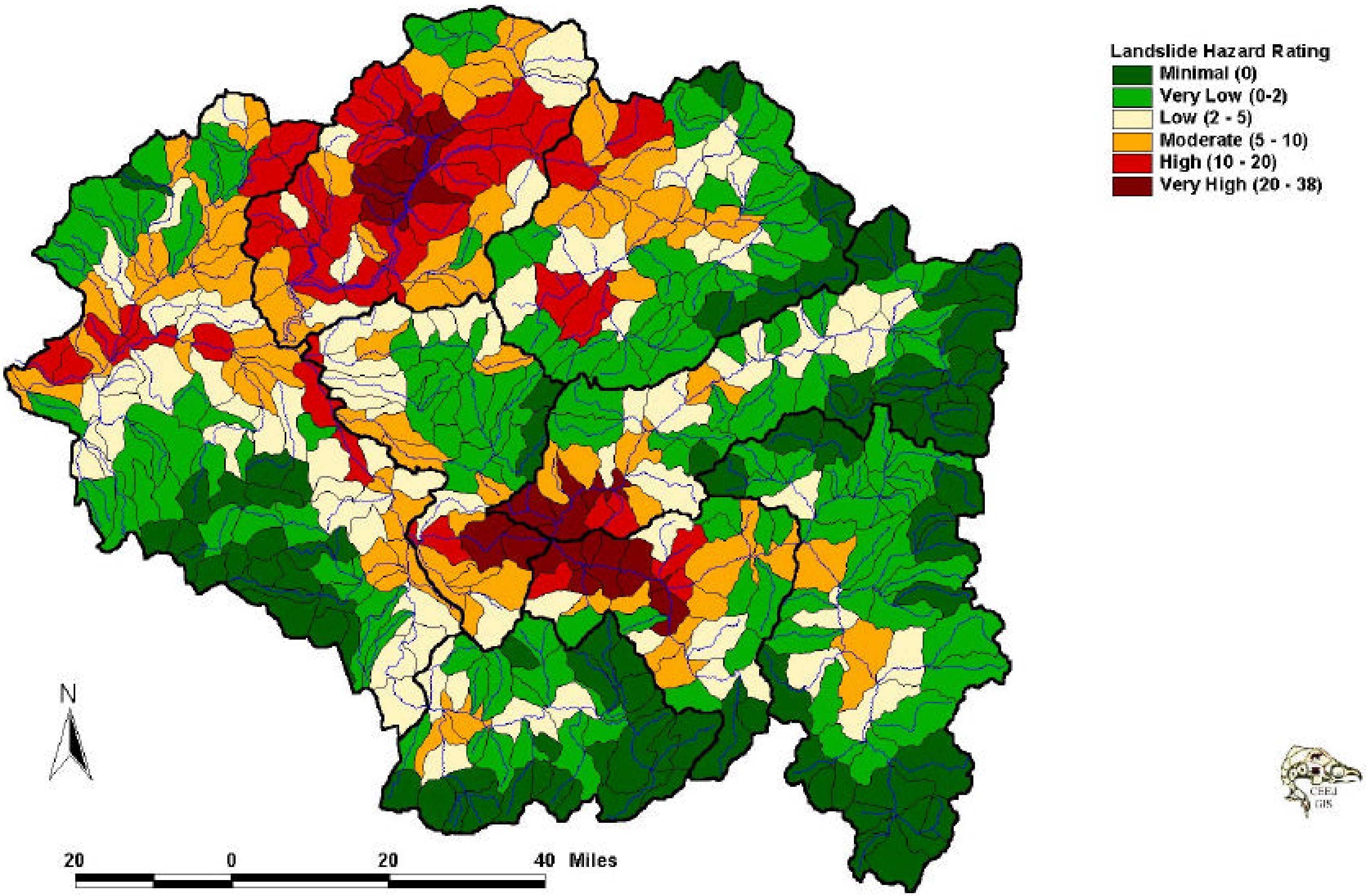

Figure 13. Relative landslide hazard in the Clearwater subbasin, as measured by the percentage of a given 6th field HUC with moderately high to high risk of landslide (adapted from Miller et al. 2001)

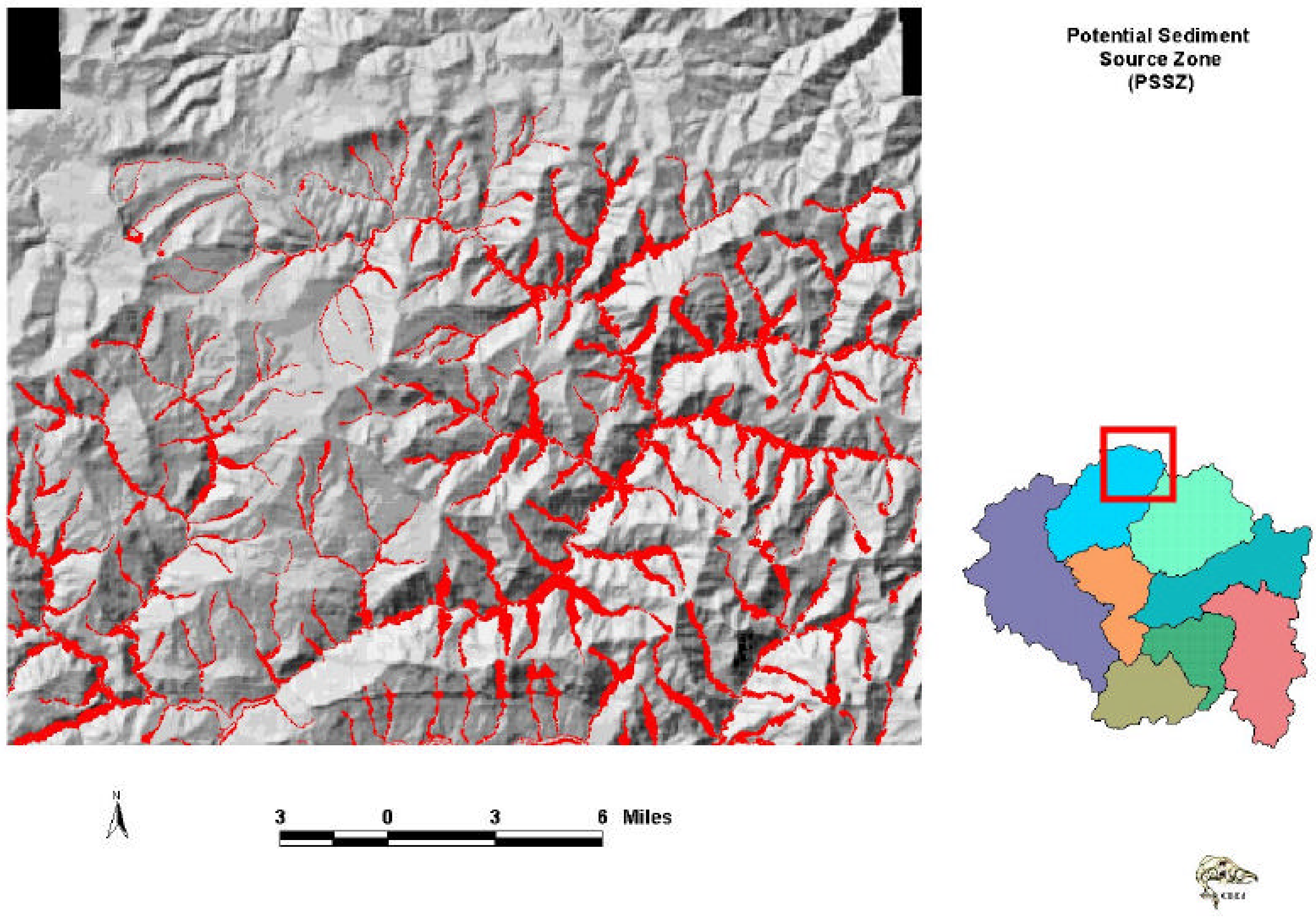

Figure 14. Example of the Potential Sediment Source Zone model output as it applies to a section of the Lower North Fork AU

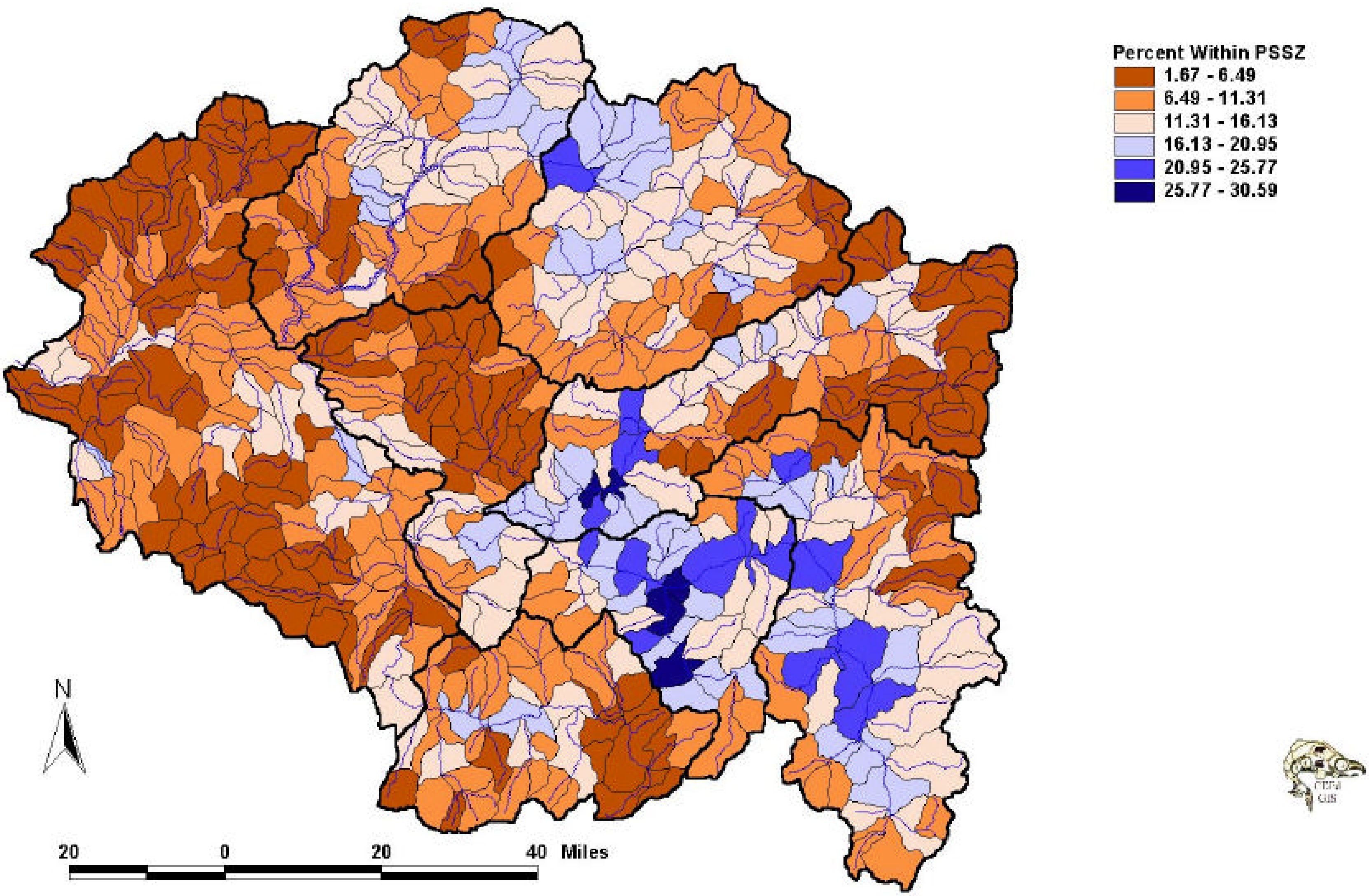

Figure 15. Percent of area, as stratified by 6th field HUC, that is within the Potential Sediment Source Zone

Based on the percentage of HUC area within the PSSZ, mobilized sediment is most likely to be conveyed to stream channels in the lower and upper Selway AUs and in downriver portions of the Lochsa AU. Similarly, PSSZs comprise relatively high percentages of 6th field HUCs upriver from Dworshak Reservoir and in mainstem portions of the South Fork Clearwater River.

4.7 Hydrology

The mainstem Clearwater River originates in the Bitterroot Mountains at elevations ranging from 8,400-9,000 feet (2,560-2,743 m). The Clearwater River contributes approximately one third the flow of the Snake River and ten percent of the flow of the Columbia River system annually (USFS 1969 cited in Maughn 1972), with a mean annual discharge of approximately 15,300 ft^3/s near its mouth (Lipscomb 1998).

The Clearwater derives its flow from a network of tributaries, four of which are primary (North and South Forks, and Lochsa and Selway rivers). The Selway and Lochsa rivers both originate at the Idaho–Montana border in the Selway Bitterroot divide and flow in a westerly to northwesterly direction through precipitous breaklands and forested canyons to their junction at Lowell, ID. The confluence of the Lochsa and Selway form the Middle Fork of the Clearwater, which flows in a westerly direction before joining the South Fork Clearwater at the town of Kooskia, ID. From this point on, the river is known as the mainstem Clearwater. The Clearwater continues to flow in a westerly to northwesterly direction through sparsely vegetated and weathered canyonlands to the town of Ahsahka, where the North Fork of the Clearwater enters. From Ahsahka, the Clearwater River courses through semi-arid canyons and agricultural land until joining the Snake River at Lewiston, ID.

4.7.1 Flood Regime

Major flood events occurred within the subbasin in 1919, 1933, 1948, 1964, 1968, 1974, and the winter/spring of 1995/1996 (McClelland et al. 1998). Stream records are not available for the 1919 event. Each of these flood events was defined based on flows recorded at the mouth of the Clearwater River (Table 9). Table 9 presents the flows recorded at various areas throughout the subbasin during these events, and illustrates the high degree of spatial variability in discharge throughout the Clearwater subbasin. The 1934 flood event appears to have been driven primarily by events originating in the North Fork Clearwater River, with relatively low flows in the South Fork Clearwater, Lochsa, and Selway AUs. Similarly, in comparing flood events of similar magnitude in the Lower Clearwater River (i.e. 1957 vs. 1964 or 1933 vs. 1938), substantial differences can be seen in the corresponding discharge from individual AUs. This data illustrates the importance of considering local hydrologic conditions in project planning and development, and accounting for the variable climatic conditions within the Clearwater subbasin which contribute to annual runoff conditions.

4.7.2 Gauging

There are a total of fifty-three gauging stations in the Clearwater subbasin. The stations are widely distributed and occur in all assessment units. Seventeen out of the fifty-three stations have only peak or historical records, and only twelve of the stations are currently active. The gauging station on the Selway River near Lowell, Id (#13342500) represents the longest period of record(70 years). The shortest period of record is at the Walton Creek Station near Powell Ranger Station (#1336635), which has collected data for only three months (Table 10).

Table 9. Comparison of discharge at various locations throughout the Clearwater subbasin during major flood events measured near the mouth of the Clearwater River

Location	1933	1934	1938	1948	1957	1964	1974
Lower Clearwater AU							
Clearwater R. at Spalding	136,000	172,000	134,000	177,000	143,000	141,000	131,000
Clearwater R. at Orofino	81,500	----	72,300	----	----	----	85,800
Potlatch River at Kendrick	----	----	----	13,000	8,500	3,800	----
Lower North Fork AU							
North Fork Clearwater R. near Ahsahka	46,700	100,000	62,700	55,600	40,600	41,800	----
Upper North Fork AU							
North Fork Clearwater R. near Bungalow Ranger Station	----	----	----	27,400	16,300	21,400	----
Lolo/Middle Fork AU							
	No Data Available						
Lower Selway AU							
Selway R. near Lowell	33,800	20,500	32,800	48,900	26,500	43,400	43,100
Upper Selway AU							
	No Data Available						
Lochsa River AU							
Lochsa R. near Lowell	34,800	22,500	24,500	34,600	21,100	35,100	32,000
South Fork AU							
South Fork Clearwater near Grangeville	6,090	2,380	6,740	12,600	8,910	----	----
South Fork Clearwater near Stites	----	----	----	----	----	17,500	6,750

The primary tributaries supplying the majority (>60%) of flow to the Clearwater are relatively similar in drainage area yet differ substantially in flow contribution (Table 11). Smaller tributaries that provide important supplemental flows to the mainstem Clearwater River include the Potlatch River, Lapwai Creek, Big Canyon Creek, Lolo Creek, Orofino Creek, and Lawyers Creek.

Mean monthly flows for select active gauging stations are shown in Table 12. Records indicate that peak flows generally occur in May and June. Base flows occur most often in August and September, corresponding with times when instream temperatures are highest and precipitation is lowest in much of the Clearwater subbasin.

In lower elevation areas, occasional thunderstorms occur from late spring through summer which may result in flash floods that produce annual peak flows in localized areas (USACE 1967). However, thunderstorms are generally brief in duration and of limited size, resulting in highly localized impacts.

Timing, duration, and volume of peak flows are driven by snowmelt or seasonal rainstorms at lower elevations (<4,000') in the Clearwater subbasin. Therefore, interannual variability in both timing and volume of peak flows is much greater than that at higher elevations. Rainstorms having the greatest impacts to hydrology at lower elevations occurduring winter or spring, when rain falls on frozen or snow covered ground (USACE 1967). These rain-on-snow events can occur from November through March (Thomas et al. 1963), and may result in hydrograph peaks throughout this period. Table 13 shows the magnitude and frequency of instantaneous peak flows at gauging stations in the Clearwater subbasin.

Table 10. Period of record (in bar chart) for all USGS gaging stations in the Clearwater River subbasin

Station Number	Station Name	Period of records in years (00 02 04 06 08 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 00)
13335690	Selway River Abv Moose Creek Nr Moose Creek R. S.	
13335700	Moose Creek At Mouth Nr Moose Creek Ranger Station	
13336000	Selway River Ab Meadow Creek Nr Lowell Id	
13336100	Meadow Creek Nr Lowell Id	
13336300	Gedney Creek Nr Selway Falls Guard Station Id	
13336450	Rackcliff Creek At O'Hara Guard Station Id	
13336500	Selway River Near Lowell, Id	
13336600	Swiftwater Creek Nr Lowell Id	
13336635	Walton Creek Nr Powell Ranger Station Id	
13336650	Ef Papoose Creek Nr Powell Ranger Station Id	
13336800	Warm Spring Creek Nr Powell Ranger Station Id	
13336850	Weir Creek Nr Powell Ranger Station Id	
13336900	Fish Creek nr Lowell Id	
13337000	Lochsa River Near Lowell, Id	
13337100	Clear Creek Nr Kooskia Id	
13337200	Red Horse Creek Nr Elk City Id	
13337500	Sf Clearwater River Nr Elk City Id	
13337540	Leggett Creek Nr Golden Id	
13337700	Peasley Creek Nr Golden Id	
13338000	Sf Clearwater River Nr Grangeville Id	
13338200	Sally Ann Creek Nr Stites Id	
13338500	South Fork Clearwater River At Stites, Id	
13338800	Lawyer Creek Nr Nezperce Id	
13339000	Clearwater River At Kamiah Id	
13339500	Lolo Creek Nr Greer Id	
13339700	Canal Gulch Creek At Pierce Ranger Station	
13339800	Orofino Creek Nr Orofino Id	
13339900	Deer Creek Nr Orofino Id	
13340000	Clearwater River At Orofino, Id	
13340500	Nf Clearwater River At Bungalow Ranger	

Table 10 (Continued)

Station Number	Station Name	Period of Records in Years 00 02 04 06 08 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 00
13340600	North Fork Clearwater River Near Canyon	
13340615	Beaver Creek Nr Canyon Ranger Station Id	
13340760	Little Nf Clearwater River Nr Elk River Id	
13340780	Breakfast Cr eek Nr Elk River Id	
13340855	Reeds Creek Nr Headquarters Id	
13340950	Dworshak Reservoir Nr Ahsahka, Id	
13340999	Nf Clearwater R - Peck Minus Orofino	
13341000	Nf Clearwater River At Ahsahka Id	
13341002	Test Site For Base Q (13341002)	
13341050	Clearwater River Near Peck, Id	
13341100	Cold Springs Creek Nr Craigmont Id	
13341128	Long Hollow Creek At Nezperce Id	
13341200	Ef Potlatch River Bl Mallory Creek Nr Bovill Id	
13341300	Bloom Creek Nr Bovill Id	
13341400	Ef Potlatch River Nr Bovill Id	
13341500	Potlatch River At Kendrick Id	
13341600	Arrow Gulch Nr Arrow Id	
13342000	Mission Creek Nr Winchester Id	
13342200	Twenty One Ranch Spring Nr Waha Id	
13342450	Lapwai Creek Near Lapwai, Id	
13342500	Clearwater River At Spalding, Id	
13343000	Clearwater River Nr Lewiston Id	
13343010	Lindsay Creek Trib No 4 Nr Lewiston Id	

Table 11. Drainage area and runoff of major tributaries in the Clearwater subbasin

Drainage	Drainage Area (sq. mi.)	Drainage % of subbasin	Average Annual Runoff (acre/feet)	Runoff % of subbasin[1]
Selway (7 mi. abv. confl. w/Lochsa)	1,910	20	883,207	16
Lochsa (0.9 mi. abv. confl. w/Selway)	1,180	12	789,095	14
South Fork Clearwater (at Stites, ID)	1,150	12	324,325	6
North Fork Clearwater (nr. Canyon Ranger station)	1,360	14	1,151,065	21

[1]Based on comparison of average annual runoff (5,552,620 acre/feet) measured at the mainstem Clearwater River at Spalding, ID (RM 11.6)

Table 12. Average monthly flows for principle tributaries and portions of the mainstem Clearwater River

Tributary/ Stream Segment	USGS Gauge #	General Location	Period of Record	Average Monthly Flows (cfs)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Selway R.	13336500	nr. Lowell ID	69 yrs.	1277	1555	2255	5998	13380	11910	3168	926	752	964	1298	1439
Lochsa R.	13337000	nr. Lowell ID	70 yrs.	1119	1303	1840	4854	10200	8395	2210	677	562	747	1091	1247
SF Clearwater	13338500	@ Stites, ID	34 yrs.	542	651	1003	2085	3304	2512	828	293	245	282	362	462
Lolo Cr.	13339500	nr. Greer, ID	20 yrs.	232	443	634	890	771	417	146	60	61	78	172	189
Clearwater R.	13340000	@ Orofino, ID	40 yrs.	4176	5133	7798	15550	28880	24450	6764	2141	1794	2139	3227	3934
NF Clearwater	13340600	nr. Canyon R.S.	30 yrs.	1837	2374	3222	6168	10910	8408	2684	1160	947	1039	1641	1864
Clearwater R.	13341050	nr. Peck, ID	33 yrs.	9869	11150	15020	21990	38470	34010	13050	6643	6627	4388	7033	9178

Table 13. Magnitude and frequency of instantaneous peak flow at gauging stations in Clearwater River subbasin

Station Number	Station Name	Period of Record	Discharge, in cfs based on the period of record for indicated recurrence interval in years and exceedance probability in percent							
			2 50%	5 20%	10 10%	25 4%	50 2%	100 1%	200 0.5%	500 0.2%
13336500	Selway River near Lowell	1911,1930-99	25,800	33,100	37,500	42,600	46,200	49,500	52,700	56,800
13336900	Fish Creek near Lowell	1958-67	1,710	2,030	2,220	2,440	2,590	2,740	2,880	3,061
13337000	Lochsa River near Lowell	1911-12,38-99	18,800	24,400	28,000	32,500	35,700	39,000	42,100	46,400
13337500	South Fork Clearwater River near Elk City	1945-74	1,940	2,610	3,050	3,610	4,030	4,440	4,870	5,430
13338000	South Fork Clearwater R near Grangeville	1911-20,23-63	5,040	6,800	7,990	9,540	10,700	11,900	13,200	14,900
13338500	South Fork Clearwater River at Stites	1964-99	6,470	9,480	11,600	14,400	16,500	18,800	21,100	24,300
13339000	Clearwater River at Kamiah	1911-65	53,300	67,800	76,500	86,400	93,200	99,700	106,000	114,000
13339500	Lolo Creek near Greer	1980-99	2,220	3,290	3,990	4,870	5,510	6,130	6,750	7,550
13340000	Clearwater River at Orofino	1931-38,65-99	54,300	68,900	77,400	87,200	93,900	100,000	106,000	114,000
13340500	NF Clearwater R at Bungalow Ranger Sta	1945-69	16,300	20,400	23,000	26,100	28,400	30,600	32,800	35,700
13340600	NF Clearwater River near Canyon R.Sta	1967-69,71-99	18,800	24,900	29,000	34,200	38,100	42,000	46,000	51,400
13341000	North Fork Clearwater River near Ahsahka	1927-68	31,100	44,300	53,700	66,100	75,700	85,700	96,000	111,000
13341050	Clearwater River near Peck	1965-97	67,800	87,800	99,900	114,000	124,000	138,000	143,000	155,000
13341300	Bloom Creek near Bovill	1960-71,73-79	58	93	120	159	192	227	266	323
13341400	East Fork Potlatch River near Bovill	1960-71	640	915	1,110	1,370	1,580	1,800	2,020	2,340
13341500	Potlatch River at Kendrick	1945-71	6,160	9,020	11,100	13,900	16,100	18,500	21,000	24,500
13342450	Lapwai Creek near Lapwai	1975-97	798	1,880	2,960	4,800	6,590	8,770	11,400	15,700
13342500	Clearwater River at Spalding	1911-13, 1923-97	79,300	106,000	122,000	141,000	155,000	168,000	180,000	19,600

4.7.3 Modeled Hydrology Data

In 1998, the USGS released a report that modeled monthly and annual discharge for over 1,000 subwatersheds within the Salmon and Clearwater subbasins (Lipscomb 1998). Subwatershed delineations used by Lipscomb (1998) are only roughly comparable to 6th field HUCs used in this assessment, but the data provide a reasonable picture of discharge patterns for general hydrologic characterization. Hydrologic characterization of the Clearwater subbasin relies on this modeled information to present a comprehensive overview of runoff timing, relative runoff quantity, and annual flow variation. Hydrograph patterns derived from Lipscomb's (1998) data are consistent with those described by Maughn(1972), Bugosh (1999), Paradis et al. (1999), Thompson (1999), and the Clearwater National Forest (1997) for smaller areas within the subbasin. It should be noted that because modeled data is based on discharge records from USGS gaging stations, it represents a 'current' situation more accurately than a natural or historic situation.

Advantages and Disadvantages of Using Modeled Flow Data

Although Lipscomb's (1998) data is useful for hydrologic characterization at the subbasin scale, it has both advantages and disadvantages when applied within a decision making process, particularly at smaller scale(s).

Advantages

- Extrapolates from gaged to ungaged subwatersheds allowing for comprehensive characterization of hydrologic condition(s) throughout the entire subbasin.
- Data is compiled by subwatershed, allowing for relatively detailed characterization.

Disadvantages

- Subwatersheds are defined in a manner which does not allow for direct comparison to available hierarchical delineation systems (i.e. USGS HUCs used in this Assessment).
- Basing estimates of ungaged subwatersheds on data from gaged subwatersheds will over- or underestimate discharge where the gaging stations used are impacted by upstream water withdrawls. Impacts of this modeling approach inconsistently influence discharge estimates across the subbasin based on the relative impact of water withdrawls on the gage used in estimation.

Flow Regimes

The hydrology of the Clearwater subbasin varies largely as a result of differences in amount and form of precipitation, which is intrinsically linked to variations in elevation and climatic patterns. Precipitation generally increases from west to east through the subbasin as elevation increases. In areas of similar elevation, precipitation generally decreases from north to south based on the relative influence of maritime (north) or Rocky Mountain (south) climate patterns.

Mean annual discharge is variable throughout the major tributaries of the Clearwater subbasin (Table 14). Mean annual discharge is approximately 1,100 cfs at the mouth of the South Fork Clearwater River, whereas the Lochsa and Selway Rivers produce approximately 2,900 and 3,900 cfs, respectively. Mean annual discharge at the mouth of the North Fork Clearwater is estimated as 5,600 cfs. Mean monthly maximum and minimum discharge follows a similar pattern between major tributaries, with greater discharge occurring from the North Fork, intermediate discharge from the Lochsa, and Selway Rivers, and lowest discharge from the South Fork Clearwater River.

Table 14. Hydrologic characterization of various locations within Clearwater River subbasin Assessment Units (Lipscomb 1998)

Assessment Unit Location	Mean Annual Q (cfs)	Maximum Monthly Q (Month)	Minimum Monthly Q (Month)	Unit Mean Annual Q (cfs/mi.^{2})	Annual Flow Stability [a]
Lower Clearwater AU					
Clearwater R. Mouth	15,000	45,000 (May)	4,000 (August)	1.2 - 1.8	27
Clearwater R. above North Fork	8,800	29,000 (May)	1,800 (September)	1.2 - 1.8	20
South Fork Clearwater R. Mouth	1,100	3,500 (May)	270 (September)	0.8 - 1.2	25
Lower North Fork AU					
North Fork Clearwater R. Mouth	5,600	18,000 (May)	1,300 (September)	1.8 - 2.7	23
Upper North Fork AU					
North Fork Clearwater R. above Dworshak Reservoir	3,300	10,000 (May)	900 (September)	1.8 - 2.7	27
Lolo/Middle Fork AU					
Middle Fork Clearwater R. Mouth	7,000	23,000 (May)	1,500 (September)	1.8 - 2.7	21
Lower Selway AU					
Selway R. Mouth	3,900	14,000 (May)	790 (September)	1.8 - 2.7	20
Upper Selway AU					
Selway/Moose Creek confluence	3,400	13,100 (May)	660 (September)	1.8 - 2.7	20
Lochsa River AU					
Lochsa R. Mouth	2,900	10,000 (May)	570 (September)	1.8 - 2.7	20
South Fork AU					
South Fork Clearwater at lower AU boundary	760	2,800 (May)	160 (September)	0.8 - 1.2	21

(a) Estimated as the percent of mean annual discharge represented by minimum mean monthly discharge

Relative discharge is greatest in the eastern portions of the subbasin, including the upper reaches and tributaries of the North Fork Clearwater and Lochsa Rivers, and some tributaries to the upper Selway River (Figure 16). Unit mean annual discharge in these areas exceeds 2.70 cfs/square mile of drainage area. Relative discharge produced by major tributaries to the Clearwater River is substantially less from the South Fork Clearwater River (0.8-1.2 cfs/sq. mile) than from other major tributaries (1.8-2.7 cfs/sq. mile; Table 14).

Unit mean annual discharge from smaller tributaries typically exceeds 1.20 cfs/square mile in the forested uplands of the five Assessment Units encompassing the North Fork, Lochsa, and Selway Rivers (Figure 16). Lesser discharge is produced from both the South Fork and Lolo/Middle Fork Assessment Units, which produce between 0.60 and 1.19 cfs/square mile from most of the contributing drainage areas. Relative annual discharge produced from smaller tributaries within the Lower Clearwater Assessment Unit rarely exceeds 0.79 cfs/square mile, but may be as high as 1.19 cfs/square mile in portions of the Potlatch River drainage. The lowest relative annual discharges estimated in the Clearwater subbasin are produced from streams within the Camas Prairie area in the southern portions of the Lower Clearwater Assessment Unit, and range from 0.20 to 0.59 cfs/square mile of drainage area.

The timing of peak (monthly mean) stream flow throughout the Clearwater subbasin is variable, occurring from March through June depending on the drainage (Figure 17). Mainstem tributaries throughout the subbasin generally experience peak flows during May, which is later than associated upland areas at lower elevations, and earlier than upland areas at higher elevations. Timing of peak monthly flows from upland areas can be expected in April throughout much of the Lower Clearwater, Lower North Fork, and Lolo Creek/Middle Fork AUs. Mean monthly flows from upland areas within the Upper Selway/Moose Creek and easternmost portions of the Lochsa and Lower Selway AUs typically peak in June. The Upper North Fork, South Fork, and western portions of the Lochsa and Lower Selway AUs typically experience the highest mean monthly flows during May, with the timing of flows from upland areas similar to that in the associated mainstem reaches. The earliest mean monthly peak flows in the Clearwater subbasin (March) occur in Lawyers, Cottonwood, Threemile, and Butcher Creeks which comprise a series of predominantly east-west drainages within the Camas Prairie plateau.

Annual flow variation is greatest in tributaries in the Camas Prairie, where base flows (minimum mean monthly discharge) can be expected to comprise less than 10% of the mean annual discharge in some areas (Figure 18). The most stable annual flows exist in the Lower North Fork AU where base flows make up 37-46% of the mean annual flow in most tributaries flowing into Dworshak Reservoir, with the exception of the Elk Creek system (10-18%). With the exception of the Lower North Fork AU, patterns in annual flow variation follow a similar pattern to other hydrologic regimes, with a gradient from the east (least variable) to the west (most variable).

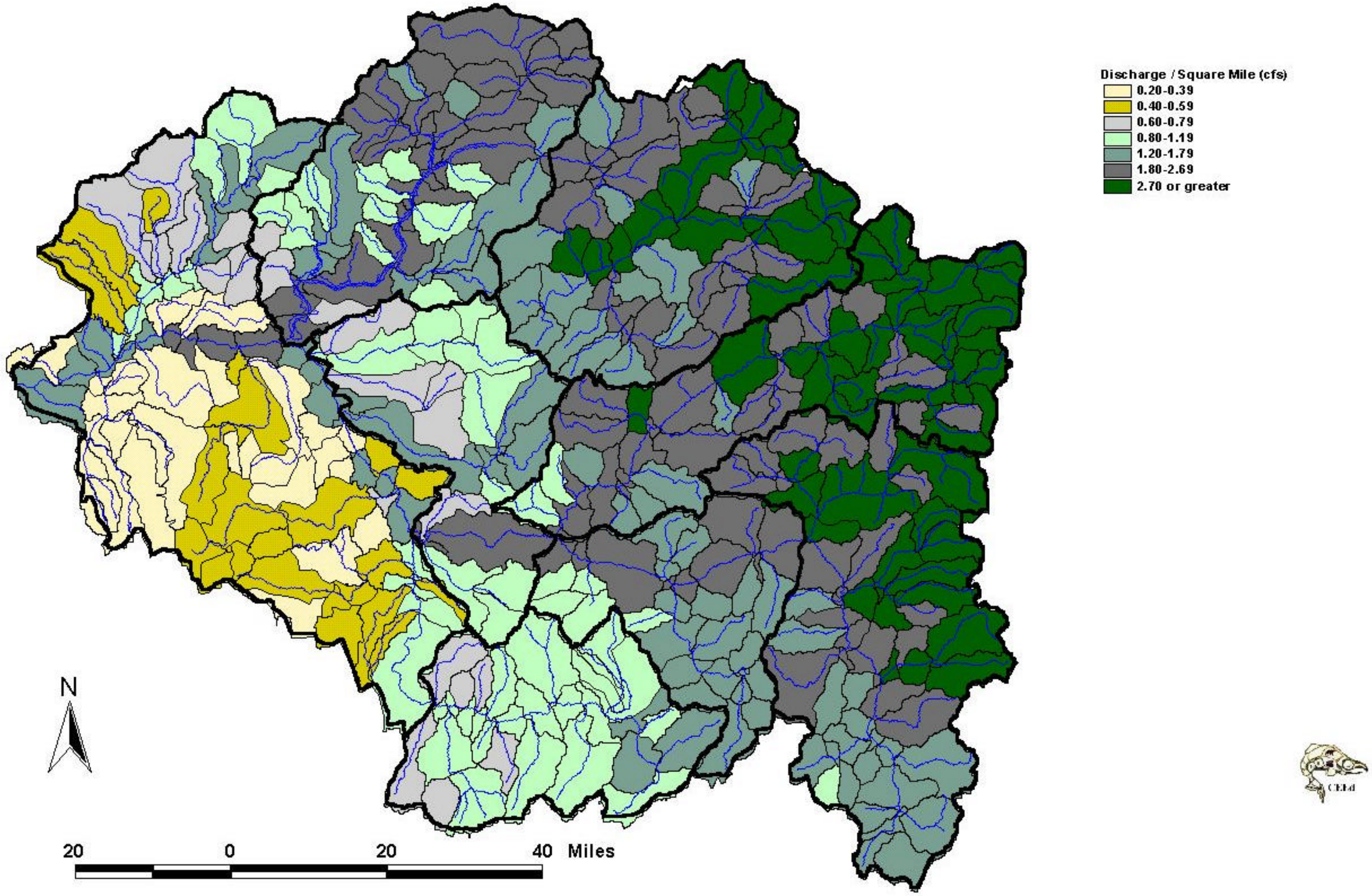

Figure 16. Unit mean annual discharge for the Clearwater subbasin, summarized using subwatersheds defined by Lipscomb (1998)

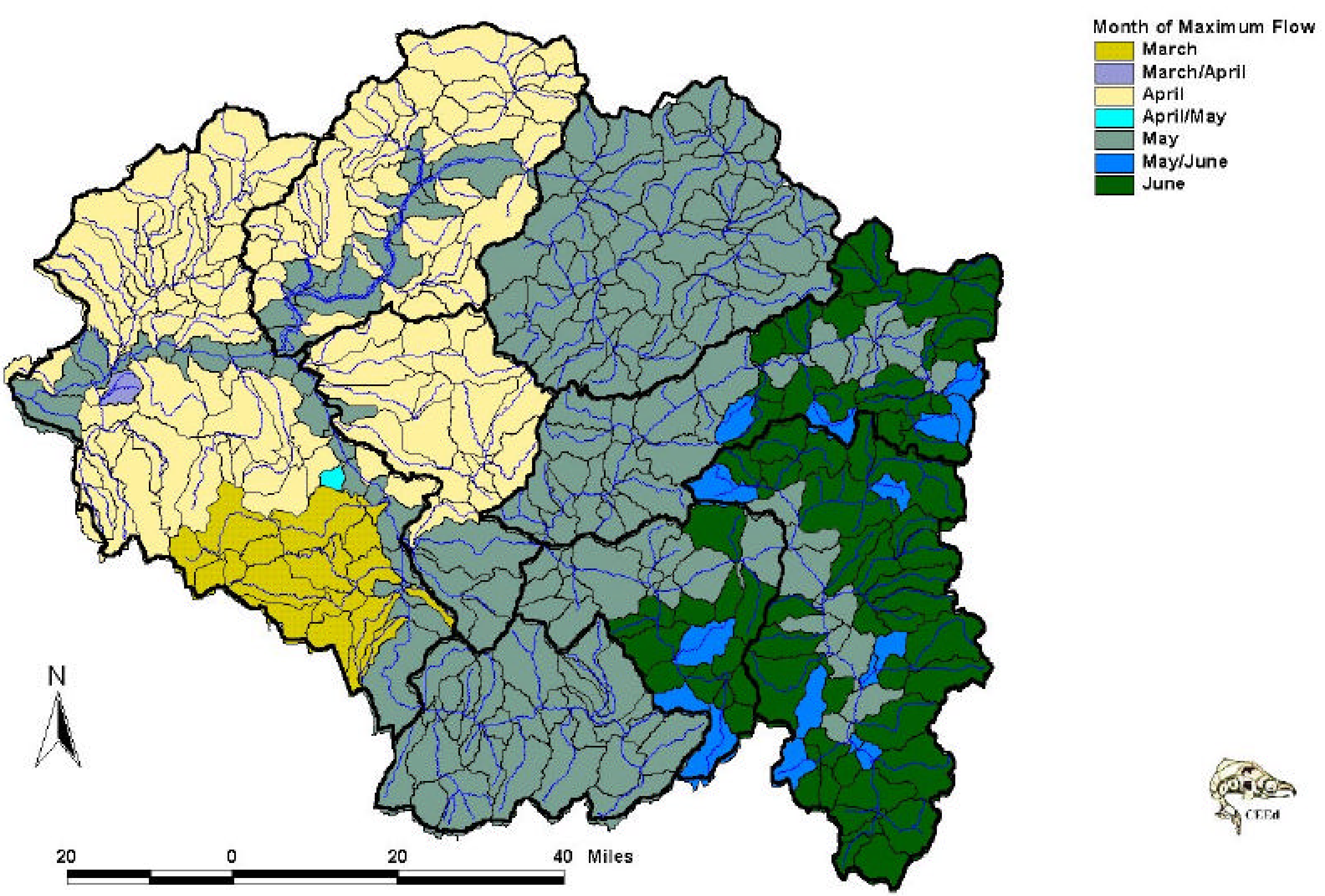

Figure 17. Timing of maximum monthly discharge across the Clearwater subbasin summarized using subwatersheds defined by Lipscomb (1998)

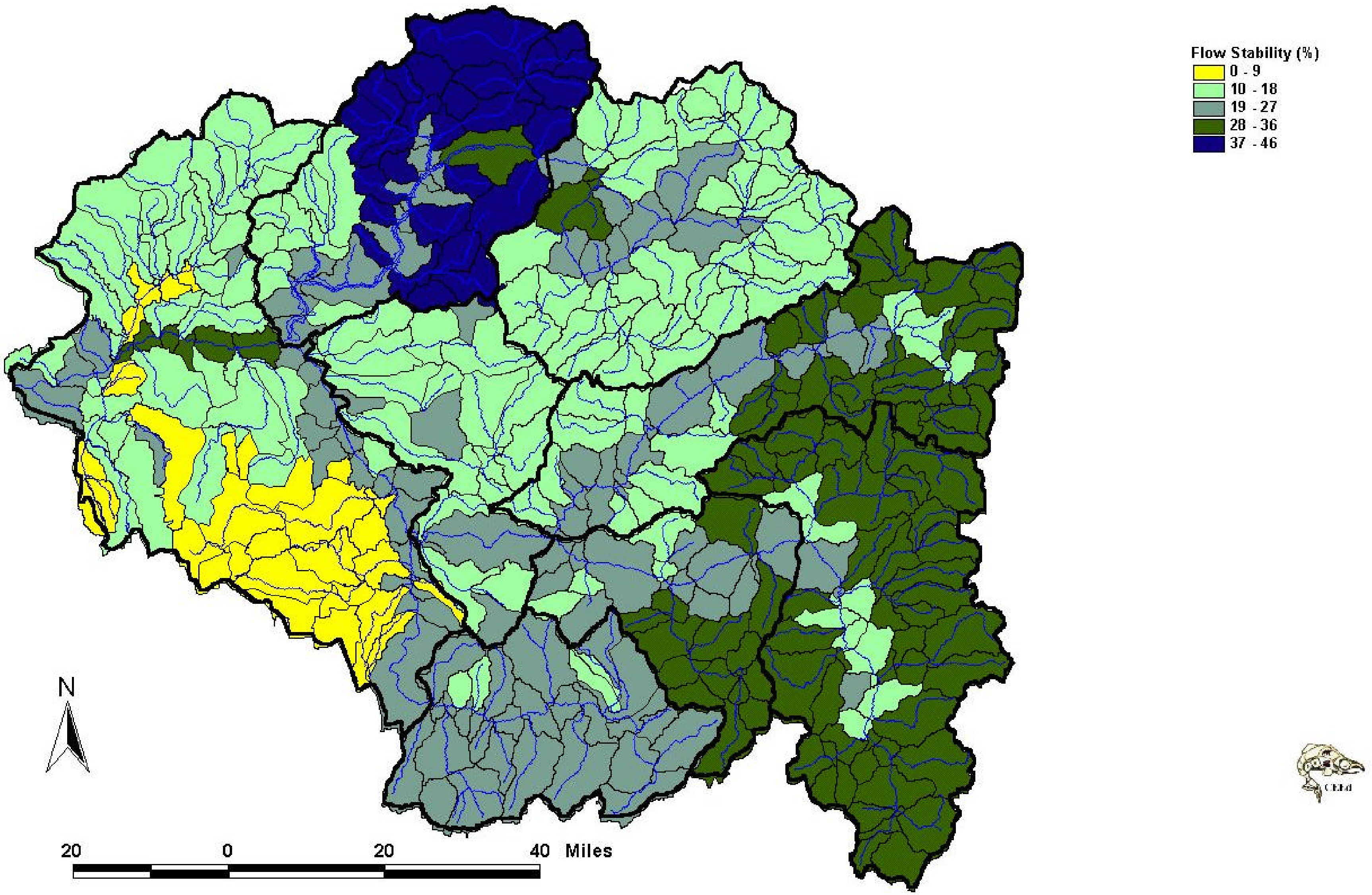

Figure 18. Flow stability for the Clearwater subbasin, summarized using subwatersheds defined by Lipscomb (1998)

4.8 Water Use

No information is available on actual rather than permitted/potential water use across large areas within Idaho. Data regarding potential water use within the Clearwater subbasin was derived from Idaho Department of Water Resources (IDWR) records on both water rights and adjudication claims filed under the Snake River Basin Adjudication (SRBA) process. Since water rights and adjudication data may lead to erroneous information regarding current water use if examined separately, both databases were integrated to produce the most accurate picture of potential current water use. The decision to integrate the two databases was made based on consultation with IDWR Water Rights Supervisor Shelly Keen (personal communication May 23, 2000).

Although water rights existed prior to 1900, the IDWR water rights database underestimates the number of rights existing prior to 1963 for groundwater and 1971 for surface water, when licensing of those rights became formally required. The database also fails to account for changes in water use over time, particularly with regard to abandoned or forfeited claims.

The adjudication claims data supplied by IDWR include only those claims to water rights existing prior to November 19, 1987 filed with the courts as part of the SRBA. The database may include competing claims for the same water right resulting in potential over-allocation of water in some areas, although this was found to be rare within the Clearwater subbasin. In contrast, numerous claims under the SRBA list a lower amount of water than that of the corresponding water right, suggesting that water use diminished over time or the amount licensed under the water right was less than that originally claimed or permitted. In these cases, it was assumed that the amount claimed under the SRBA best represented actual use rather than the amount listed in the water rights database.

To integrate information from both the water rights and adjudication claims databases supplied by IDWR, the following "rules" were applied.

1. Claims filed under the SRBA with illustrated beneficial uses represent real and legal water uses that may not be represented in the water rights database. Such rights may have been in place prior to the current permitting process (1963/1971) or do not require water rights permits under the current process (e.g. small domestic or groundwater uses).
2. Water rights data is assumed to accurately represent water use associated with claims filed after November 19, 1987.
3. Adjudication claims data best represents existing water uses for water rights filed prior to November 19, 1987. Adjudication claims data includes claims to legal non-licensed rights filed prior to 1963/1971 but omits abandoned water rights.
4. Where applicable, reductions in the amount of water claimed (SRBA) provide a more accurate depiction of current water use than information for corresponding water rights.
5. Water rights listed in the water rights database with priority dates prior to November 19, 1987 with no corresponding claim filed under the SRBA are considered abandoned.

Water use for this assessment was summarized as Maximum Allowable Use (MAU) by land section. MAU was determined by summing the maximum legal water use from all water rights or applicable adjudication claims within each section, and is presented in this report as the volume allowed in acre feet per year (AFY). Water use rates (cfs) are presented in this section for comparative purposes only. Water use rates represent the continual (year round) diversion rate necessary to supply the maximal allowable volume, and may differ substantially from those reported in water rights databases if water use is permitted only during a portion of the year. Approximately 724 AFY would be supplied by a source providing 1 cfs continually over the course of one year.

The amount of water available under a water right may be limited by either the rate (cfs) at which water may be drawn under the right, the volume (AFY) allowed to be taken, or both. For determining MAU, the maximum volume allowed (AFY) was compared with the volume that could be drawn under the maximum rate (cfs) limitations of the water right, assuming a constant diversion rate throughout the allowable period of use. MAU was defined as the most limiting (minimum) of these two water use estimates. Where only one factor (rate or volume) limited water use under a particular water right or claim, that factor was used to estimate the MAU for that water right/claim.

Many water rights include numerous points of diversion/take, with no stipulation on how much water can or should be drawn from any single diversion point. Therefore, where water rights or claims have multiple sources included in multiple land sections, the entire amount claimed was included in the MAU for each section. This approach produces an accurate picture of MAU within any single section, but will overestimate the total water use within the watershed if sectional maxima are summed.

Separation of water uses into either instream or out-of-stream uses is difficult, since up to three uses are associated with any given water right or claim. These allowable uses may include both in and out-of-stream uses for the same right, and some uses (e.g. storage for minimum flows) may essentially be both--holding water from the stream at one point in time for release at another time. For these reasons, only information about MAU is presented here. Additional detail about in and out-of-stream uses is available for project planning purposes, but should be examined on a case by case basis as necessary.

4.8.1 Surface Water Use

Surface water use is permitted in all eight AUs within the Clearwater subbasin, but is most prevalent within the Lower Clearwater, Lolo/Middle Fork, and South Fork AUs (Figure 19). With the exception of substantial licensed water rights dedicated to the maintenance of minimum instream flows on the Lochsa and Selway Rivers, surface water use in both of these drainages is limited. Surface water MAU is also substantial at the head of the Middle Fork Clearwater River, the only other stream segment in the Clearwater subbasin with licensed surface water rights designated for maintenance of minimum instream flows. Minimum instream flow requirements have been recommended and applied for on seven additional stream segments in the Lower Clearwater and Upper and Lower North Fork AUs (Figure 19). Surface water rights for these recommended minimum instream flows are yet to be licensed and are therefore not represented in descriptions of MAU presented in Figure 19.

In the Clearwater subbasin, most subwatersheds in which surface water use is permitted contain less than 1,000 AFY (1.4 cfs) of surface water allocation (Figure 19). The highest MAUs (> 400,000 AFY; > 500 cfs) associated with surface water rights are associated with minimum instream flows on the Lochsa, Selway, and Middle Fork Clearwater rivers. Other substantial surface water use (50,000–150,000 AFY; 70-207 cfs) is associated with the Lewiston Orchards Irrigation District’s use of water from the Lapwai Creek system (Lower Clearwater AU), and with Elk Creek Reservoir in the Lower North Fork AU. With the exception of areas near Lewiston, Pierce, and Kooskia where MAU ranges from 10,000 to 35,000 AFY (14-50 cfs), water use in other subwatersheds is generally below 5,000 AFY (7 cfs).

4.8.2 Groundwater Use

Groundwater use in the Clearwater subbasin is less substantial than surface water use in both amount and distribution. The overall distribution of allowable groundwater use is predominantly associated with privately owned portions of the subbasin (Lower Clearwater and Lolo/Middle Fork AUs), and is most likely comprised of municipal and domestic (Figure 20). No groundwater use is permitted in the Selway River drainage or the Upper North Fork AU. Allowable groundwater use in the Lochsa, Lower North Fork, and South Fork AUs is both limited and localized.

Maximum allowable use of groundwater uncommonly exceeds 724 AFY (1 cfs) and does not exceed 4,344 AFY (6 cfs) in any individual land section. Maximum allowable use of groundwater does not exceed 5,864 AFY (8.1 cfs) in any individual subwatershed within the Clearwater subbasin. Where groundwater use does exceed 724 AFY, it is typically associated with municipal water supplies and other uses associated with the towns of Grangeville, Kooskia, Lewiston Orchards, Weippe, and Kamiah (Figure 20).

4.9 Water Quality

To provide an overview of water quality throughout the Clearwater subbasin, summaries were made using data collected at USGS gaging sites. The USGS data was selected for use because it provided consistent and widespread sampling sites with relatively long periods of record for multiple parameters. The USGS data is intended for trend monitoring, and does not supply adequate information for detailed analysis (spatial or temporal) of water quality. Substantial amounts of water quality data exist from other sources within the subbasin which are useful for more detailed analyses, although parameters sampled, locations and period of record are often inconsistent, resulting in more localized applicability. A substantial effort to conduct consistent, coordinated temperature monitoring throughout the Clearwater subbasin has been implemented in recent years, and Idaho Department of Environmental Quality maintains information regarding sampling periods and locations.

U.S. Geological Survey (USGS) water quality data for the Clearwater River drainage was gathered from the National Water Information System (NWIS) and EarthInfo, Inc. databases, as well as the annual Water Resources Data reports for Idaho. Fifty-seven gauging stations were identified within the subbasin where water quality data was, or is still being, collected. Individual data sets vary with respect to the number of data points and parameters, as well as the period of record and sampling intensities.

The seven stations with data for the longest period are detailed in Table 15, and can be subdivided into four broad categories. The first category includes the stations at Peck, Orofino, and the North Fork Clearwater near Canyon Ranger Station. Temperature and specific conductance (conductivity) were the most data-rich parameters at these locations. The second category includes the stations at Selway and Lochsa near Lowell, Idaho. These two sites are closer to the headwaters than the other six, and a suite of analytes were evaluated between 1974 and 1980. Although dated, these sites provide important background information , which is useful for comparing reaches at that time or as baseline data if new monitoring programs are initiated. The third category includes the stations at Stites on the South Fork of the Clearwater and Lapwai Creek near Lapwai, Idaho. These stations were also monitored from the mid 1970s to the early 1980s, but sampling was resumed in the early 1990s for many of the same parameters. The final category belongs to the Spalding gauging station on the mainstem of the Clearwater. This station stands out among the others as having the largest number of analytes and the longest period of record. In addition, many of the parameters evaluated by the USGS at this location were analyzed during limnological studies by researchers at the University of Idaho and Washington State University during the late 1970s and mid 1990s.

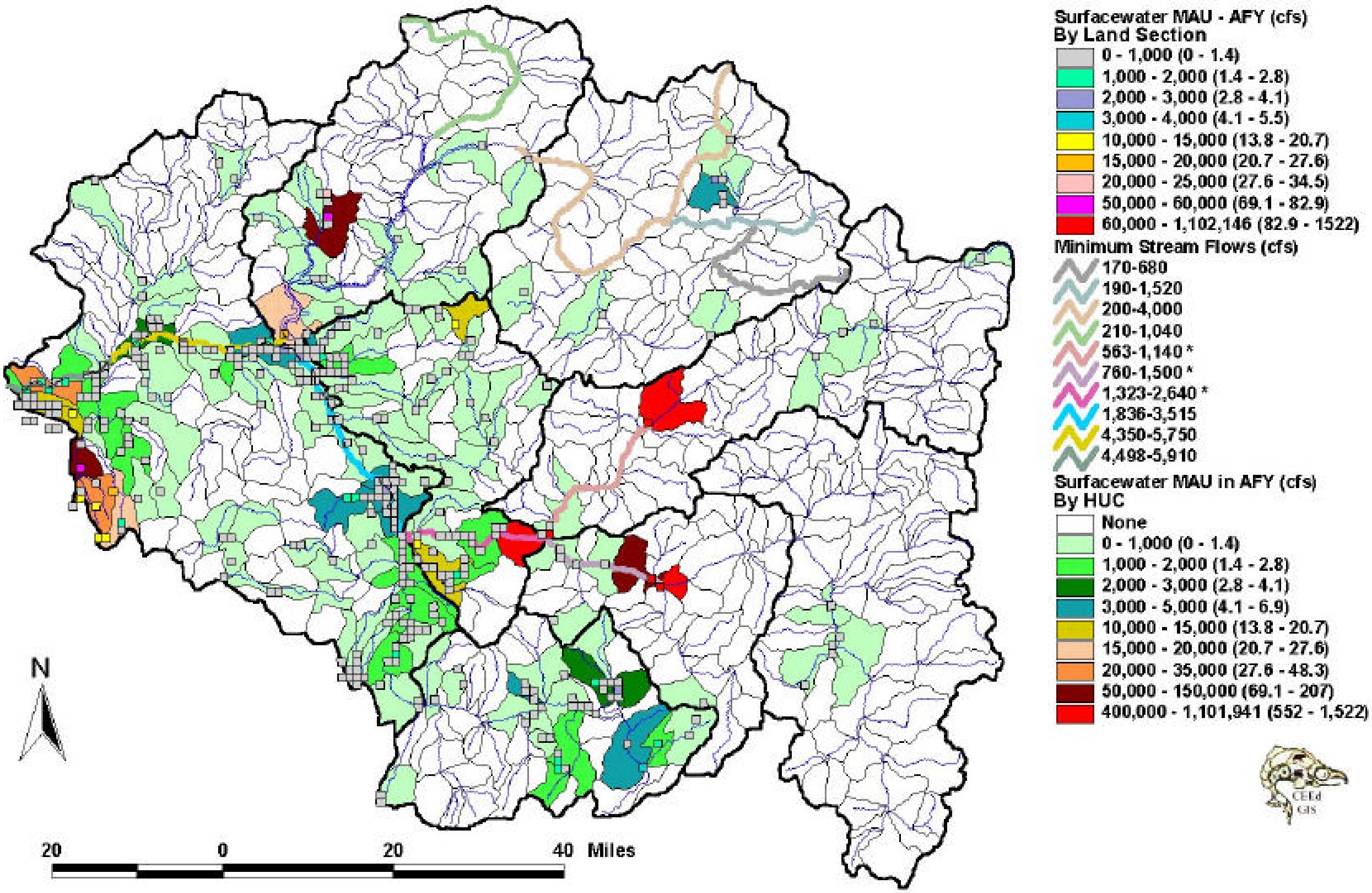

Figure 19. Maximum Allowable Use (MAU) of surface water summarized by both land section and HUC. Minimum instream flows are represented for comparison if either licensed (*) or recommended

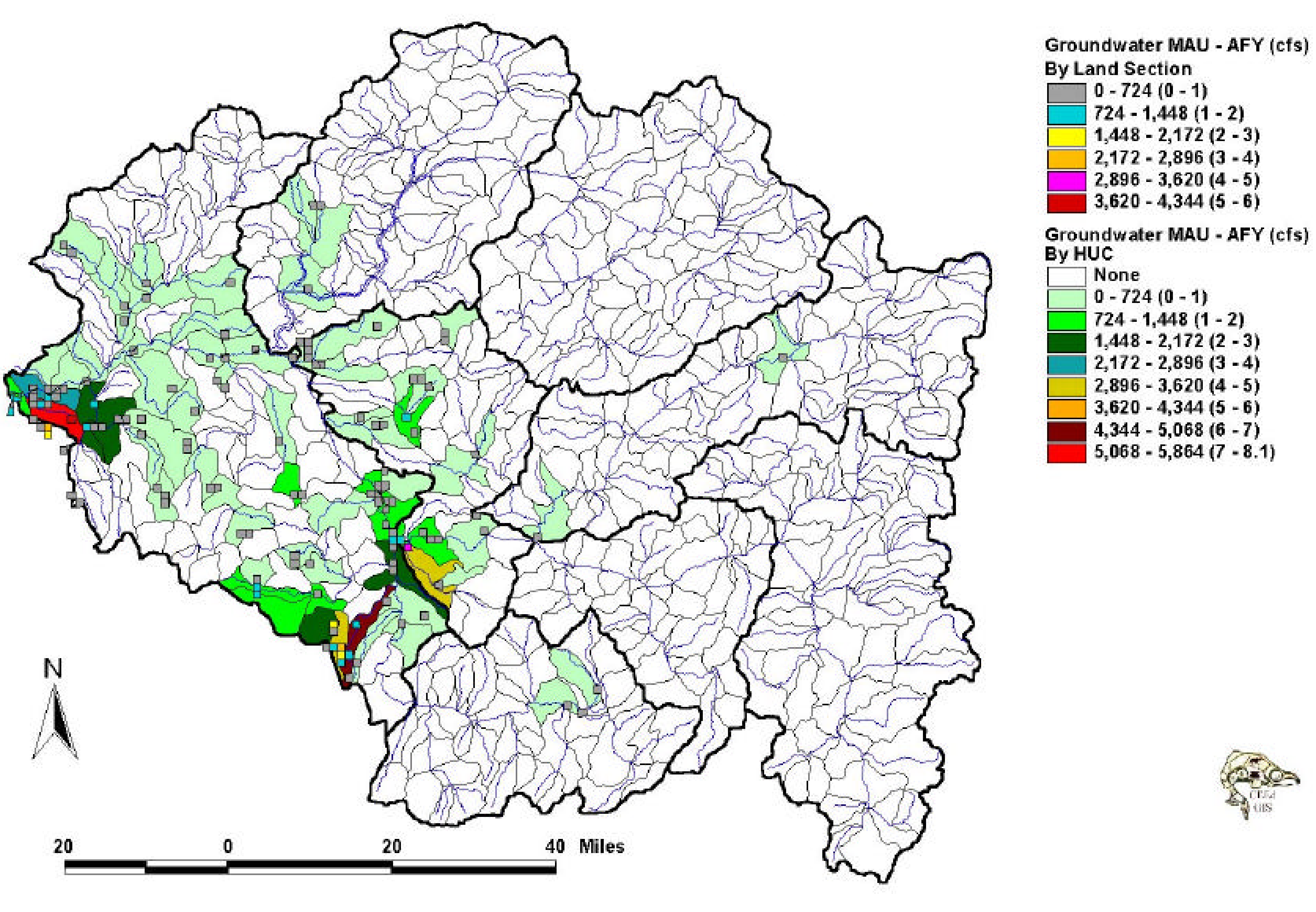

Figure 20. Maximum Allowable Use (MAU) of groundwater summarized by both land section and HUC

Table 15. Median values for selected parameters at seven USGS gauging stations within the Clearwater River subbasin

Station	Period of Interest	Specific Conductance (µS/cm)	NO_2+NO_3-N (mg/L)	Total Phosphorus (mg/L)	Chloride (mg/L)	Fecal Coliforms (CFU/ 100mL)
Lower Clearwater AU						
Stites	1972–1981		0.04	0.030	0.6	
	1972–1996	64			0.8	
	1990–1993					30
	1990–1998					21
Orofino	1973–1996	58				
Lapwai	1975–1996	220				
	1975–1981		0.63	0.095	3.1	
	1975–1997				3.2	
	1991–1993					267
	1991–1998		1.01	0.100	3.7	212
Spalding	1973–1995	44				
	1972–1982		0.11	0.030	0.6	
	1959–1995				0.5	
	1991–1993					13
	1990–1995					8
Lochsa AU						
Lochsa	1973–1996	27				
	1974–1980		0.03	0.015	0.4	
Lower Selway AU						
Selway	1973–1996	24				
	1974–1980		0.04	0.020	0.4	
Upper North Fork AU						
Canyon	1973–1996	33				

4.9.1 Temperature

Daily temperature information is available for only eight gauging stations within the subbasin, and periods of record vary for each one. The most complete long-term data set is from the station at Spalding (RM 11.6) where maximum and minimum temperatures have been recorded daily since October 1959. The second most complete set is upstream at the Peck gauging station (RM 37.4) where over 11,000 average measurements were calculated from October 1964 to the present. Daily temperature data from the discontinued gauging station at Ahsahka and the current one near the Canyon Ranger station provide a relatively long period of record for the North Fork Clearwater. The Ahsahka station at RM 0.4 was operated from October 1958 until December 1970–shortly before Dworshak Reservoir became operational. The current North Fork Clearwater station is located at RM 58, and temperature data is available from February 1970 through September 2000. The daily measurements taken at Kamiah represent the earliest daily USGS temperature data available for the Clearwater system. Information from the latter half of the 1956 water year, along with most of the 1957 and 1959 water years is available and useful from a historical perspective.

Temperature, and total dissolved gas data is also available from monitoring stations operated by the U.S. Army Corps of Engineers (USACE) along the lower reaches of the Clearwater River. This data is collected hourly, allowing the study of diel variability. Three stations are maintained within the Clearwater drainage area. The first is on the right bank of the Clearwater River at about RM 4. Data from this location is available from 1996 through 2000, with monitoring beginning in April or May and continuing through August or September depending on the year. The second site is located approximately 32 miles upstream on the left bank near Peck. This station has also been in place since 1996, but temperature information is available from April 1997 through December 1998, and from March 1999 through August 2000. The final station is in the North Fork Clearwater below Dworshak Dam. The collection schedule at that site was the same as the one at Peck, with the addition of April through September 1994 and July through September 1993. However, the temperature data obtained below Dworshak Dam is not representative of natural conditions. The selector gates at the dam are controlled so that released water is between 10–12^{o}C.

The ability to regulate the outflow temperature at Dworshak has impacts beyond the immediate outlet. Prior to 1992, the facility was operated primarily for flood control. The water level was kept close to full pool through the summer and lowered beginning September 1st. Reservoir water was then used throughout the winter for power production, effectively lowering the pool elevation to provide storage for flood control. Additional water up to about 20 kcfs was spilled in May when additional snow course information became available. This scenario changed in 1992 when up to 25 kcfs was released during parts of July and August to facilitate anadromous fish migration in the lower Snake River. The NMFS, 2000 BIOP calls for an 80 foot summer drawdown of Dworshak Reservoir for flow augmentation and cooling of the Lower Snake River.

This action also changed the thermal regime of the downstream Clearwater River (Figure 21). The primary differences occur between early July and late September. Between 1974-1990, mean temperatures peaked close to 19^{o}C during the last week of July and first week of August before declining towards the winter lows. During the 1993-1998 period, three peak averages of about 17^{o}C occurred during the first weeks of July, August, and September. Two troughs averaging 14^{o}C were recorded during the latter parts of July and August. Water temperatures during September 1993-1998 were 1-3^{o}C higher than during the historical period as a result of the 30% reduction in reservoir discharges (Figure 21).

Another interesting result surfaces when comparing Spalding data to sites higher in the watershed. No comparable long-term daily data is available from stations in the Selway River or Lochsa River, but it does exist for the discontinued station at Ahsahka and near the Canyon Creek Ranger Station on the North Fork Clearwater. When these data are divided into three time intervals, patterns are evident. First, the temperature values for the 1950-1970 Ahsahka and 1960-1970 Spalding data are quite similar (Table 16; Figure 21). The comparison shows that temperatures in all categories increased by about a 1^{o}C between Ahsahka and downstream Spalding; downstream warming is common. Second, statistics for the 1970-1990 and 1992-2000 intervals at the upstream site on the North Fork Clearwater are quite close, suggesting that mean water temperatures have not changed significantly in that 30 year interval. Also, water temperatures at the Canyon Creek Ranger Station site were generally cooler than at the two other (downstream) locations. Finally, the data from the Spalding site provides information that further suggests temperatures in that reach changed as a result of construction and operation of Dworshak Dam. The mean and maximum temperatures decreased slightly in the 1970-1990 period relative to the ten years prior to that. This shift was more noticeable in the maximum values. However, the same trends continued into the 1992-1999 interval. The overall average decreased slightly, but the maximum declined by an additional 2°C after the implementation of summer drawdowns at Dworshak. These shifts are apparent in Figure 21, as is the increase in minimum temperatures.

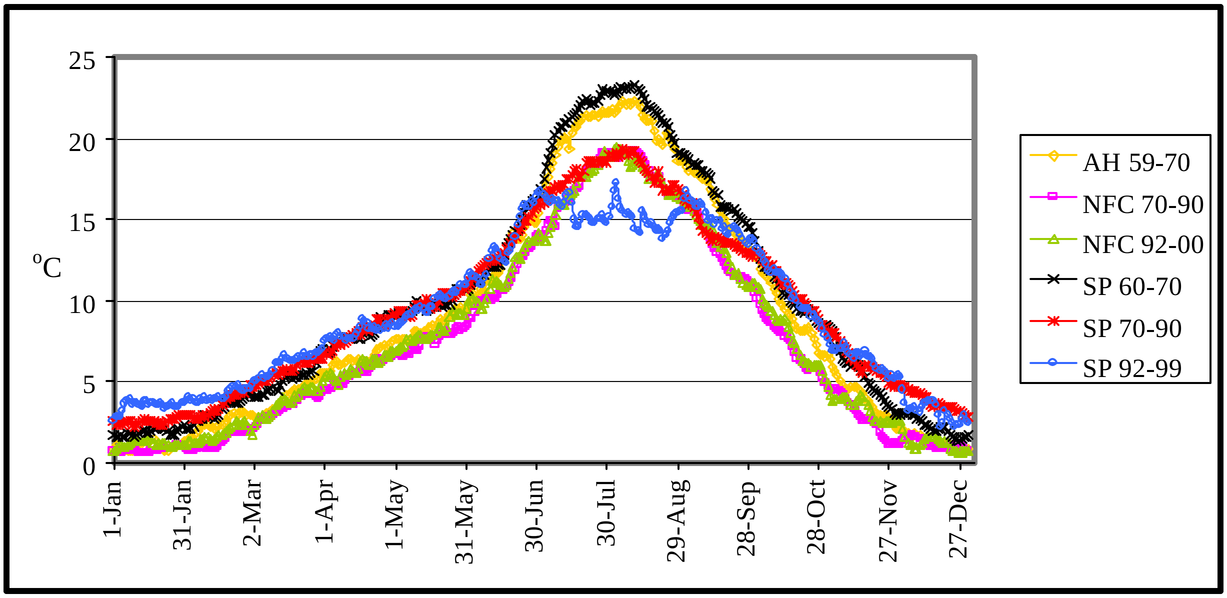

Figure 21. Average temperatures for the USGS gauging stations at Ahsahka (AH), North Fork Clearwater at Canyon Creek (NFC), and Spalding (SP) during various intervals

Table 16. Mean, maximum, and minimum temperatures for the USGS gauging stations at Ahsahka, North Fork Clearwater, and Spalding

Temperature		Ahsahka	NFC		Spalding		
		1959-1970	1970-1990	1992-2000	1960-1970	1970-1990	1992-1999
°C	Mean	8.9	7.4	7.8	9.9	9.5	9.2
	Max	22.3	19.2	19.5	23.3	19.4	17.3
	Min	0.7	0.6	0.6	1.3	2.2	2.1

4.9.2 Water Quality Limited Segments – §303(d)

Water quality limited segments are streams or lakes listed under Section 303(d) of the Clean Water Act for either failing to meet their designated beneficial uses, or for exceeding state water quality criteria. The current list of §303(d) listed segments was compiled by Idaho Department of Environmental Quality (IDEQ) in 1998, and includes 135 defined stream reaches within the Clearwater subbasin. Individual stream reaches are often listed for multiple (up to 11) parameters, making tabular summary difficult. Figure 22 illustrates the distribution of listed stream segments, and Table 17 summarizes listed segments by AU and individual pollutant. Maps delineating stream reaches listed for individual pollutants are included in Appendix B.

The Upper Selway AU lies entirely within the Selway-Bitterroot Wilderness and is the only AU in the Clearwater subbasin without stream segments listed as water quality limited (Table 17). The Lower Selway and Lochsa AUs also have a high portion of wilderness designation and inventoried roadless areas, and reflect a limited number of stream miles (11.7 and 71.1, respectively) listed on the §303(d) list relative to other AUs. Of the 71 miles of §303(d) listed stream in the Lochsa AU, 67 mainstem miles are listed for temperature.

Although temperatures in the mainstem Lochsa River often exceed state standards, Bugosh (1999) concluded that beneficial uses are being met, and the temperature exceedances are a regular and natural occurrence. Gilbert and Evermann (1895) examined temperatures in the lower mainstem Clearwater River (mouth to Potlatch Creek), and found that summer water temperature was highly correlated to air temperature. This work supports the concept that temperatures in larger rivers of the Clearwater subbasin were historically likely to naturally exceed current temperature criteria in some areas, with such exceedances dependent on localized environmental conditions.

4.9.3 NPDES Information

National Pollutant Discharge Elimination System (NPDES) permits are used to track point source discharges for potential impacts to water quality. Point source discharges do not generally present a substantial water quality issue within the Clearwater subbasin, with the exception of the Potlatch Corporation Mill located on the lower mainstem Clearwater River (Terry Cundy, Potlatch Corporation, personal communication, April 18, 2001). Using the online Permit Compliance System (U.S. Environmental Protection Agency 1999), thirty-eight facilities within the Clearwater subbasin were identified as having NPDES identification numbers, and all are described as active. However, only 30 have been issued NPDES permits, and of those only the Dworshak National Fish Hatchery permit is defined as current.

The majority of these units are sewage treatment plants and the amount of monitoring depends on size and type. Baseline monitoring at facilities such as those at Deary, Cottonwood, and the City of Nez Perce typically includes discharge, BOD-5, pH, total suspended solids, and fecal coliforms. Residual chloride analyses are included at Bovill, Elk City, and Kooskia, while the facility at Grangeville also monitors ammonia concentrations. The largest facility in the subbasin is in Lewiston, and is the only wastewater treatment plant in the area that monitors concentrations of heavy metals such as copper, lead, nickel, and zinc. The Potlatch mill in Lewiston also monitors metals in their effluent, and is required to evaluate the concentrations of several organic compounds. The effluents monitored by the fish hatcheries are not identified in the available information, with the exception of the Kooskia National Fish Hatchery that monitors total suspended solids and settlable solids. The requirements for several of the water supply, gold ore, and other facilities are not identified online in the Permit Compliance System.

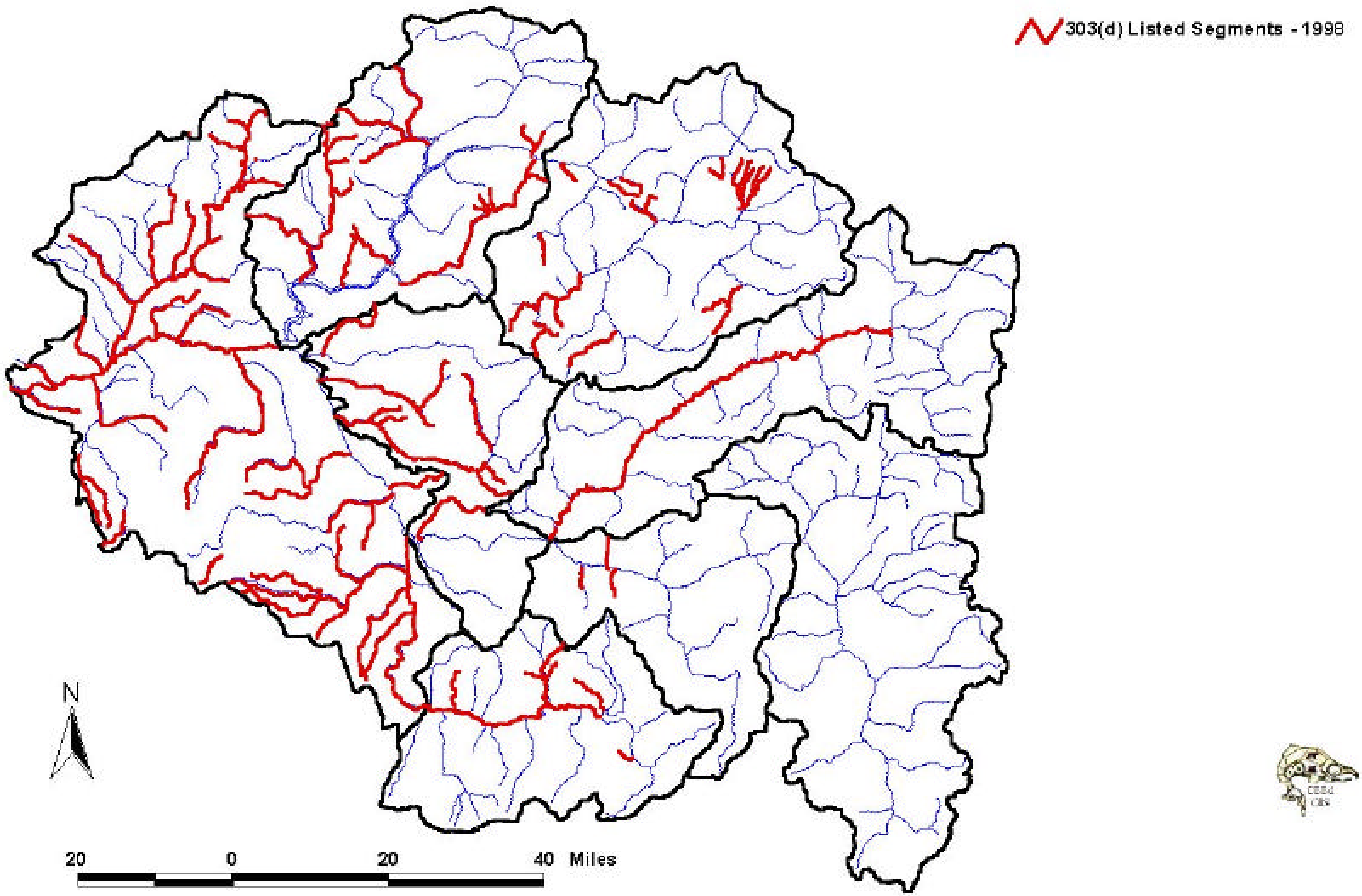

Figure 22. Distribution of water quality limited stream segments on IDEQ’s 1998 303(d) list

Table 17. Miles of water quality limited streams on the 1998 §303(d) list within Clearwater subbasin AUs. Numbers in parenthesis represent total miles of stream within each AU

Parameter	Assessment Unit								Total
	Lower Clearwater	Lower North Fork	Upper North Fork	Lolo/ Middle Fork	Lochsa	Lower Selway	Upper Selway	South Fork	
	(432.1)	(149.0)	(110.6)	(101.8)	(71.1)	(11.7)	(0.0)	(45.9)	(822.2)
Temperature	32.2	0.0	0.0	22.8	67.2	0.0	0.0	29.4	151.6
Thermal Modification	269.7	55.6	8.0	74.8	0.0	0.0	0.0	0.0	408.1
Sediment	376.4	149.0	107.2	101.8	3.8	11.7	0.0	45.9	795.8
Bank Instability	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	3.4
Habitat Alteration	357.5	90.9	8.0	74.8	0.0	0.0	0.0	29.4	560.6
Pathogens	331.0	55.6	0.0	74.8	0.0	0.0	0.0	0.0	461.4
Fecal Coliforms	14.9	0.0	0.0	19.1	0.0	0.0	0.0	0.0	34.0
Oil/Grease	46.5	0.0	0.0	0.0	45.3	0.0	0.0	0.0	91.8
Synthetic Organics	74.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.2
Pesticides	74.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.2
Nutrients	311.6	55.6	0.0	74.8	0.0	0.0	0.0	0.0	442.0
pH	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
Dissolved Oxygen	208.8	35.3	0.0	57.9	0.0	0.0	0.0	0.0	302.1
Total Dissolved Gas	43.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.8
Flow	306.9	90.9	8.0	74.8	0.0	0.0	0.0	0.0	480.6

Valuable water quality monitoring data are potentially available from several of these point sources. This information may prove beneficial for development of total maximum daily loads (TMDLs) and other water quality programs within the subbasin, and should be coupled with in-stream monitoring programs.

4.10 Population and Land Uses

Six counties (Clearwater, Idaho, Latah, Lewis, Nez Perce, and Shoshone) make up portions of the Clearwater subbasin. Idaho and Clearwater counties have the greatest land area in the Clearwater subbasin, accounting for roughly two-thirds of the total subbasin land area (Table 18). Five of the six counties making up the Clearwater subbasin have populated areas within the subbasin boundary; portions of Shoshone county within the subbasin are unpopulated.

More than two thirds of the total acreage of the Clearwater subbasin is evergreen forests (over four million acres), largely in the mountainous eastern portion of the subbasin. The western third of the subbasin is part of the Columbia Plateau and is comprised almost entirely of crop and pastureland (Table 19; Figure 23). Most of the forested land within the Clearwater subbasin is owned by the federal government and managed by the U.S. Forest Service (over 3.7 million acres), but the state of Idaho, Potlatch Corporation and Plum Creek Timber Company also own extensive forested tracts (Table 20; Figure 24).

The western half of the subbasin is primarily in the private ownership of small forest landowners and timber companies, as well as farming and ranching families and companies. Some small private inholdings exist within the boundaries of USFS lands in the eastern portion of the subbasin. Nez Perce Tribal lands are located primarily within or adjacent to Lewis, Nez Perce, and Idaho Counties within the current boundaries of the Nez Perce Reservation (Figure 24). These properties consist of both Fee lands owned and managed by the Nez Perce Tribe, and properties placed in trust status with the BIA. Other agencies managing land in the Clearwater subbasin include the National Park Service, U.S. Bureau of Land Management, U.S. Army Corps of Engineers, and Idaho Department of Fish and Game.

Table 18. Relative land area of counties in the Clearwater subbasin (ESRI 1999)

County	Acres in Clearwater Subbasin	Total Acres in County	% of County in Subbasin
Clearwater	1,582,467	1,591,549	99.4
Idaho	3,186,572	5,439,702	58.6
Latah	343,138	688,642	49.8
Lewis	272,775	306,831	88.9
Nez Perce	352,215	547,616	64.3
Shoshone	244,167	1,685,667	14.5

Table 19. Clearwater subbasin land use

Land Use	Acres
Evergreen forest land	4,277,815
Herbaceous rangeland	30,693
Shrub and brush rangeland	393,082
Non-forested wetland	1,123
Bare exposed rock	85,856
Lakes	2,447
Mixed rangeland	199,159
Cropland and pasture	765,926
Strip Mines	1,436
Reservoirs	17,805
Industrial	1,880
Commercial and services	2,660
Residential	6,443
Mixed urban or built up	2,261
Other urban or built up	368
Streams and canals	5,972
Transitional areas	251
Bare ground	2,928
Shrub and brush tundra	2,872
Mixed forest land	182,062
Deciduous forest land	3,057

Table 20. Approximate acreage owned or managed by various entities in the Clearwater subbasin.

Owner/Manager		Acreage (Rounded to nearest 100)
Federal Government		
	U.S. Bureau of Land Management	45,600
	U.S. Forest Service	3,718,700
	U.S. Army Corps of Engineers	31,600
	National Park Service	100
State Government		
	Idaho Department of Lands	320,100
	Idaho Dept. of Fish and Game	3,400
Nez Perce Tribe		
	Tribal Fee Lands	15,200
	Tribal Trust Lands	36,000
	Individual Allotments	44,800
Private Entities		
	Potlatch Corporation	425,000
	Plum Creek Timber Company	64,100
	Other Private Holdings	1,275,300

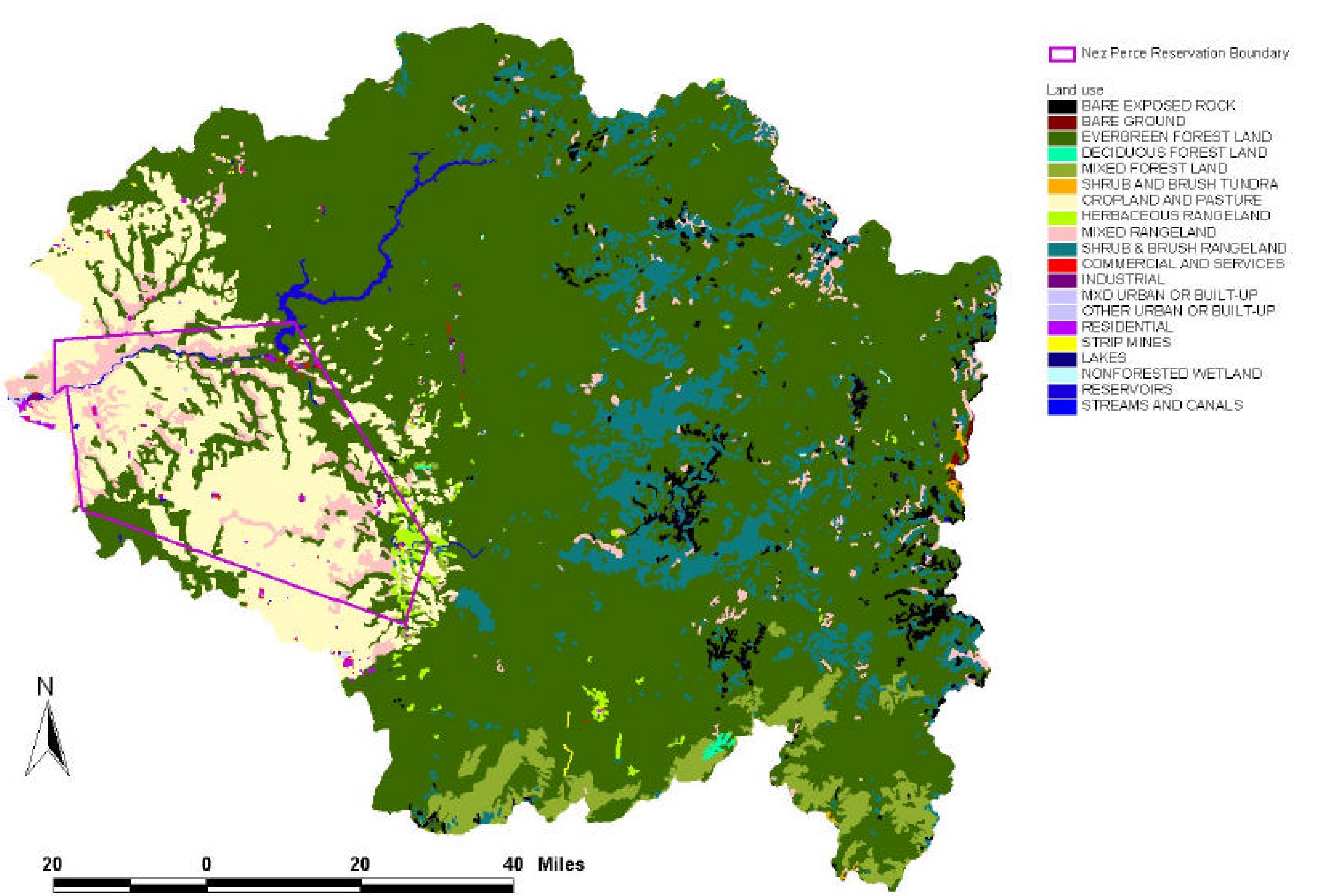

Figure 23. Clearwater subbasin land use

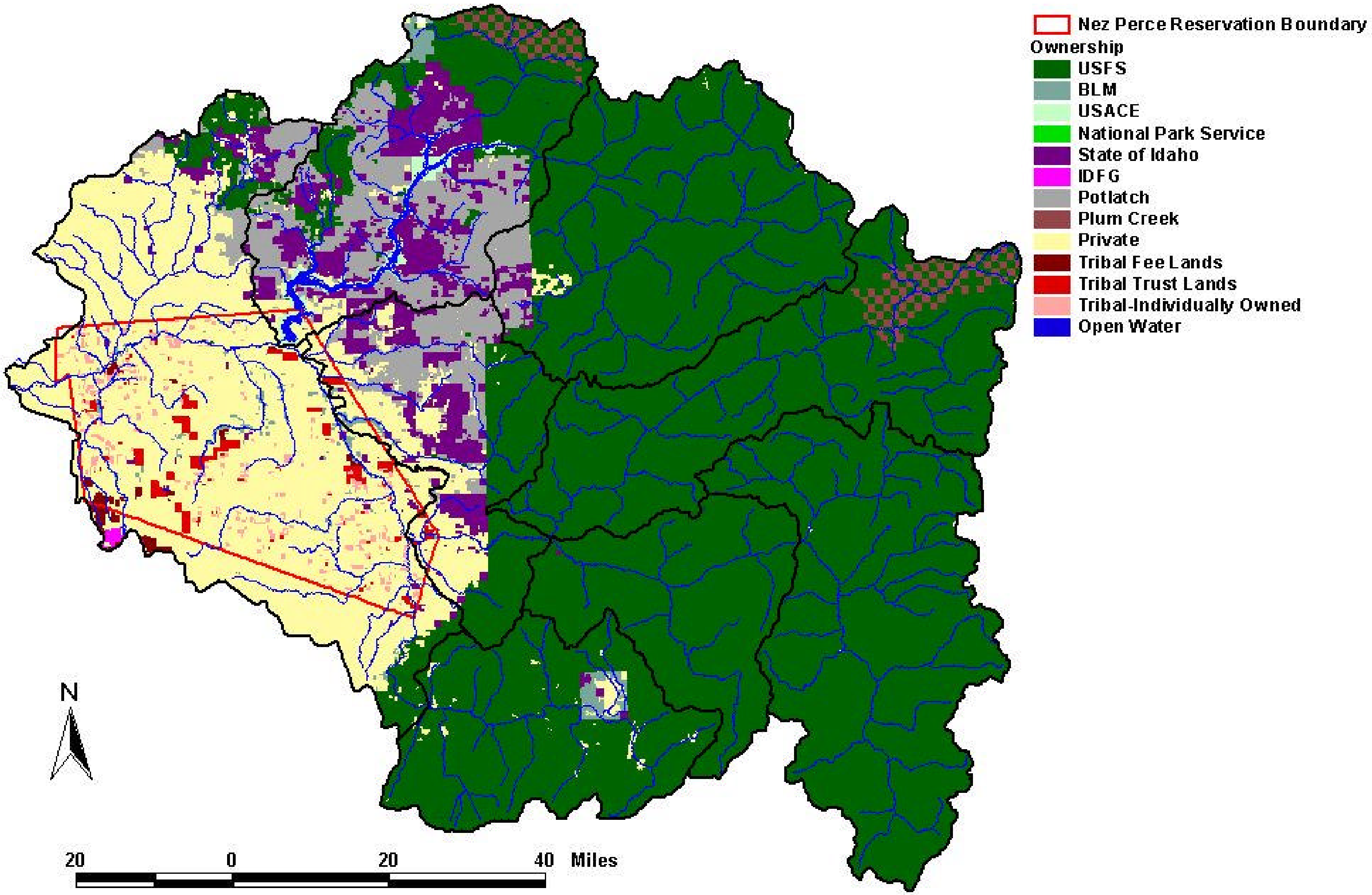

Figure 24. Clearwater subbasin land ownership

4.10.1 Demographics

An estimated population of 60,000 resides within the boundaries of the Clearwater subbasin, the majority within Nez Perce and Latah Counties (Table 21). These counties are considered urban by the U.S. Census Bureau, maintaining an average population density of over 25 people per square mile. The population of Nez Perce County generally resides in the city of Lewiston (30,904 people in 2000). Likewise, the city of Moscow (which lies outside the Clearwater subbasin) accounts for the majority of the population in Latah County (21,291 people in 2000; IDOC 2002). The other four populated counties within the subbasin are classified as either rural or frontier areas, with densities between 0.4-4.9 persons per square mile (McGinnis and Christenson 1996). Between 1990 and 1999, the population of the Clearwater subbasin grew by approximately 8.7% (Idaho Department of Commerce 2000; Table 21).

Table 21. Clearwater subbasin population trends by county (U.S. Census Bureau 2000)

County	1990	1999	# Change 1990-1999	% Change 1990-1999
Clearwater	8,505	9,359	854	10.0%
Idaho	13,768	15,030	1,262	9.2%
Latah	30,617	32,509	1,892	6.2%
Lewis	3,516	3,943	427	12.1%
Nez Perce	33,754	36,913	3,159	9.4%
State Total	1,006,734	1,251,700	244,966	24.3%

The perimeter of the Lower Clearwater AU includes most population centers within the Clearwater subbasin. The Lower Clearwater AU contains 19 towns with a total population of approximately 42,656. This includes the county seats of four of the six counties, and over 80% of the estimated population that reside within the Clearwater subbasin. The largest city is Lewiston, with 30,597 people. The second largest is Grangeville, the county seat for Idaho County, with 3,377 people. The remaining towns in the Lower Clearwater AU each have populations of under 1,000 people, except Kamiah with 1,304 people (Idaho Department of Commerce 2000).

Because county seats are centers for governmental, social, and economic activity, they consistently encompass over 30% of the total county population. They also have the highest growth rate of any of the population loci. Between 1990 and 1998 all of the county seats within the Clearwater subbasin grew by at least 5% (U.S. Census Bureau 2000).

The median age of persons living in the Clearwater subbasin is approximately 35 years old. The distribution of races is broad, with the largest part of the minority community comprised of American Indians (Idaho Department of Commerce 2000).

4.10.2 Socioeconomic Overview

This following overview provides a brief description of economic, social and cultural conditions within the counties of the Clearwater subbasin. It provides an elementary overview of prominent economic activities within each county. Used in conjunction with other information presented throughout Section 4.10, it provides an elementary overview of prominent economic activities in the Clearwater subbasin, connections to natural resources, and levels of related income and employment as called for by the *Recommendations and Guidance for Economic Analysis in Subbasin Planning* (IEAB 2003).

Clearwater County ranks 29th among Idaho counties in population and 10th in area. Over 53 percent of the lands within Clearwater County are publicly owned and managed by federal agencies, primarily the U.S. Forest Service. Forest products manufacturing is the major basic industry, with trade, services and government providing the largest employment opportunities (Figure 25). Major employers include Orofino Joint School District, the U.S. Forest Service, Clearwater County government, Clearwater Valley Hospital & Clinic, Idaho State Penitentiary, Idaho Department of Health & Welfare, DEBCO, and Konkoville Lumber Company, Inc (IDOC 2002).

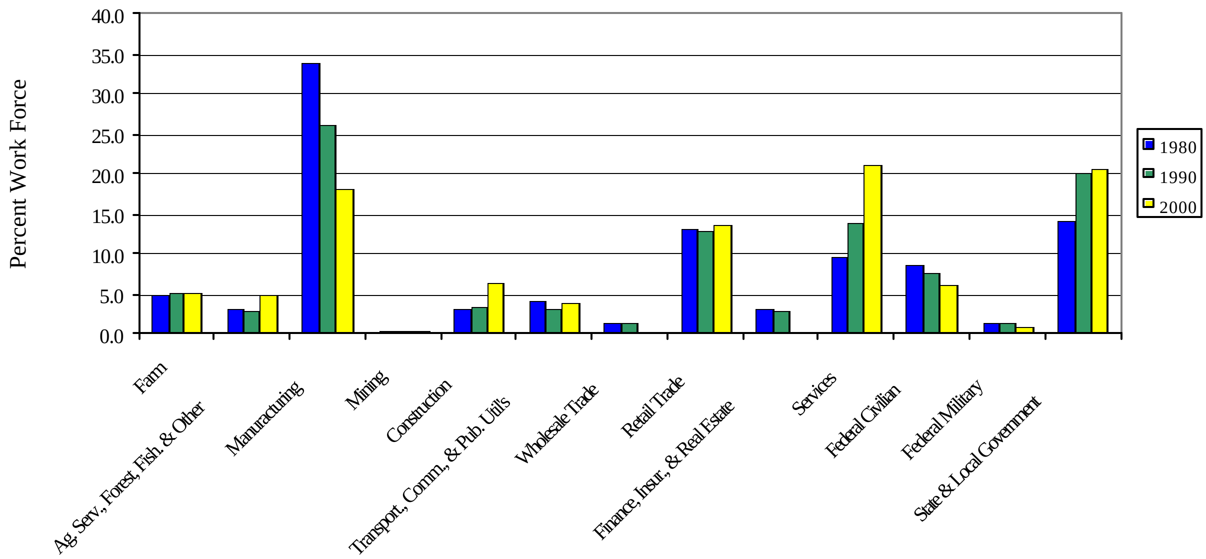

Figure 25. Proportion of workers by industry in Clearwater County (IDOC 2002).

Idaho County ranks 20th among Idaho counties in population and 1st in area (IDOC 2002). The federal government manages over 83 percent of the land within Idaho county. Forest products manufacturing and agriculture are the basic industries, but government is the largest employment sector (Figure 26). Trade and services also provide substantial employment. Major employers include Bennett Lumber Products, Clearwater Forest Industries, Inc., Department of Corrections, Seubert Excavators, Inc., St. Mary's Hospital, Three Rivers Timber, Inc., and the U.S. Forest Service (IDOC 2002).

Latah County ranks 10th among Idaho counties in population and 29th in area (IDOC 2002). The federal government manages about 16 percent of the land within Latah county. Agriculture, forest products manufacturing and the University of Idaho heavily influence the local economy (Figure 27). Major employers include the University of Idaho, Bennett Lumber Products, Wal-Mart, Winco, Gritman Medical Center, the school districts, Latah Health Services, Inc., and Rosauers Super Markets (IDOC 2002).

Lewis County ranks 40th among Idaho counties in population and 41st in area (IDOC 2002). Only 2.6 percent of its land is federally managed, the least of any Idaho county.

Agriculture and forest and wood products manufacturing are important to the local economy, and government provides nearly half the non-farm wage and salary employment (Figure 28). Major employers include the Idaho Department of Lands, Highland and Nez Perce Joint School Districts, Hillco, Inc., Lewiston Grain Growers, U.S. Timber Corporation, Kamiah Mills, Three Rivers Timber Company, Clonningers Thrift, and the U.S. Forest Service (IDOC 2002).

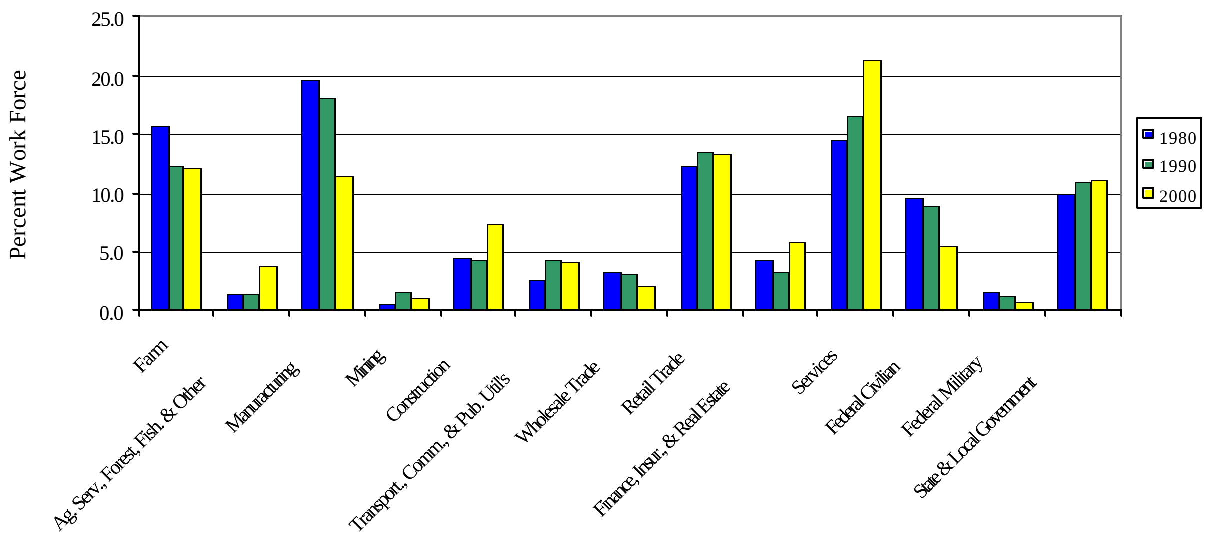

Figure 26. Proportion of workers by industry in Idaho County (IDOC 2002).

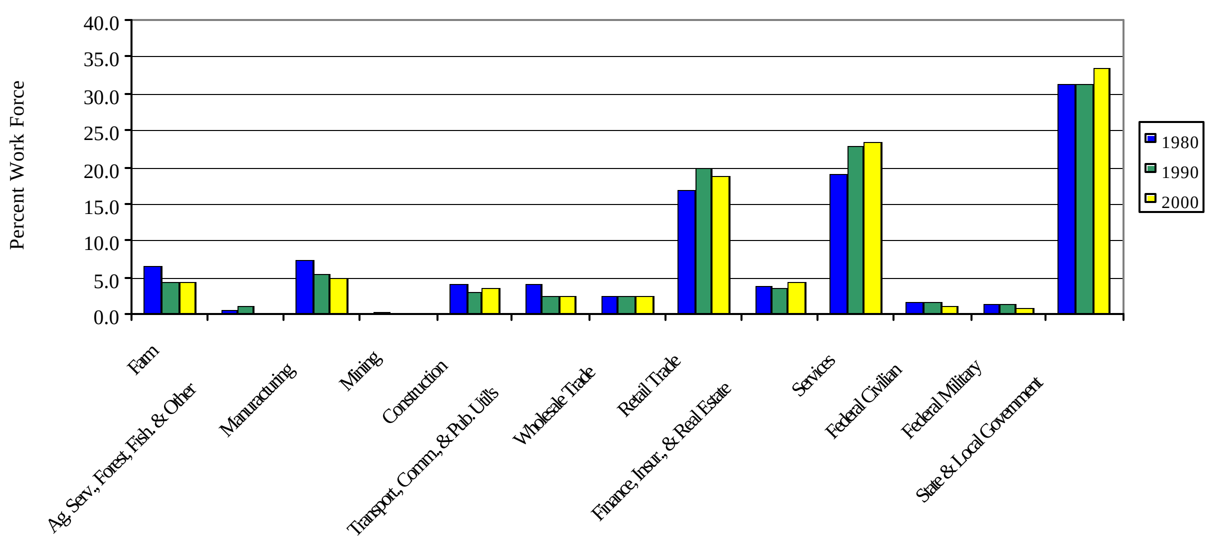

Figure 27. Proportion of workers by industry in Latah County (IDOC 2002).

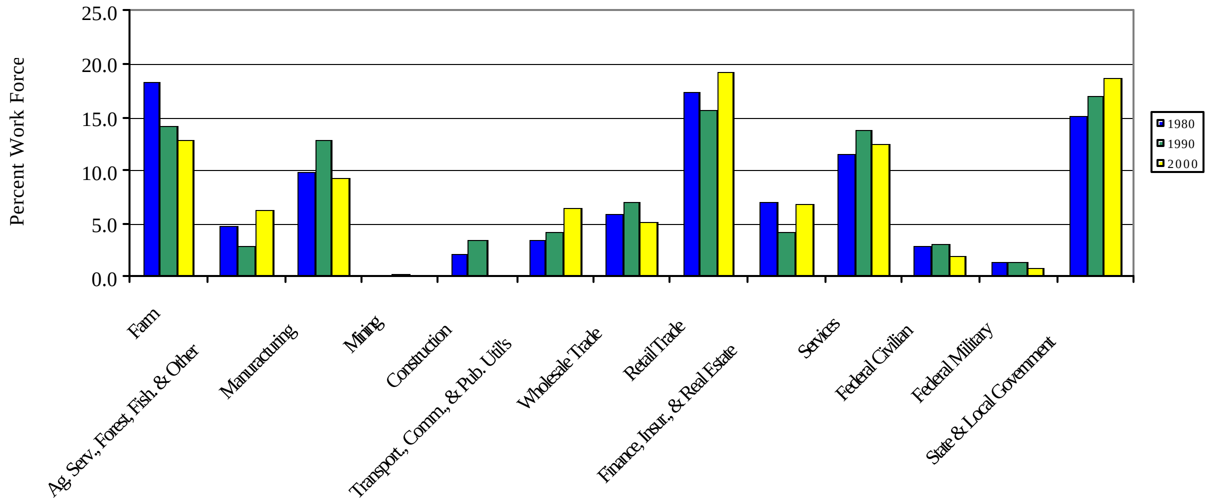

Figure 28. Proportion of workers by industry in Lewis County (IDOC 2002).

Nez Perce County ranks 9th among Idaho counties in population and 33rd in area (IDOC 2002). Only 6.2 percent of the county is managed as federal land, the second lowest of all Idaho counties. Paper and wood products manufacturing form the foundation of the local economy (Figure 29). Trade and transportation are also important due to the influence of the Port of Lewiston, Idaho's only seaport. Major employers include Potlatch Corporation, Albertson's, Inc., Lewis-Clark State College, Alliant Techsystems, Swift Transportation Company, Tribune Publishing Company, Twin City Foods, Inc., Wal-Mart, and Northwest Children's Home, Inc (IDOC 2002).

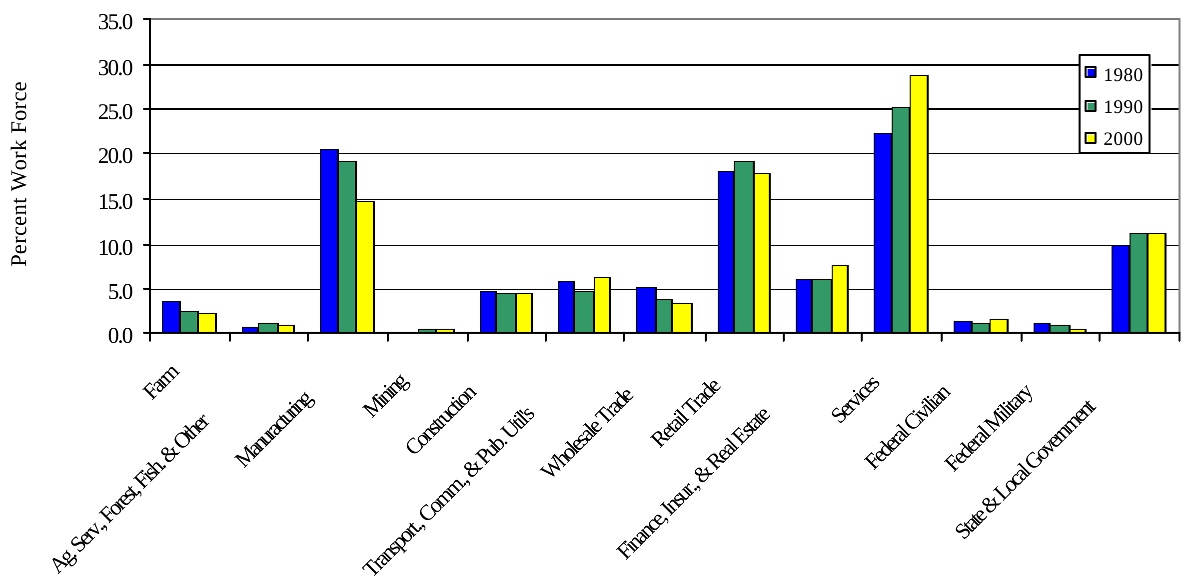

Figure 29. Proportion of workers by industry in Nez Perce County (IDOC 2002) .

The per capita income trends of most counties in the Clearwater subbasin are slightly lower than for Idaho State, with the exception of Nez Perce County. In all counties there has been an upward trend in income from 1980 to 2001 (Figure 30).

The unemployment rates of counties within the Clearwater subbasin have decreased slightly, from 1980 to 2000 (Figure 31). The unemployment rate of the most populous counties in the subbasin (Latah and Nez Perce) was below 4.5 percent in 2000, compared to 4.9 percent in Idaho State (IDOC 2002).

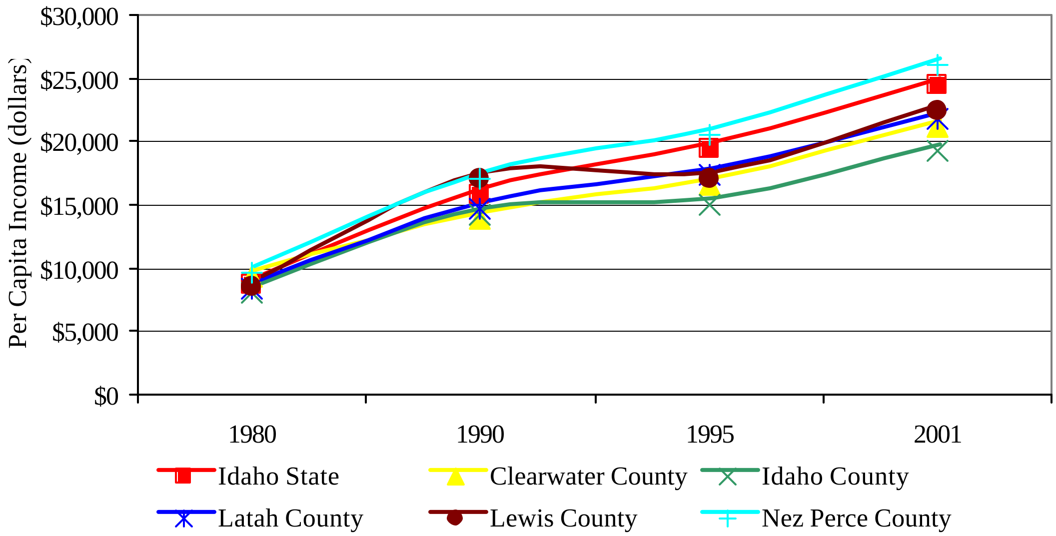

Figure 30. Per capita income trends of counties in the Clearwater subbasin from 1980-2001 (IDOC 2002)

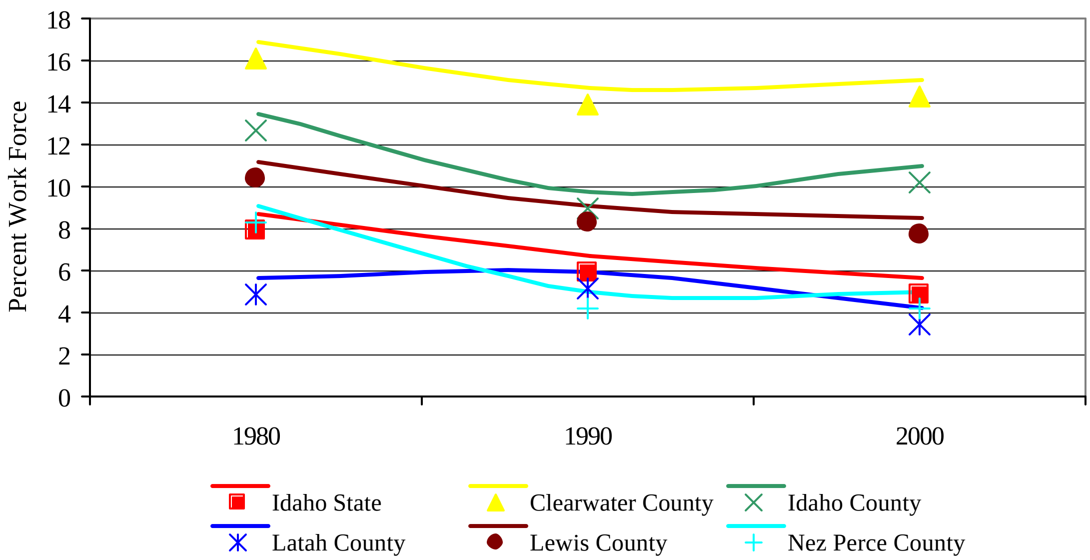

Figure 31. Percent civilian labor force unemployment trends from 1980 to 2000 for the counties within the Clearwater subbasin (IDOC 2002)

The percentage of persons living below the poverty level varied between counties in the Clearwater subbasin (Figure 32). Latah County generally had more people below poverty, while Clearwater County usually had the least. The poverty level of half the counties in the subbasin peaked in 1989, while the other half peaked in 1999.

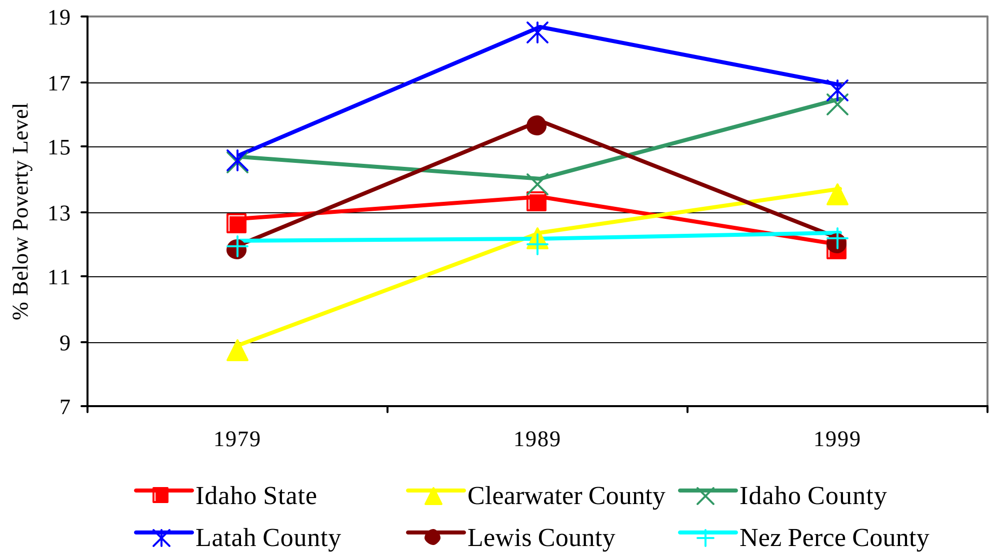

Figure 32. Percent of persons living below poverty in each county within the Clearwater subbasin (IDOC 2002).

The three major industries in the subbasin, with focus on the population centers of Latah and Nez Perce counties, are in manufacturing, retail sales, and education, health, or social services (IDOC 2002; Figure 33). In Nez Perce County, manufacturing supplies nearly 3,000 jobs while education, health, or social services supports nearly 4,000 people. In Latah County retail trade employs over 2,000 people while education, health, or social services provides nearly 7,000 jobs. The number and types of jobs in Latah County is most likely skewed by the city of Moscow and the University of Idaho, which lie outside the subbasin boundary. Clearwater and Idaho counties, which are heavily forested and lightly populated, are supported mainly by industries in two areas: 1) agriculture, forestry, fishing, hunting and mining, 2) education, health, or social services (Figure 33).

The International Association of Fish and Wildlife Agencies estimated the number of jobs created in Idaho from all hunting activities to be 6,197 (Southwick Associates 2002). The number of jobs created from all fishing and wildlife-watching activities was not modeled, but higher expectations could be made based on the high percentage of fishing and wildlife-watching expenditures in Idaho. Rural community economies are generally considered to benefit from hunting and fishing activities, while some are highly dependant on it (Southwick Associates 2002).

4.10.3 Urban Development

Urban land uses comprise only 0.2% of the Clearwater subbasin. The largest urban area is Lewiston, with the largest amount of commercial, residential, and industrial site development in the subbasin. The relative isolation from major transportation corridors such as an interstate or airport, a relatively large proportion of public land in the eastern portion of the subbasin, and rugged topography limit the potential for urban development.

Although currently a minor influence, second homes, immigration by the affluent to rural areas for quality of life factors, and associated development could increase throughout the subbasin in future years. In addition, the potential decline of traditional economies such as forestry may create an incentive for attracting urban industrial land uses to the subbasin to provide employment and revenue for local governments.

Many urban and ranchette developments in the lower Clearwater are located near streams, in riparian areas or on floodplains. Septic systems, stormwater runoff, livestock management, home lawn and garden management, culverts, and roads all impact the natural resources in the area. Direct and indirect impacts of development on wildlife species in these areas include loss of habitat, increased mortality from domestic pets, and increased conflicts with humans. Domestic cats and dogs can have significant impacts on small mammal, bird, and reptile populations and some evidence suggests that rural pets have the greatest impacts (Coleman et al. 1997; See also California Department of Fish and Game 2000 and Tufts University 1999).

Increased rural development also results in higher road densities, which can impact wildlife by acting as mortality agents, movement barriers, and establishment sites for noxious weeds (Trombulak and Frissell 2000; Ferguson et al. 2001). Roads also allow greater human access into wildlife habitat areas, which results in disturbance and can lead to increased poaching or harassment.

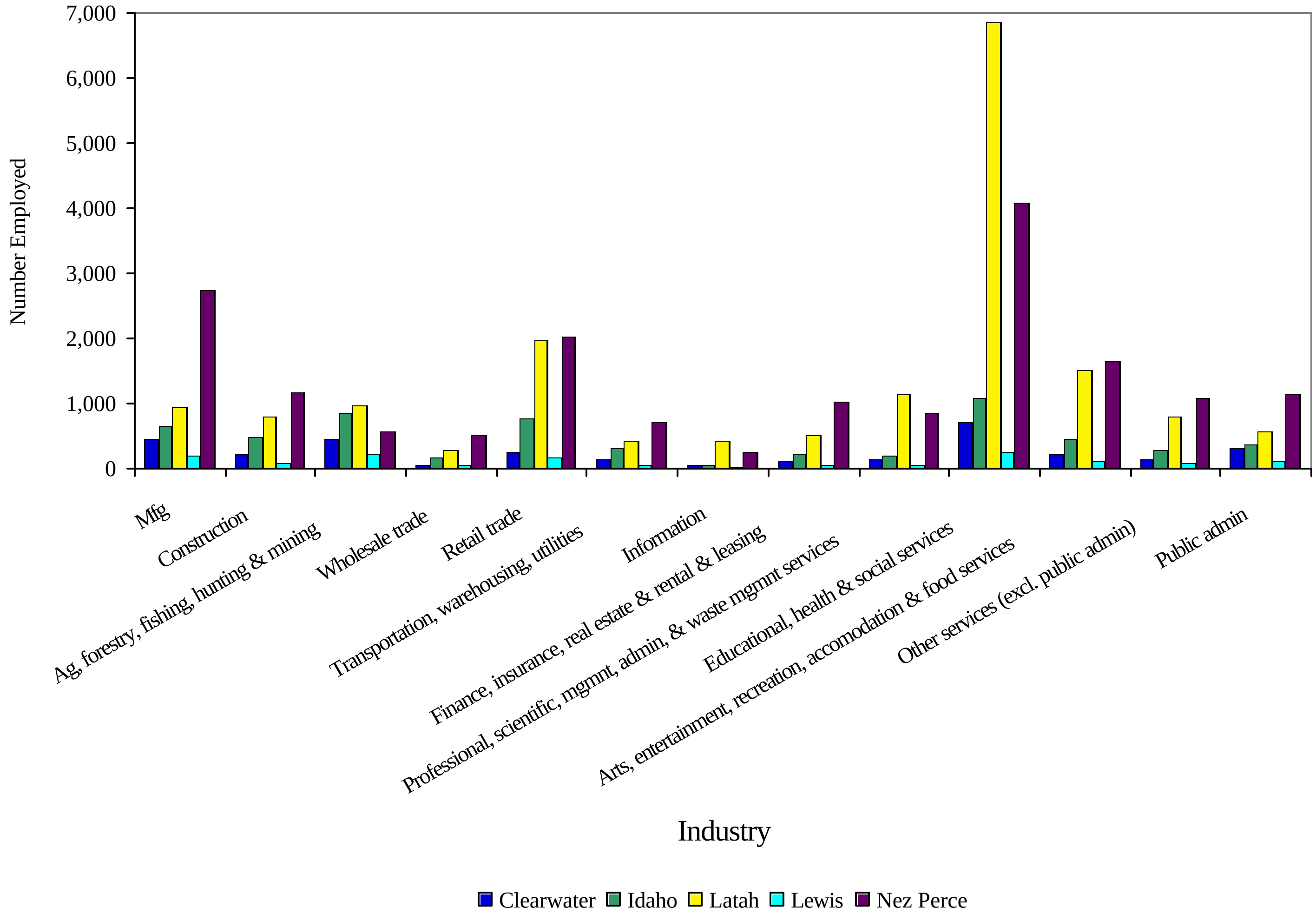

Figure 33. Employment by industry in the Clearwater subbasin by county (IDOC 2002).

4.10.4 Recreation

Recreation has become the dominant use of the Clearwater and Nez Perce National Forests. With the Selway Bitterroot Wilderness Area, wild and scenic rivers, world class big game hunting and trout fishing, and river rafting, the Clearwater subbasin is a recreation resource of national significance. The USFWS and U.S. Census Bureau (2003) found 868,000 Idaho residents and nonresidents (16 and older) spent nearly 983 million dollars in Idaho for wildlife-related recreation during 2001. Of the 983 million dollars spent, 755 million dollars was due to fishing and hunting expenditures and 227 million dollars was due to wildlife-watching expenditures.

The steelhead sport fishery in the Clearwater subbasin attracts anglers both from within Idaho and out-of-state, and is an important component of the local and state economy. During the 1999-2000 season 50,600 angler days (278,317 hours) were expended. Reading (1996) estimated that the average daily expenditure for steelhead anglers in the Clearwater in 1993 was $168.40. Using this figure, over $8,500,000 was generated during the 1999-2000 season.

General season chinook salmon fisheries have not been held since the 1970s. Recently, however, limited seasons were held in the Clearwater in 1997, 1998, 2000 and 2001. Almost 79,000 angler hours were expended in the two month season in 2000. Using an expansion of effort and average daily expenditure of $189.29 from the 1997 fishery (Reading 1999), $5.5 million in direct expenditures and $9.5 million in economic activity resulted from the 2000 chinook season in the Clearwater drainage during that year. Idaho Fish and Wildlife Foundation (2001)estimated that salmon fishing during 2001 contributed 8.8 and 8 million dollars, respectively, to the economies of Lewiston and Orofino (both within the Clearwater subbasin).

Recreational fishing throughout the North Fork, Lochsa, Selway and South Fork Clearwater Rivers also provides tens of thousands of angler hours annually. Fisheries in the North Fork, Lochsa, and Selway Rivers are primarily based on wild native westslope cutthroat trout. These wild cutthroat fisheries are managed with a variety of restrictive harvest regulations applying to non-tribal anglers. Lowland lakes within the Clearwater River subbasin provide approximately 150,000 hours of fishing annually. These fisheries are primarily based on regular stocking of catchable sized hatchery trout. Fishing regulations are generally liberal and allow for consumptive harvest. Revenues generated from the sales of Idaho fishing and hunting licenses provide the necessary funding to produce hatchery trout for these fisheries.

Dworshak Reservoir also provides a recreational resource of regional significance, with documented angler usage near 150,000 angler hours annually (Maiolie et al. 1993). Recreational use of Dworshak Reservoir and other recreational resources throughout the Clearwater subbasin is projected to increase dramatically in coming decades.

Hunting is also an important recreational activity within the Clearwater subbasin. Information regarding hunter locations or expenditures was not readily available. Resident Hunting license sales by county in 2002 were variable, with the highest numbers of licenses sold in the most populated counties. Nez Perce and Latah counties had 11,473 and 8,443 resident hunting licenses sold, respectively in 2002 (Figure 34; IDFG 2002). The 1991 *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* found 49 percent of all hunters and 52 percent of freshwater anglers traveled less than 25 miles to the sites they used most often (USFWS 1993) suggesting that license sale figures by county reasonably represent hunter and angler distributions.

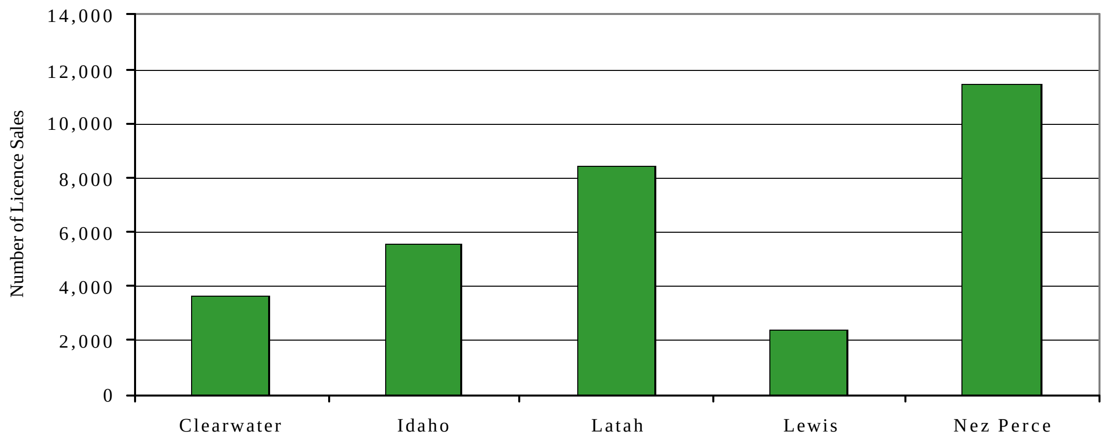

Figure 34. Resident hunting and fishing license sales in 2002 for counties in the Clearwater subbasin (IDFG 2003).

4.10.5 Roads

Road construction is closely tied to land use patterns, and may be dictated by some uses (i.e. timber harvest) and dictate where other uses are likely to occur (i.e. recreational access). Roads on the plateau in the southwestern part of the subbasin are typically rural and access roads for modern agriculture and are easily recognized by their straight north/south and east/west alignment (Figure 35). Road densities are greatest in the central portions of the subbasin where logging roads predominate, commonly exceeding 3 miles/square mile and often exceeding 5 miles/square mile (Figure 35 and Figure 36).

There is relatively little road development in the eastern part of the subbasin. The Selway-Bitterroot and Gospel Hump Wilderness Areas contribute to the lack of road development in some areas, as does the local fire history. The distribution of logging roads in the Clearwater subbasin is tied to fire history, with most currently existing forest roads located in areas that did not burn during major fires of 1910 and 1917.

Roads have become a major cause of forest fragmentation because they divide large landscape patches into smaller ones and convert forest interior habitat into edge habitat (Reed et al. 1996). In addition to disturbance caused by traffic, roads remove about 5 acres of productive habitat per mile (Leege 1984). It has also been found that the richness of plant and wildlife communities decreased as road density within the adjacent 2 kilometers increased (Findlay and Bourdages in press).

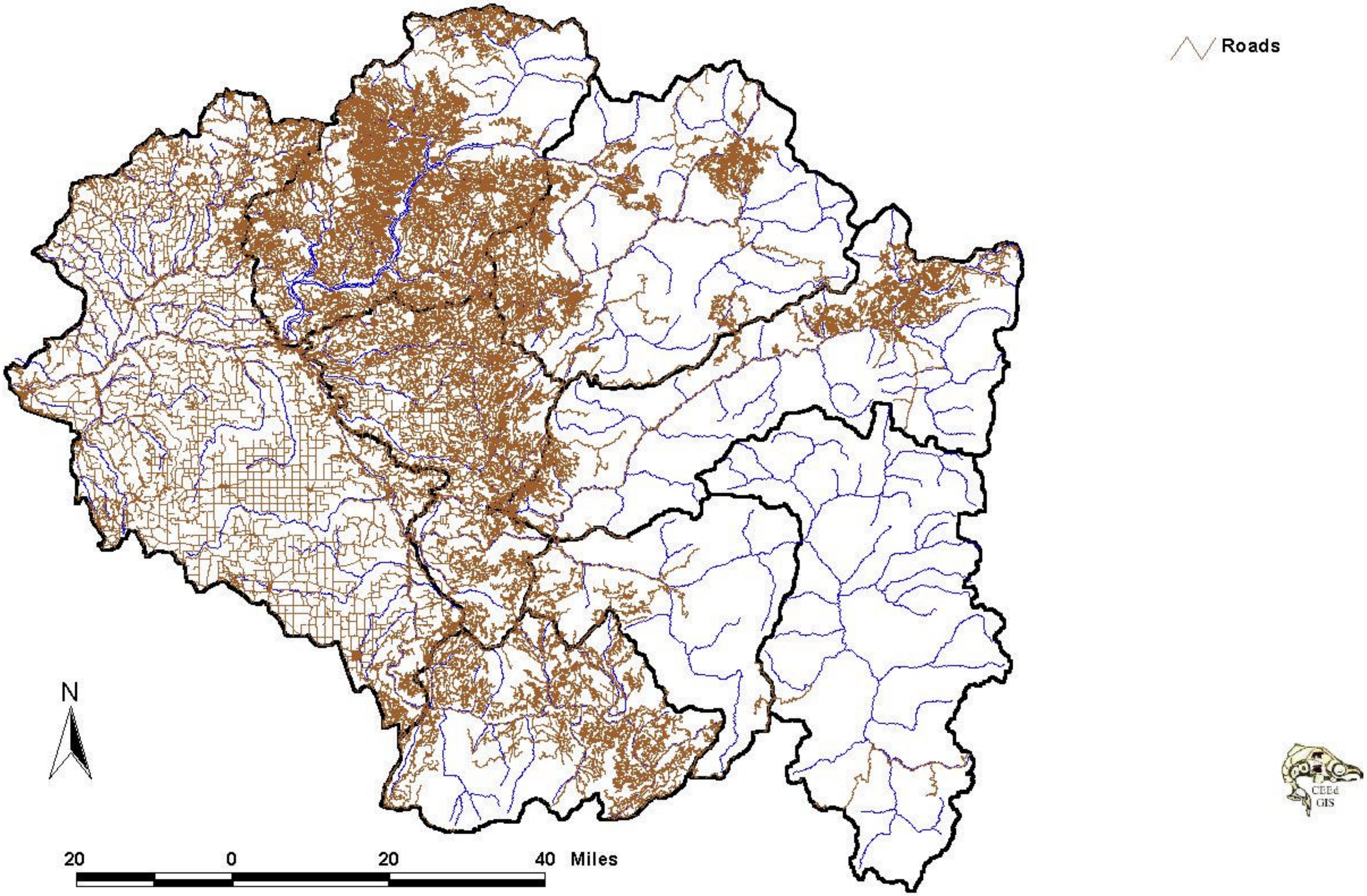

Figure 35. Road distribution throughout the Clearwater subbasin

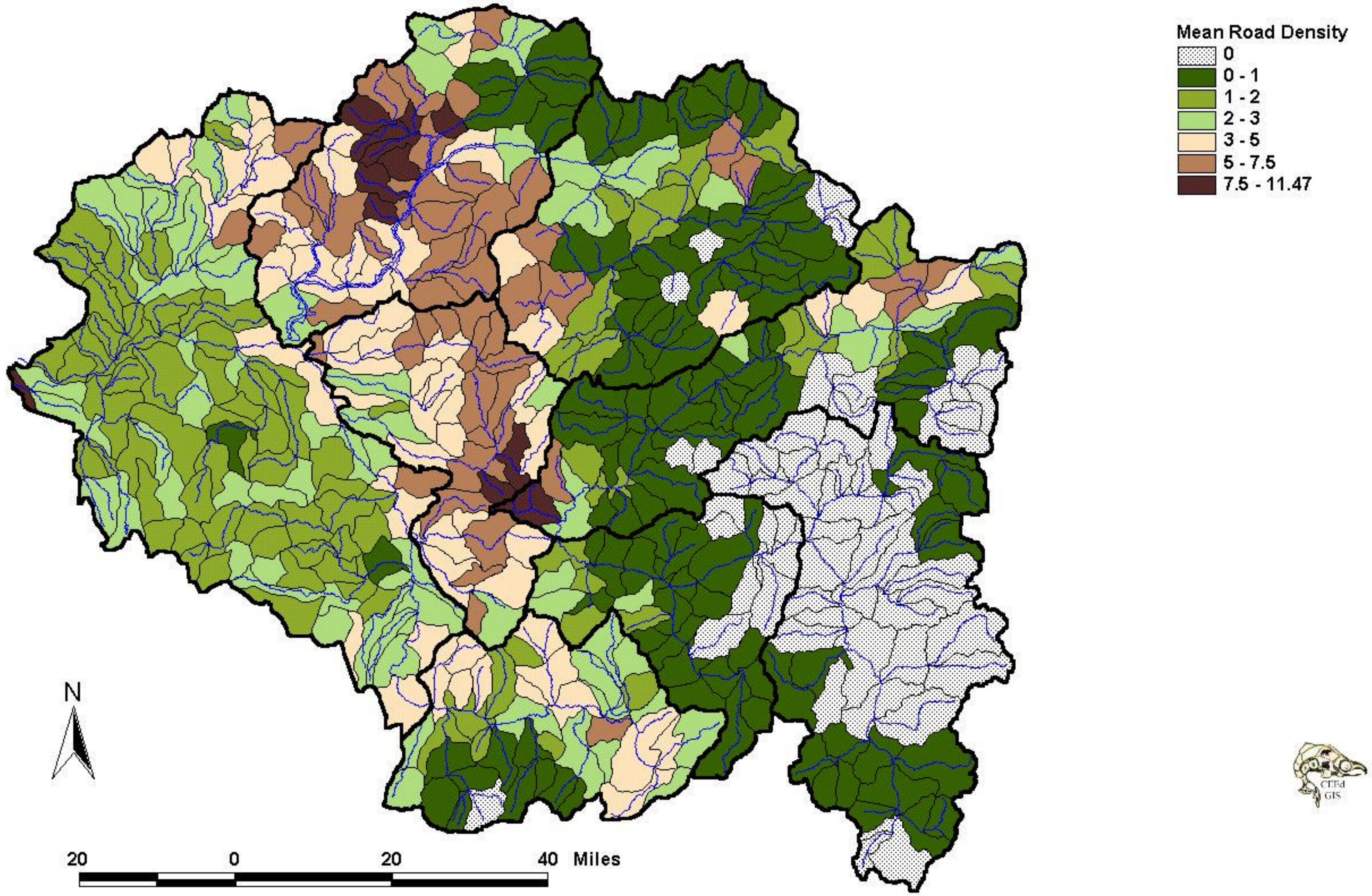

Figure 36. Mean road density within the Clearwater subbasin plotted by 6th field HUC

4.10.6 Timber

Industrial forestry practices have occurred in the Clearwater subbasin since the late 19th century. The first significant commercial logging began in the Clearwater in the 1880s, but did start on a grand scale until Fredrick Weyerhaeuser's Clearwater Timber Company began bringing logs out of the upper Clearwater country by rail to the world's largest electrically driven sawmill, built on the banks of the Clearwater River at Lewiston, Idaho in 1927 (Woods and Horstmann 1994). A Prospectus dated August 1, 1914 advertised 600 million board feet (mbf) of timber for sale within Lolo Creek on the Clearwater National Forest (unpublished Forest Service document). All of this timber was considered good quality sawlogs, with an estimated 126 mbf of white pine, of which 40% was in trees over 30 inches diameter breast height (dbh). Today, forests containing trees of this size would be considered old growth.

Much of the federal forest land in the subbasin was set aside as the Bitterroot Forest Reserve in 1897. Today, the Clearwater, Nez Perce, St. Joe, and Bitterroot National Forests contain most of the forest in the subbasin. Logging on these national forests was minimal prior to WWII: the largest annual cut on the Clearwater National Forest prior to 1946 was 18.0 million board feet (mbf). After the war the annual cut increased dramatically and has been at or above 100 mbf since 1959 (Cooper et al. 1987) until the 1990s. During 1971-1980 the average annual timber harvest on the Clearwater National Forest was 170 mbf (USFS 1987a). The cut has declined through the 1990s, dropping to only 25 mbf (C. Mitchell, Clearwater National Forest, personal communication 1998). Although detailed examination of records was not done for other National Forests within the subbasin, trends in timber harvest were likely similar to those noted for the Clearwater National Forest. Much of the reduction in timber harvest has been due to restrictions related to ESA listed salmon stocks, concerns with resident salmonids, lack of resolution on the management of remaining roadless areas on the forest, and change in Forest Service management policy.

In addition to National Forest timber harvest activities, several commercial logging companies have operated within the subbasin over the years. Currently, Plum Creek Timber Co. operates within the Upper North Fork and Lochsa AUs, and Potlatch Corporation operates primarily (not entirely) within the Lower North Fork and Lolo/Middle Fork AUs. The Nez Perce Tribe also has an active timber management program on tribally managed lands primarily within the Lower Clearwater AU.

Recent timberland ownership and production by county and ownership is presented in Table 22, Table 23, Table 24, and Table 25 for the five principle counties encompassing the Clearwater subbasin (Shoshone county is excluded since only a very small portion of the county in located in the Clearwater subbasin).

4.10.7 Agriculture

Agriculture primarily affects the western third of the subbasin on lands below 2,500 feet elevation, largely on the Camas Prairie both south and north of the mainstem Clearwater River. Additional agriculture is found on benches along the main Clearwater and its lower tributaries such as Lapwai, Potlatch, and Big Canyon Creeks. Hay production in the meadow areas of the Red River and Big Elk Creek in the American River watershed accounts for most of the agriculture in the South Fork Clearwater AU (Clearwater subbasin Bull Trout Technical Advisory Team 1998d). Total cropland and pasture in the subbasin exceeds 760,000 acres (Table 26). Table 26 indicates the scale of agricultural production in the area by county and indicates changes in agricultural activity over a ten year period.

Table 22. Acres of timberland by county and ownership class (1991) - thousand acres (FIA Database Retrieval System 2001)

County	All Ownerships	USFS	BLM	Nez Perce Tribe	State	County and Municipality	Forest Industry	Farmer/ Rancher	Corporation	Individual	Misc. Federal
Idaho	2,497	2,094	53	7	66	0	53	176	6	42	0
Clearwater	1,235	532	0	0	244	0	361	44	0	25	29
Latah	426	175	0	0	36	0	105	92	0	18	0
Lewis	76	0	7	11	0	0	0	58	0	0	0
Nez Perce	96	0	0	7	13	0	0	47	29	0	0
All Counties	4,330	2,800	60	25	359	0	518	417	35	86	29

Table 23. Timber harvest (MBF) by ownership during 1996 for the five principal counties in the Clearwater subbasin (FIA Database Retrieval System 2001)

	National Forest	Other Public Lands	Forest Industry	Other Private Lands	Total
MBF Timber Removed	149,691	115,269	285,274	163,428	713,713

Table 24. Timber harvest (MBF) by county during 1996. (FIA Database Retrieval System 2001)

	Clearwater	Idaho	Latah	Lewis	Nez Perce	Total
MBF Timber Removed	353,537	170,246	149,060	24,732	10,408	713,713

Table 25. Harvest (MBF) of various timber products by ownership removed during 1996 (FIA Database Retrieval System 2001)

	Saw Logs	Veneer Logs	Pulp Wood	Fuel Wood	Post Poles Pilings	Other Products	All Products
National Forest	88,100	5,752	11,903	11,950	2,203	9,352	117,555
Other Public Lands	66,814	7,176	22,525	612	2,515	1,375	89,659
Forest Industry	109,061	59,105	87,209	20,738	0	3,094	226,236
Other Private Lands	104,089	2,602	22,386	19,925	229	567	129,039
Total	368,064	74,636	144,024	53,225	4,940	14,387	562,489

Table 26. Indicators of agricultural production

Year/ County	Farms (#)	Land in Farms (ac)	Total Cropland (ac)	Pasture (ac)	Wheat (bu)	Barley (bu)	Hay (tons)	Beans (100 wt)	Cattle (#)	Grazing Perm (#)	CRP (ac)	Fertilizer (ac)	Pesti-cides (ac)	Herbi-cides (ac)
1987														
Clearwater	216	134,891	40,095	5,910	560,933	296,028	11,262	1 farm	4,852	32	429	16,581	4,798	12,354
Idaho	774	802,746	265,065	502,919	4,304,514	1,971,819	62,271	1 farm	49,736	101	5,999	114,034	21,765	66,719
Latah	644	352,777	263,759	72,141	6,595,679	2,154,124	24,232	10,629	12,385	42	4,788	158,075	93,194	125,654
Lewis	191	222,624	157,551	58,890	3,509,523	1,806,156	12,174	0	6,466	20	6 farms	112,794	48,322	75,962
Nez Perce	405	473,987	216,575	247,886	5,942,291	1,529,791	16,244	24,469	16,082	30	1,463	135,106	74,536	136,514
1997														
Clearwater	210	73,103	41,614	7,327	436,644	331,159	14,101	2,741	3,963	23	2,570	23,215	9013+	10,759
Idaho	661	193,582	225,585	429,546	3,726,933	1,738,752	73,653	2 farms	41,393	117	11,519	120,417	15,955	86,468
Latah	659	325,484	237,543	65,497	5,759,698	1,177,324	34,882	15,890	10,301	43	32,743	134,913	63,277	131,173
Lewis	182	193,582	140,160	46,629	3,497,755	1,292,117	12,191	0	4,723	15	3,697	99,868	23,339	79,263
Nez Perce	383	339,476	208,288	130,778	5,922,902	1,280,687	21,640	74,736	14,168	35	5,874	142,912	47,164	130,443
% Change														
Clearwater	-2.8	-45.8	3.8	19.3	-22.2	11.9	25.2	~300	-18.3	-28.1	499.1	40.0	~87.84	-14.8
Idaho	-14.6	-75.9	-14.9	-14.6	-13.4	-11.8	15.5	~100	-16.8	15.8	92.0	5.6	-26.7	29.6
Latah	2.3	-7.7	-9.9	-9.2	-12.7	-45.3	44.0	49.5	-16.8	2.4	583.9	-14.7	-32.1	4.4
Lewis	-4.7	-13.0	-11.0	-20.8	-0.3	-28.5	0.1	0.0	-27.0	-25.0	~516.7	-12.9	-51.7	4.3
Nez Perce	-5.4	-28.4	-3.8	-47.2	-0.3	-16.3	33.2	205.4	-11.9	16.7	301.5	5.8	-36.7	-4.4

Table 27. Clearwater subbasin CRP practices in acreage from 1986-2001 (U.S. Department of Agriculture 2000a)

County	Conservation Reserve Practice by Activity Acre								
	Established Grass	Introduced Grasses	Native Grasses	Tree Planting	Established Trees	Wildlife Habitat	Wildlife Food Plots	Filter Strips	Riparian Buffers
Clearwater	1,481.9	894.6	1,637.9	257.1	20.0	0	0	0	142.2
Idaho	8,168.6	2,590.5	441.0	623.7	454.6	2,156.1	98.9	37.2	4.0
Latah	20,284.4	16,220.3	4,973.1	1,029.4	1,259.5	677.8	30.4	84.6	25.4
Lewis	1,345.5	2,813.9	799.0	562.3	89.6	239.7	59.6	92.7	316.8
Nez Perce	1,390.4	3,191.3	700.4	214.5	5.4	3,326.9	36.7	170.5	5.6

Agriculture is a large part of the economy in Nez Perce, Latah, Lewis, and Idaho Counties, which have large areas of gentle terrain west of the Clearwater Mountains. Small grains are the major crop, primarily wheat and barley. Landscape dynamics, hydrology, and erosion in these areas are primarily determined by agricultural practices. In recent years programs run by NRCS have made headway in addressing some of the worst erosion problems on these lands.

The Conservation Reserve Program (CRP) as managed by NRCS, assists farmland owners and operators in conserving and improving soil, water, and wildlife resources. Highly erodible and other environmentally sensitive acreage previously devoted to the production of agricultural commodities is converted to a long-term approved cover for 10 to 15 years. CRP enhances habitats, forage, and sediment delivery reduction. Signups have been occurring since the 1985 Farm Bill (Greg Schlenz, NRCS, personal communication January 3, 2001). The CRP has made improvements to over 79,000 acres within the Clearwater subbasin from 1986-2001 (U.S. Department of Agriculture 2000a; Table 27).

4.10.8 Grazing

Historical Grazing in the Clearwater

Before the era of fire suppression, forage availability in forested habitats was much greater. With fire suppression, opportunistic grazing that occurred after natural wildfires has slowly been replaced by grazing openings resulting from timber harvest. Historically, both Native Americans and Euroamerican settlers recognized that forage for domestic livestock was abundant in some forested habitats. Large bands of horses or sheep were moved into previously burned areas to take advantage of the flush of new forage that emerged after fires. The Nez Perce Indians implemented prescribed fire management, in part to create forage for their large horse herds. Use was probably concentrated in areas where forage was abundant and horses were easily gathered. Mountain grazing was probably light. During the gold rush in the mid 1860s, immigrants brought domestic sheep and cattle to the area. As more people moved to remote boomtowns, livestock ranching increased. Stock growers set up livestock operations around major trailheads that led to the mining camps.

By 1908, when the Nez Perce National Forest was established and grazing laws were enacted, combination farm and ranch homesteads on the prairie were common. Stites, a community along the South Fork Clearwater, was the major livestock shipping area for the entire county. Since the mid 1800s, domestic livestock have grazed BLM, State, and Tribal lands. The location, extent, and effects of that early grazing are unknown. Early surveys for some locations indicate poor conditions of riparian zones resulting from both agricultural use and overgrazing.

Historical information on livestock grazing within the Clearwater subbasin is limited in scope and availability, pertaining almost entirely to the Clearwater National Forest. General trends throughout the subbasin were likely similar to those described for the Clearwater National Forest. Although no information is available regarding the earliest numbers of sheep grazed, historical documentation suggests that grazing of sheep on National Forest lands began as early as the 1890s (Space 1964). Due to both increased forage available caused by fires and the end of World War I, numbers of sheep grazed within the Clearwater National Forest increased through the mid 1930s, peaking at about 33,300 in 1933. Intensity of sheep grazing declined sharply in subsequent years to 2,000 by 1949, and remained relatively consistent until the mid 1960s. Permits for cattle grazing were not issued in the Clearwater National Forest until 1937, with 25 head permitted. By 1943, over 400 head of cattle were permitted for grazing in the Clearwater National Forest and although it was suggested that grazing pressure was too heavy even at these levels, it was considered a wartime necessity. Cattle grazing continued to increase, reaching 1,199 head by 1960 (Space 1964).

Current Grazing in the Clearwater

Available data on current grazing distribution is limited to allotments on public lands within the subbasin. Grazing also occurs on much of the privately owned land (without public record of grazing intensity or duration). Data on grazing intensity of public lands is limited to permitted numbers of animal unit months (AUMs) and does not necessarily reflect actual numbers of animals grazed (One AUM is equal to: one bull, steer, or cow with suckling calf, one horse/ mule, or five sheep/goats grazing for one month). This lack of accurate data, especially on private lands, makes summarization of realized grazing intensity impractical for the subbasin as a whole using available information on grazing allotments and associated AUMs.

Current grazing distribution and intensity was estimated in a relative sense for each HUC according to the percent of the total land area defined as grazeable. Using available GIS layers, the distributions of known grazing allotments and other grazeable lands (as defined in the USGS GIRAS database) were combined to estimate the actual area of lands potentially grazed on both public and private lands throughout the subbasin. The grazeable area within each 6th field HUC was summarized as a percentage of the total land area (Figure 37). Subwatersheds with the highest proportion of grazeable area (> 50%) within the Clearwater subbasin are typically associated with USFS grazing allotments in lower elevation management areas. However, the majority of lands managed by the USFS within the Clearwater subbasin are not subjected to grazing by cattle or sheep, including all or nearly all of the Upper Selway, Lochsa, and Upper and Lower North Fork AUs. Subwatersheds outside of the Forest Service boundary typically have less than 25% of the land area defined as grazeable, although this is as much as 75% for some (Figure 37). Privately owned property within the subbasin typically contains a high percentage of agricultural use, with grazeable lands found only in uncultivated areas. In contrast, grazing allotments on Forest Service lands are typically large, often encompassing multiple HUCs, resulting in higher proportions of grazeable area than those contained in primarily privately owned lands. Current descriptions of grazing management entities and areas managed are provided below.

Idaho Department of Lands

In 2000 the IDL leased 15 active allotments within the Lower North Fork Clearwater and the Potlatch drainage systems. Grazing took place from June 1 to November 31, with all allotments running cow/calf pairs. Five allotments on the Lower Clearwater drainage cover 42,433 acres, with 1,970 AUMs. Total range consisted of 107,327 acres supporting 4,758 AUMs. No concerns regarding range condition were noted. State lands often overlap Forest Service properties and allotment use totals.

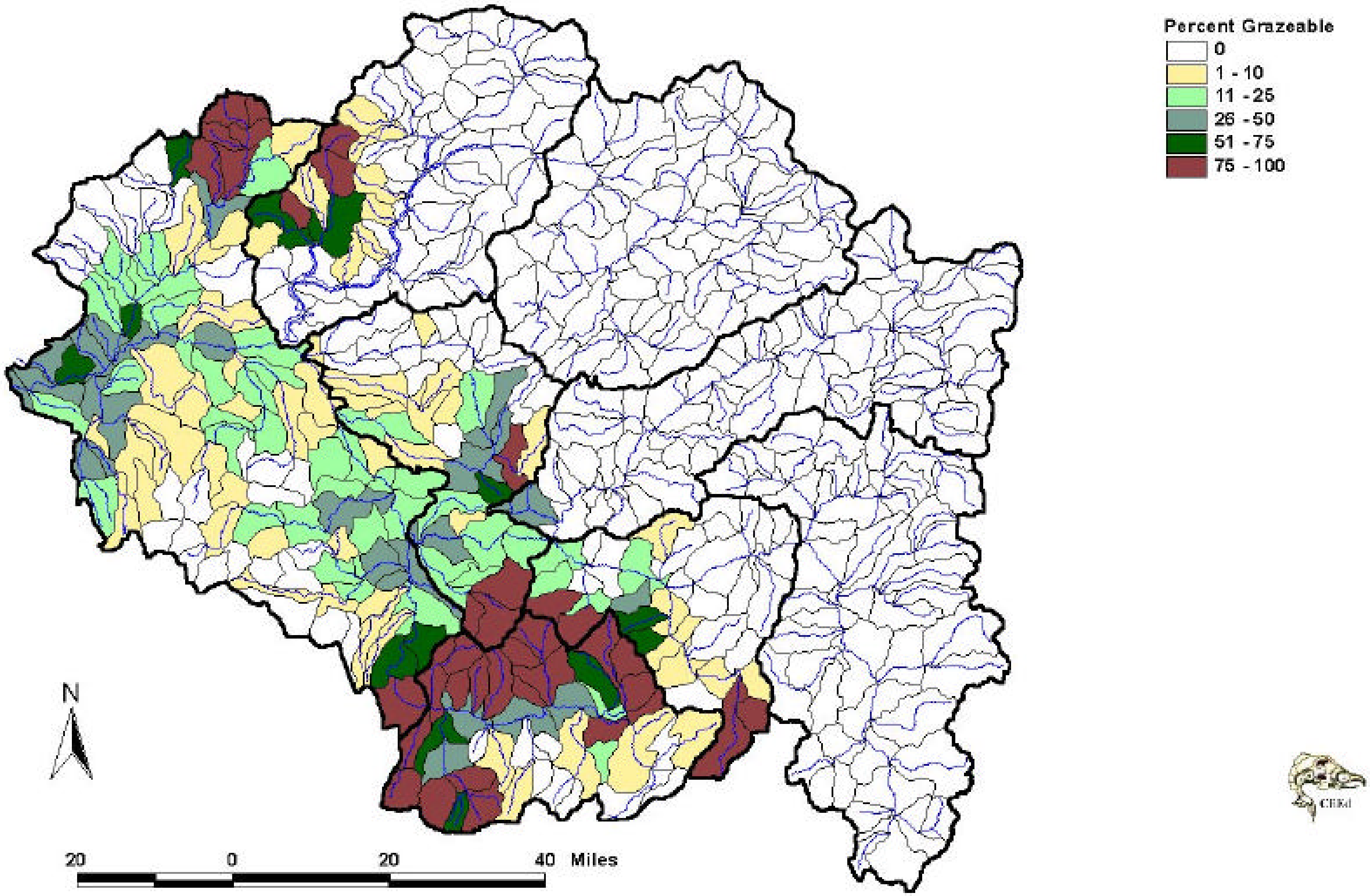

Figure 37. Spatial distribution of probable grazing activities within the Clearwater subbasin and the approximate percentage of each subwatershed defined as grazeable

Nez Perce County

Cattle and horses from 427 animal feeding operations, account for 95% of species and 98% of the AUMs in the county. Livestock grazing occurs predominantly in the spring and summer months, although some rangeland units are grazed for a 12 month period (Nez Perce Resource Conservation Plan 2000). A majority of rangeland acres occur on steep canyon sides, with slopes ranging from 40 to 90 percent, and adjacent to perennial streams or intermittent drainages. Of the feeding areas inventoried, 41% allowed livestock direct access to streams and 46% had less than adequate means of containing feedlot runoff to prevent stream contamination (Nez Perce Resource Conservation Plan 2000). Prescribed grazing plans have been implemented on 1,442 acres (Nez Perce Resource Conservation Plan 2000).

Watersheds were ranked according to risk for negatively impacting water quality due to livestock grazing. Lindsay Creek was listed as the only Very High risk watershed, while High risk drainages listed included Tammany Creek, Middle Potlatch, Pine Creek, Lapwai Lake, Cottonwood Creek, Garden Gulch, Lower Clearwater River, Cedar Creek, and Main stem Lapwai Creek (Nez Perce Resource Conservation Plan 2000).

Plant resource concerns associated with Nez Perce County grazing lands are poor grazing management and noxious weed infestations. Noxious weed invasions onto rangelands have drastically reduced forage production, and aggressive weeds of concern include Yellow starthistle (*Centaurea solstitialis*) and cheatgrass brome (*Bromus tectorum*) (Nez Perce Resource Conservation Plan 2000). Severe soil limitations and low production potential of rangelands cause habitat improvement practices to be very costly and result in small returns on investments.

Bureau of Land Management

Available data for BLM grazing allotments is only partial information and based on incomplete coverage. The BLM manages approximately 32,959 acres of rangeland with a potential grazing capacity of 17,189 AUMs. The actual grazed rangeland in 2000 was approximately 27,400 acres with 3,555 AUMs.

Nez Perce Tribe

The total grazing coverage of Tribal properties totals 33,738 acres with an estimated 10,420 AUMs. Most grazing operations are running cow/calf pairs.

Clearwater National Forest

In 1996 there were 50 permittees with 1,600 cattle, and 2,600 horses for a total of 10,500 AUMs on the Clearwater National Forest. Livestock forage was available and range was in good condition per established allotments (Clearwater National Forest 1996).

Historically, meadow and riparian communities would have contained more riparian shrubs than they did in 1996. Past logging activities and livestock grazing have contributed to a decline of riparian shrub cover. In 1996, cattle utilized 50-60% of the herbaceous material, and shrub cover within the Potlatch allotments has been reduced to 40% or less along stream banks and meadow margins. Desired condition is 80–100% shrub cover in riparian areas, and greater than 30% shrub cover around meadow margins where shrubs naturally occur (Clearwater National Forest 2000).

Currently there are 17 active allotments–14 on the Palouse Ranger District and 3 on the Lochsa Ranger District. Thirty-five permittees have 1,466 cattle and 416 horses with a total of 9,700 AUM (Clearwater Monitoring and Evaluation Report 2000). Noxious weeds were controlled on about 1,400 acres, and certain areas along the Lower Lochsa, North Fork

Clearwater, Cayuse Air Field, and the Palouse Ranger District (Clearwater Monitoring and Evaluation Report 2000).

Nez Perce National Forest

In 1987, 65 permittees ran livestock on 59 allotments for 4-6 months between May and October. Use consisted of approximately 6,600 cattle and 3,400 sheep, while 25 commercial outfitters grazed approximately 350 horses during the hunting season (supplemental feed accounts for ½ of the feeding requirements). Between 1,200 and 1,500 recreational horses grazed the forest periodically (Nez Perce National Forest 1987). Domestic livestock on 316,000 acres of suitable range grazed 42,000 AUMs. An estimated 52,000 acres are transitory range created by timber harvests (transitory range is only available 20-40 years after stand removal until forest canopy closure is reestablished), with the remaining 266,500 acres spread throughout various primary range vegetation types. An additional 2,500 acres of suitable range in wilderness areas were open to commercial outfitters and recreational horse grazing. Grazing occurs in the Gospel Hump Wilderness but not in the Selway-Bitterroot or the Nez Perce National Forest portion of the Frank Church River of No Return Wilderness (Nez Perce National Forest 1987).

Livestock grazing gradually increased to 43,000 AUMs by 1997. Since primary range on the Forest is fully stocked, any increase in future livestock grazing will be on acres of temporary range created by vegetative management activities. The maximum potential for range in 1987, after adjusting for wildlife use, closed allotments, and remote locations, was 59,300 AUMs (Nez Perce National Forest 1987). Range condition and trend surveys in the mid-80s indicated that most riparian areas were stable. Over 58% of the grassland and browse vegetative types were in good or better condition, while the remaining range was in fair condition (Nez Perce National Forest 1987). Livestock grazed elk winter range during the summer months and this use combined with elk grazing in the winter and spring adversely affects grass vigor if combined use is excessive. Reduction in elk wintering range varied from 0-43% (20% across the Forest), and loss in summer range varied from 10–13% (Nez Perce National Forest 1987).

Grazing guidelines have been established to manage the effects of livestock grazing, with the goal of maintaining desirable riparian conditions and restoring degraded streams. Under the new guidelines, forage and shrub utilization would each be 40 percent or less, and stream bank disturbance would be held to 10 percent of the bank distance. Results for this year (2000) suggest that permittees were fairly successful in meeting the new standards. Forty-eight riparian areas were monitored and all but one were within the disturbance limits (Nez Perce National Forest 2000). Noxious weed control program target areas are Moose Creek and Shearer Airstrips, but funding is currently unavailable to implement the program.

There were 33,500 AUMs permitted on the Nez Perce National Forest in 2000, but actual utilization was approximately 32,000 AUMs. Animal composition consisted of 12,266 sheep or goats, and 19,549 cattle or horses (Nez Perce National Forest 2000). There are seven allotments in the Selway drainage at this time: 3 active, 2 closed and 2 vacant. Allotments cover 155,506 acres with 910 active AUMs being currently utilized.

Cattle are the only livestock permitted on USFS lands in the South Fork Clearwater drainage (NPNF 1998). There are 12 active allotments totaling 222,100 acres, and 105,450 acres have suitable forage for grazing. Approximately 8 of those allotments are within the Clearwater subbasin boundaries and total 220,580 acres. About one third of the total allotments in the South Fork Clearwater drainage have documented areas of overuse resulting in damage to stream banks and reduced riparian vegetation (NPNF 1998). Erosion concerns on rangelands are primarily ephemeral gully and stream bank erosion where livestock have direct access to streams for drinking and crossing (Nez Perce Resource Conservation Plan 2000). Riparian areas adjacent to pastures with excessive livestock grazing are degraded from lack of protective wood and perennial grass cover. Lack of protective vegetation along stream channels increases channel erosion during runoff events. (Nez Perce Resource Conservation Plan 2000).

4.10.9 Mining

The South Fork Clearwater drainage in particular has a complex mining history that included periods of intense placer, dredge, and hydraulic mining (see Figure 38) (Paradis et al. 1999b). Within the North Fork drainage, mining activity was widely dispersed and methods used varied by area and included dredging, hydraulics, draglines, drag shovels, and hand operations (Staley 1940).

Mining of placer and surface deposits is more often represented by mining claims than by physical mines. Mine claim density is typically indicative of relatively small-scale placer and dredging operations, and impacts of these operations are often more directly tied to streams than those of mines themselves.

Mines are distributed throughout all eight AUs in the Clearwater subbasin, with the lowest number of occurrences in the Upper and Lower Selway AUs (Figure 40). Ecological hazard ratings for mines (delineated by ICBEMP) indicate that the vast majority of mines throughout the subbasin pose a low relative degree of environmental risk. However, clusters of mines with relatively high ecological hazard ratings are located in the South Fork AU and in the Orofino Creek drainage (Lolo/Middle Fork AU).

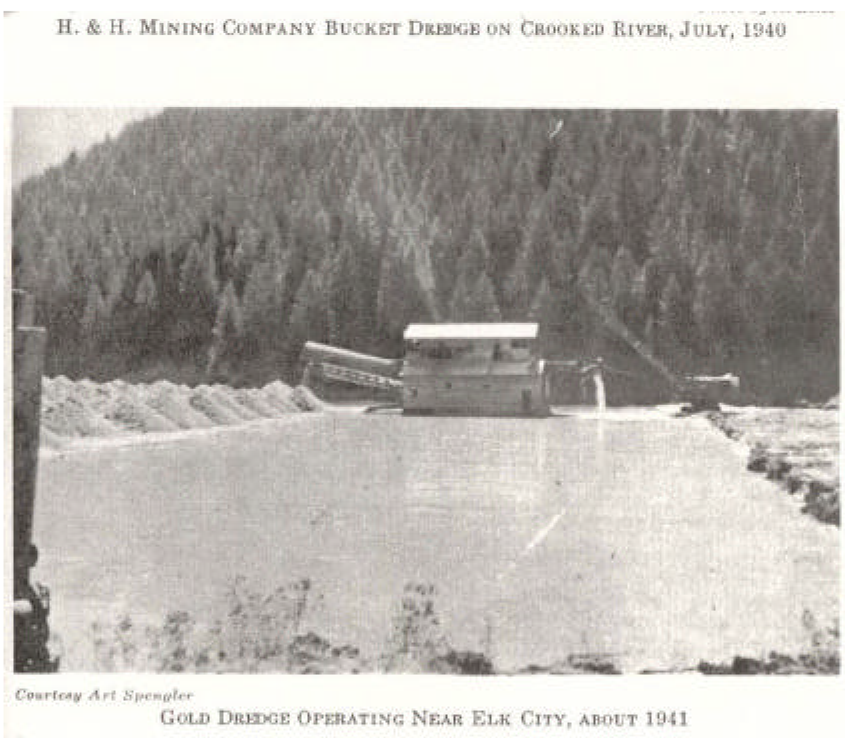

Figure 38 Gold Dredge in Crooked River in the South Fork Clearwater drainage (Photo courtesy of Don Morrow)

Mining claims are most widely and densely distributed within the South Fork drainage, although substantial numbers of claims have been staked in other areas as well (Figure 41). Mining claims are also aggregated in a line extending from the upper Middle Fork and lower Lochsa River northward to Orogrande Creek, then along the upper North Fork to its headwaters including Meadow, Long, Osier, and upper Kelly Creeks. Another conglomeration of mining claims exists in the Little North Fork drainage, and includes the Foehl Creek drainage and an adjacent portion of the Little North Fork itself. Within the Clearwater subbasin, mining claim distribution does not correspond well with the general distribution of actual mines, although exceptions to this can be seen in the South Fork Clearwater and Osier Creek (Upper North Fork Clearwater) drainages. Effects of past placer mining activity, including extensive dredge spoils, are still evident, particularly in the South Fork AU.

Figure 39 Hydrologic mining on Leggett Creek in the South Fork Clearwater drainage (photo courtesy of Don Morrow)

4.11 Diversions, Impoundments, and Irrigation Projects

Based on records obtained from the Idaho Department of Water Resources, 70 dams currently exist within the boundaries of the Clearwater subbasin (Figure 42). The vast majority of existing dams occur within the Lower Clearwater AU (56), although dams also currently exist in the Lower North Fork (3), Lolo/Middle Fork (5), and South Fork (6) AUs. Of the 70 dams, descriptive data concerning the size, capacity and ownership is available for only 46 (Table 28). The remainder are thought to be small earthen structures with minimal storage capacity.

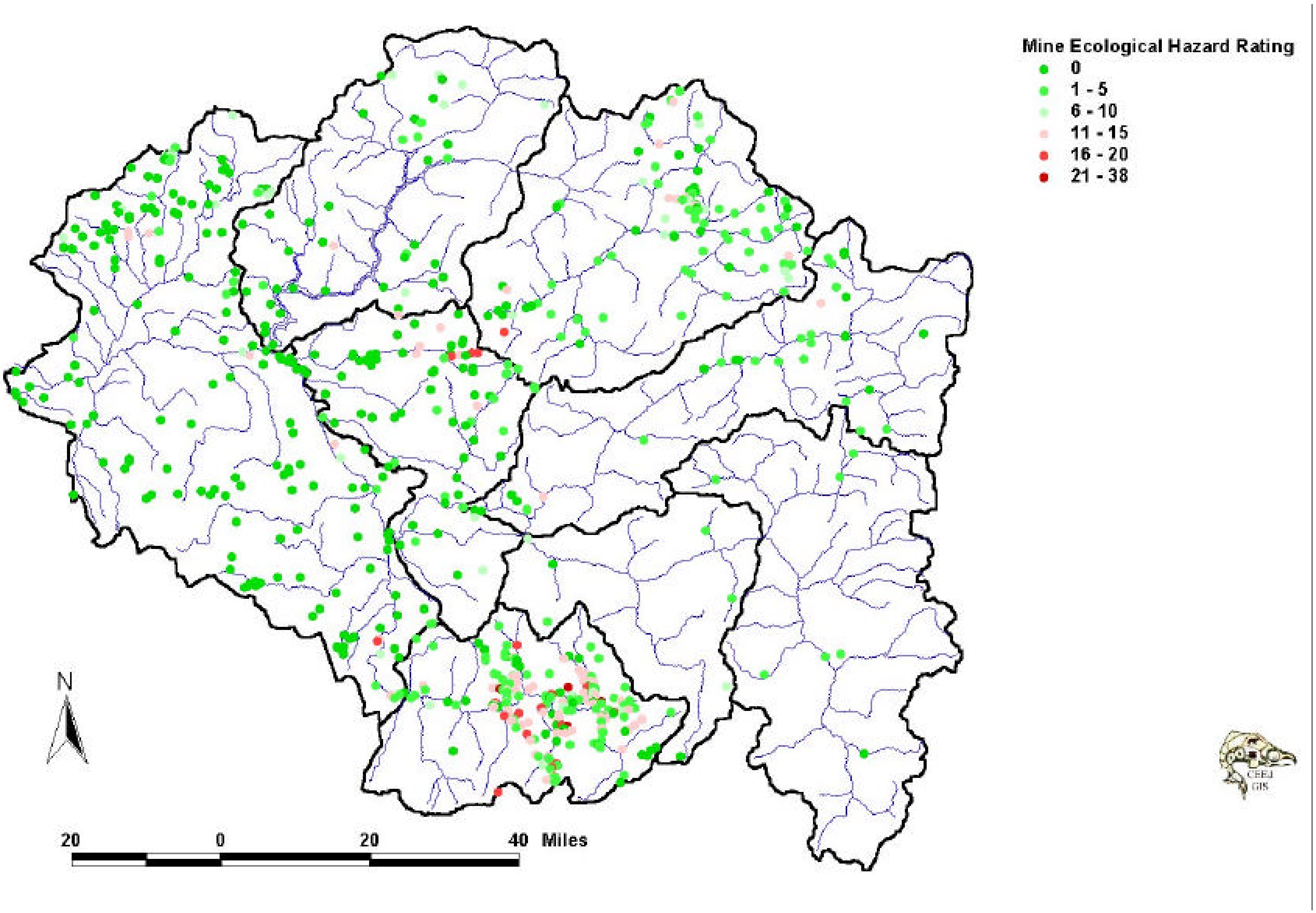

Figure 40. Mine locations throughout the Clearwater subbasin. Color codes signify relative ecological hazard of individual mines as defined by ICBEMP

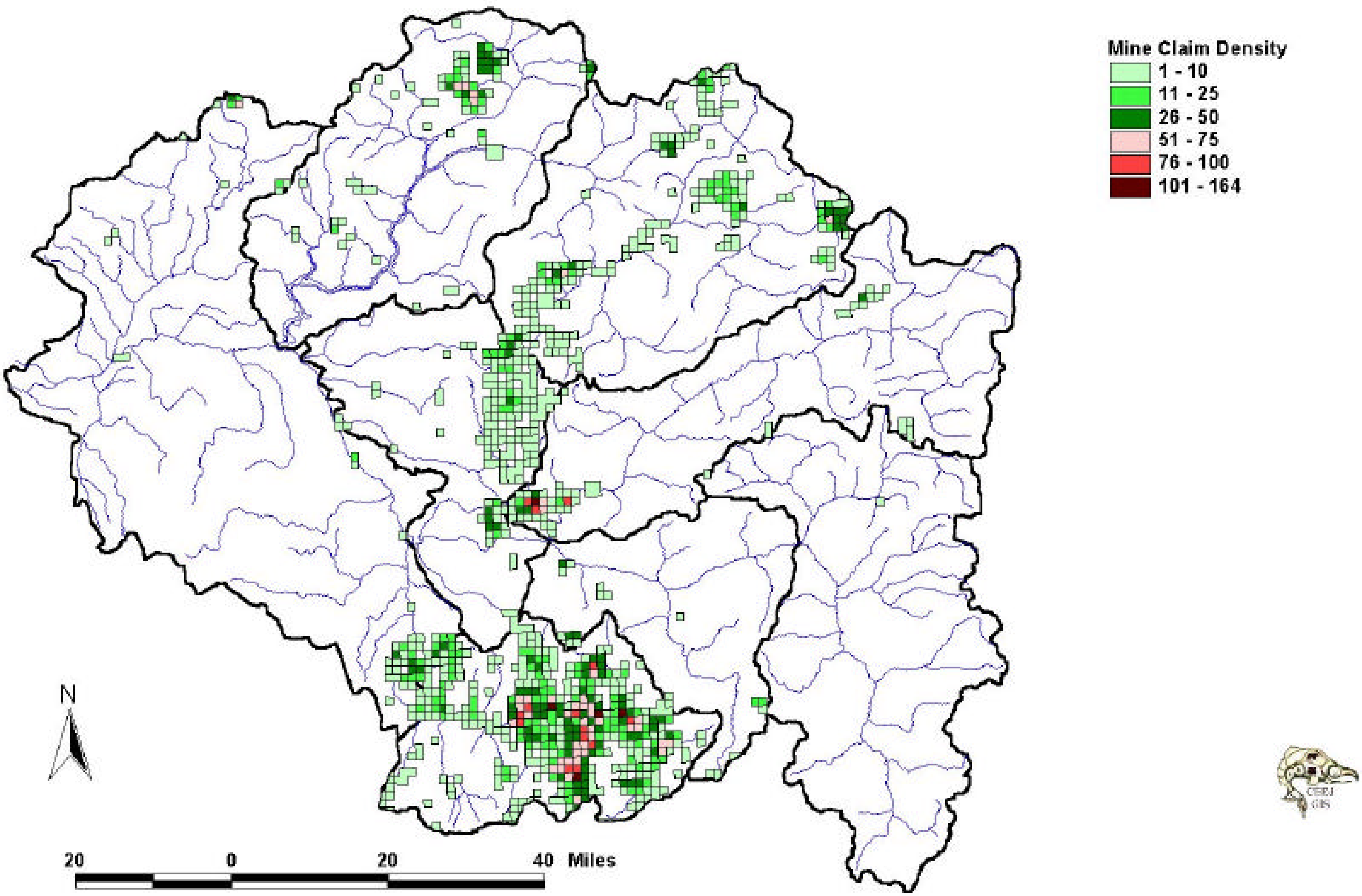

Figure 41. Mining claim distribution and density within the Clearwater subbasin

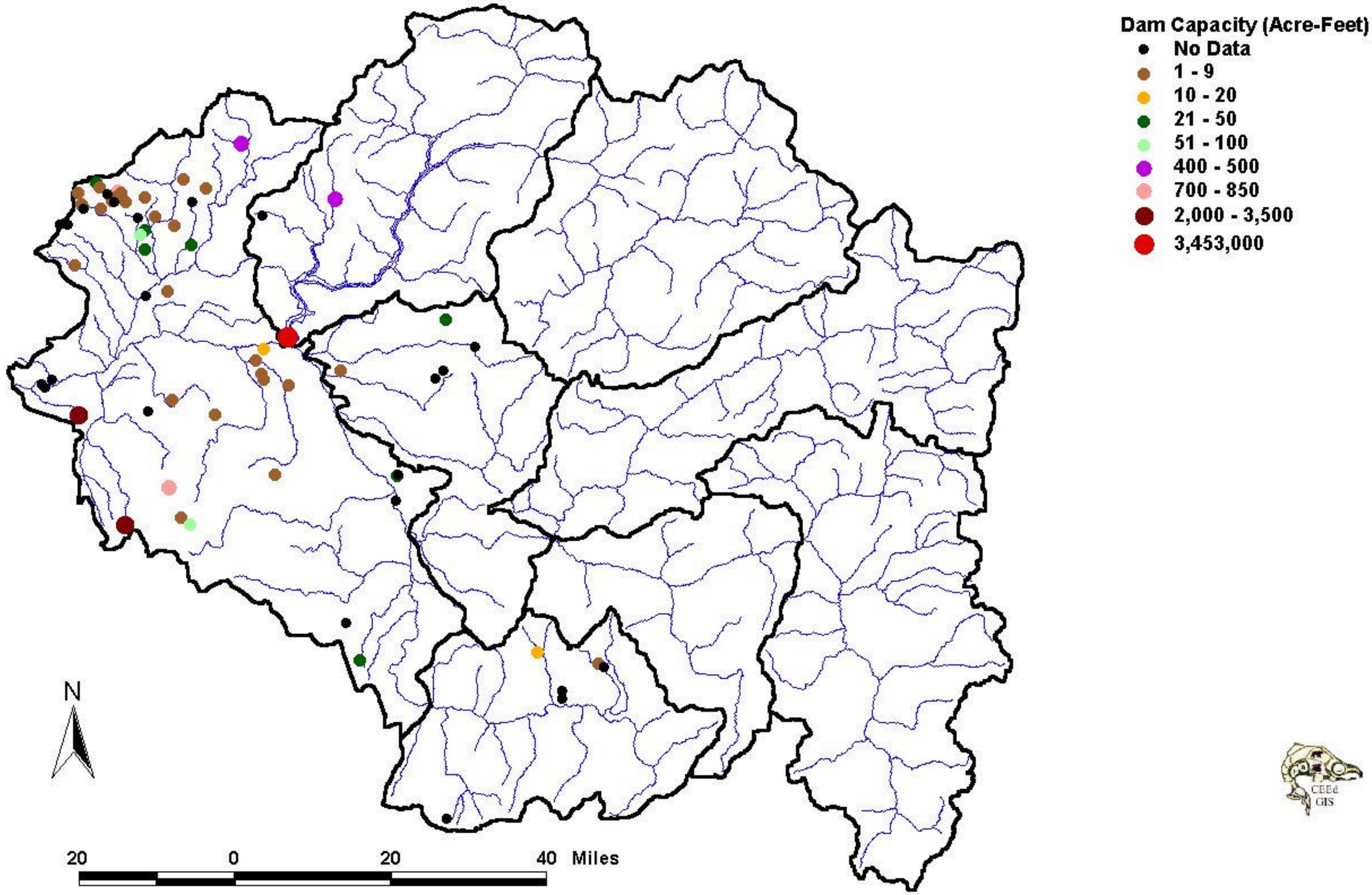

Figure 42. Location of existing dams within the Clearwater subbasin

Table 28. Information pertaining to dams located within the Clearwater subbasin, ordered by reservoir storage capacity

Dam Name	Stream	Type	Storage Capacity (Acre-ft)	Height (feet)	Reservoir Area (Acres)	Year Filled	Owner
Dworshak	N Fork Clearwater R.	Concrete	3,453,000	633.0	16,417	1973	U S Army Corps Of Engineers
Reservoir A (Manns Lake)	Sweetwater Creek (Os)	Earth	3300	57.0	145	1907	U S Bureau Of Reclamation
Soldiers Meadow	Webb Creek	Earth	2370	50.0	121	1923	U S Bureau Of Reclamation
Winchester (Lapwai Lake)	Lapwai Creek	Earth	850	36.0	98	1910	Idaho Fish And Game Department
Spring Valley	Spring Valley Creek	Earth	721	42.3	53	1962	Idaho Fish And Game Department
Elk River	Elk Creek	Earth	481	11.0	61	1951	Elk River Recreation Dist.
Moose Creek	Moose Creek	Earth	420	15.0	70	1960	Idaho Department Of Lands
Nelson	Tr-Big Bear Creek	Earth	65	13.5	9	1907	Maxine Nelson
Talmaks Campground	N Fk Willow Creek	Earth	56	7.0	10		U S Bureau Of Indian Affairs
Mud Springs [1]		Earth					US Bureau of Indian Affairs
Thompson No 1	Tr-Little Canyon Ck.	Earth	54	15.0	7	1967	Tim Craig
Arneberg	Tr-Dry Creek	Earth	45	19.0	6	1952	Arneberg Brothers
Mariposa Foundation	Tr-Pine Creek	Earth	38	19.0	7	Prop	Mariposa Foundation Inc.
Campbells Pond	Hay Creek	Earth	35	19.0	7	1939	Idaho Department of Fish and Game
Spencer	Tr-Threemile Creek	Earth	30	13.0	5	1954	Spencer Ranch Inc.
Reierson	Tr-Little Bear Creek	Earth	30	14.5	5	1901	Paul E Reierson Trust
Troy	Big Meadow Creek	Earth	25	43.0	2	1950	City Of Troy
Rundell	Tr-Tom Taha Creek	Earth	23	14.5	6	1975	Richard Duclercque
Thompson No 2	Tr-Clearwater River	Earth	11	16.0	3	1970	Clint Thompson
Newsome Creek	Tr-Newsome Creek	Earth	10	20.0	1	Prop	U S Forest Service
Ericson Creek	Ericson Creek	Earth	9	16.0	2	1975	U S Forest Service
Stauber	Tr-Little Potlatch Creek	Earth	9	14.3	3	1991	Erik Stauber
Bower	Tr-Pine Creek	Earth	9	15.0	2	Unk.	Charles Bower
Thompson	Tr-Little Canyon Creek	Earth	9	21.0	2	Unk.	George Thompson
Ruckman	Tr-Sixmile Canyon	Earth	9	15.0	2	Unk.	Edward And Thomas Ruckman

Table 28 (Continued)

Dam Name	Stream	Type	Storage Capacity (Acre-ft)	Height (feet)	Reservoir Area (Acres)	Year Filled	Owner
Carlson No 3	Tr-Big Meadow Creek	Earth	8	14.0	3	Unk.	Dave Carlson
Pfeifer	Tr-Lapwai Creek	Earth	8	15.0	1	Prop	Ronald And Judy Pfeifer
Butler	Tr-Cottonwood Creek	Earth	8	18.3	1	1950	Evelyn Bulen
Hofstrnd	Tr-Felton Creek	Earth	7	15.0	1	1996	Mark And Debra Hofstrand
Ewert (Carlson No 2)	Tr-Big Meadow Creek	Earth	6	15.0	1	Unk.	Steve Ewert
Kingery	Tr-Mt Deary Creek	Earth	6	11.4	1	1991	Peggy E Kingery
Henderson	Tr-Holes Creek	Earth	6	18.0	1	1958	Wynne Henderson
Stillman No 1	Tr-Little Canyon Creek	Earth	6	14.0	1	Unk.	Carl Stillman
Stillman No 2	Tr-Little Canyon Creek	Earth	6	16.0	1	Unk.	Carl Stillman
Bowman	Tr-Jim Ford Creek	Earth	5	11.2	1	1994	Dwight Bowman
Olson	Tr-W Fk Little Bear Ck	Earth	5	17.0	1		Lester And Nancy Morfin
Carlson No 1	Tr-Spring Valley Creek	Earth	3	12.0	1	1966	Dave Carlson
Henry	Tr-Wauncher Gulch	Earth	3	14.0	1	1969	Allen Henry
Albers	Tr-Little Canyon Creek	Earth	2	14.0	1	1979	Raymond Albers
Hokanson	Tr-Dry Creek	Earth	2	17.0	1	1972	Kenneth Hokanson
Caldwell No 1	Tr-Randal Flat Creek	Earth	2	19.0	1	1977	Delbert Caldwell
Caldwell No 2	Tr-Randal Flat Creek	Earth	2	14.0	1	Unk.	Delbert Caldwell
Feldman	Tr-Spring Valley Creek	Earth	2	16.0	1	1971	L Gene Feldman
Gilder	Tr-Spring Valley Creek	Earth	2	16.0	1	1971	Glen Gilder
Deters	Tr-Big Meadow Ck.	Earth	1	12.0	1	1978	Don Deters
Winn	Tr-Brush Creek	Earth	1	14.0	1	1971	Mrs Clarence Winn
Kerley	Tr-Dry Creek	Earth	1	12.0	1	1985	Mike Kerley

1 Mud Springs Dam is not included in the IDWR database. Information supplied by Nez Perce Tribe.

The seven largest reservoirs in the subbasin provide recreational and other beneficial uses. Dworshak, Reservoir A, Soldiers Meadows, Winchester, Spring Valley, Elk River, and Moose Creek reservoirs all provide recreational fishing opportunities. Reservoir A and Soldiers Meadows Reservoir are also part of the Lewiston Orchards Irrigation District system. Capacity of other reservoirs within the Clearwater subbasin is limited to 65 acre-feet or less, and in most cases is less than 15 acre-feet (Table 28), limiting their recreational capacity.

Dworshak Dam is the largest straight axis concrete dam in the United States. The project was authorized primarily for flood control (Mehrhoff and Sather-Blair 1985), with other purposes including power generation, commercial navigation and recreation (USACE 1974). Planning for the dam and reservoir was initiated by the USACE in the 1950s. Authority for construction was contained in Public Law 87-874, Section 201 of the Flood Control Act of 1962 in accordance with House Document 403, 87th Congress, 2nd Session (USACE 1975). On September 27, 1971, the river diversion tunnel was sealed and Dworshak Reservoir was formed (Hanson and Martin 1989). Filling of the reservoir was started in 1972 and power generation began in 1973 (USACE 1974). The final environmental impact statement (EIS) was completed in 1985 (Hanson and Martin 1989).

The reservoir behind Dworshak dam is 53.4 miles (86 km) long at full pool, with a surface area of 16,417 acres (6,644 ha). Maximum and mean depths are 636.5 ft. (194 m) and 183 ft. (56 m), respectively. Dworshak reservoir provides 3.453 million acre-feet of storage, making it the largest storage project within the Nez Perce Tribe ceded area and the state of Idaho (IDFG and NPT 1991; USACE 1975). Located two miles (3 km) above the mouth of the North Fork Clearwater River, the dam blocked fish passage for anadromous fish to spawning habitat that could accommodate 109,000 steelhead trout redds and 74,000 chinook salmon redds (USFWS 1962). The dam also inundated 16,970 acres (69 km^2) of terrestrial and riverine habitats at full pool (USACE 1975). The reservoir provides 13,343 acres (5,400 ha) of kokanee habitat (defined as the area over 49 ft. deep) at full pool.

Dworshak reservoir drawdowns for flood control may lower the surface elevation 154 ft. (47 m) and reduce surface area by as much as 52%. The reservoir has a mean water retention time of 10.2 months and a mean annual discharge of 162 m^3/s (Falter 1982). High releases from the reservoir occur during spring runoff, during late summer when water is released for anadromous fish flows, and during the fall/winter when the reservoir is lowered for flood control.

Numerous dams that have been removed had substantial impacts on fisheries resources within the subbasin. Lewiston dam, constructed in 1927 on the lower Clearwater River near the present site of the Potlatch pulp mill (RM 4) and operated by Washington Water Power, virtually eliminated chinook salmon runs and substantially reduced steelhead runs into the Clearwater subbasin (NPT and IDFG 1990). Modifications were later made to Lewiston Dam to facilitate fish passage, and the dam was removed in 1973 as part of the Lower Granite Lock and Dam Project.

A low-head hydroelectric diversion dam on the North Fork Moose Creek (Upper Selway AU) thought to be a partial barrier for anadromous species was removed in the mid 1960s (NPT and IDFG 1990). A dam constructed by Washington Water Power in 1910 on the lower South Fork Clearwater (RM 22) near the town of Harpster blocked anadromous salmon species from the South Fork Clearwater River. The dam formed a complete barrier to fish migration, and anadromous salmonids were excluded from the upper watershed from 1911 to 1935 and from 1949 until 1963, when the dam was removed (Paradis et al. 1999b). A fish ladder was installed in 1935 and was destroyed in 1949 by high flows (Paradis et al. 1999b). Murphy and Metsker (1962) reported that steelhead were able to pass over the dam from 1935-1949, but Siddall (1992) reported that the dam failed to pass significant numbers of fish during this period.

The Dewey Dam was built in about 1895 on the South Fork Clearwater River about 0.1 miles above the mouth of Mill Creek (Gerhardt 1999). The dam washed out after only a few years. The Dewey Dam was approximately 6-8 feet high and no known documentation of fish passage conditions exist, except a photo (Figure 43) which does not show fish passage facilities.

Figure 43 Dewey Dam (Courtesy Don Morrow)

The Kooskia Flower Mill Dam, located on the South Fork Clearwater River about 0.6 miles from its mouth, was built prior to 1910 and was in place until some time in the 1930's (Gerhardt 1999). The dam is estimated to have been about 6 feet high, and although fish passage is not documented, it has been suggested that upstream migration of anadromous salmonids was probably not impaired by this structure (Gerhardt 1999).

Dams in the Clearwater subbasin have also had an effect on resident fishes such as bull trout and cutthroat trout. Free movement was blocked, resulting in fragmentation of metapopulations, especially for the North Fork Clearwater River. The impact due to this is not known (Jody Brostrom, IDFG, personal communication, March 30, 2001).

Small scale irrigation, primarily using removable instream pumps, is relatively common for hay and pasture lands scattered throughout the lower elevation portions of the subbasin, but has not been quantified. The only large scale irrigation/diversion system within the Clearwater subbasin is operated by the Lewiston Orchards Irrigation District within the Lower Clearwater AU. The District's irrigation water supply depends on surface water runoff from the Sweetwater Creek drainage, a tributary to Lapwai Creek. Water is stored in three reservoirs, and delivered through a system of canals and natural streams (Morrison Knudsen Corporation 1992).

The storage reservoirs include two man-made reservoirs (Reservoir A and Soldiers Meadows) and one natural lake (Lake Waha). Water is diverted from Soldiers Meadows, Lake Waha, and Sweetwater Creek to Reservoir A through Webb Creek Canal, Lake Waha Feeder Canal, Sweetwater Canal, and Sweetwater and Webb Creeks.

4.12 Protected Areas

Approximately 47% of the Clearwater subbasin is designated as having some degree of protected status, the majority of which is designated as either inventoried roadless or wilderness area (Table 29). Wild and scenic river corridors and research natural areas are each present in seven of eight AUs in the Clearwater subbasin. Other less abundant protected areas include wilderness study areas, BLM designated areas of critical environmental concern, special interest areas, and areas maintained by the National Park Service.

The vast majority of protected areas are in the eastern half of the subbasin (Figure 44), and on lands managed by the U.S. Forest Service. Of eight AUs in the Clearwater subbasin, four have 75% or more of their total land area included in protected areas; the entire Upper Selway AU is protected, and the Upper North Fork, Lochsa and Lower Selway AUs each have at least 75% of their land area designated as protected (Table 29).

Inventoried roadless areas account for the largest proportion of protected area within the Clearwater subbasin, accounting for 51% of all protected areas. Inventoried roadless areas consist of over 2,200 mi^2, or roughly 24% of the Clearwater subbasin. Roadless areas are primarily located in the Upper North Fork, Lochsa, and Lower Selway AUs.

Portions of the Selway-Bitterroot and Gospel Hump Wilderness exist within the Clearwater subbasin, contributing substantially to the total protected area. The Selway-Bitterroot Wilderness encompasses portions of the upper and lower Selway and Lochsa AUs. The Gospel Hump Wilderness extends into the southern edge of the South Fork AU. Combined, the two wilderness areas encompass approximately 1,950 mi^2 within the Clearwater subbasin, accounting for 21% of the total land area and nearly 45% of the total protected area.

Table 29. Approximate area (mi^2) within each AU with various forms of protected status. Numbers in parenthesis represent approximate percent of total land area

Assessment Unit	Inventoried Roadless	Wilderness Areas	Wilderness Study Area	Wild and Scenic River Corridor	Areas of Critical Environmental Concern (ACEC)	Research Natural Area (RNA)	RNA in Wilderness Area	Special Interest Area	National Park Service	Total
Lower Clearwater	0.0	0.0	0.0	15.9 (0.7)	0.0	0.0	0.0	0.0	0.2 (0.0)	16.2 (0.8)
Lower North Fork	215.4 (18.7)	0.0	5.8 (0.5)	19.2 (1.7)	4.2 (0.4)	6.6 (0.6)	0.0	0.2 (0.0)	0.0	251.4 (21.8)
Upper North Fork	962.1 (74.4)	0.0	0.0	0.0	0.0	2.6 (0.2)	0.0	0.0	0.0	964.7 (74.6)
Lolo/Middle Fork	46.1 (6.0)	0.0	0.0	12.2 (1.6)	5.8 (0.8)	0.7 (0.1)	0.0	0.2 (0.0)	0.0	65.1 (8.4)
Lochsa	514.2 (43.7)	369.3 (31.4)	0.0	38.7 (3.3)	0.0	4.9 (0.4)	1.5 (0.1)	0.0	0.0	928.6 (78.8)
Lower Selway	343.8 (51.9)	216.2 (32.6)	0.0	21.4 (3.2)	0.0	13.2 (2.0)	0.0	0.0	0.0	594.6 (89.8)
Upper Selway	50.1 (3.7)	1,266.8 (94.1)	0.0	30.8 (2.3)	0.0	1.3 (0.1)	0.0	0.0	0.0	1,349.0 (100.0)
South Fork	81.1 (10.2)	101.3 (12.8)	0.0	14.3 (1.8)	0.1 (0.0)	1.6 (0.2)	1.1 (0.1)	0.0	0.0	199.4 (25.1)
Totals	2,212.8	1,953.7	5.8	152.5	10.1	30.9	2.5	0.5	0.2	4,369.0 (46.7)

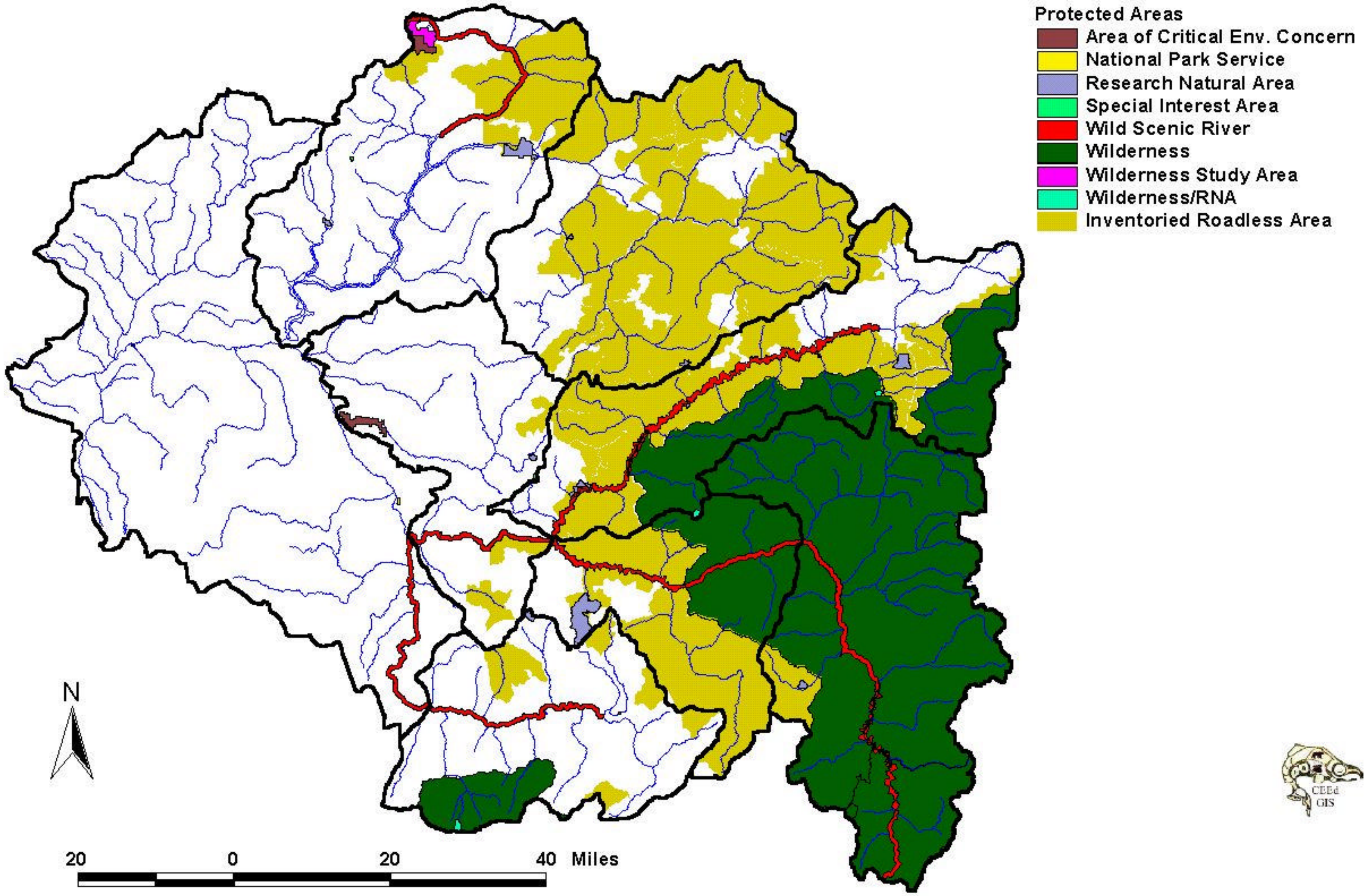

Figure 44. Protected areas within the Clearwater subbasin