3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the existing physical, biological, and social and economic environment in the study area in which the proposed access would take place. The scope of the request for access to parcels of land on the former Spruce #4 mining claim, begins at the park entrance area and ends at the private parcels. Except for the fly and drive alternative, all alternatives require vehicle access on the existing Denali Park Road from mile 14 to mile 89 and beyond. The description of the affected environment is essentially the same for all action alternatives to mile 89. Much of this environment has been described in recent park documents, such as the *EIS on the Cumulative Impacts of Mining in Denali National Park and Preserve* (NPS 1990), the *EIS on the Entrance Area and Road Corridor Development Concept Plan for Denali National Park and Preserve* (NPS 1996), and the *Draft EIS for on Spruce Creek Access* for improved access to a lodge (NPS 1999). This chapter summarizes information from past documents and adds pertinent new information from field studies and literature searches.

3.2 Regional Setting and Weather

Denali National Park and Preserve lies in Southcentral Alaska between latitudes 62° north and 64° N and longitudes 148°30' west and 153° W. The park unit is in the Denali Borough. The Alaska Range bisects the park, culminating in North America's tallest mountain, Mount McKinley, at 20,320 feet. The climate in the region is subarctic continental, with the north side of the Alaska Range being much drier and colder than the south side. The north side of the Alaska Range, where the Denali Park Road lies, is famous for its abundance and variety of wildlife. Views of wildlife and the spectacular mountain setting attract hundreds of thousands of visitors from around the world each year.

Year round weather data are obtained from recording devices at park headquarters, reflecting a 30-year average. The station is located in a white spruce forest on a sheltered southeast exposure at an elevation of 2,070 feet. Annual temperature extremes there range from 90°F to -51°F (32°C to -47°C). Average total annual precipitation is about 15 inches, including an average annual snowfall of 75 inches.

The NPS has recorded summer weather data at Wonder Lake since 1993. The 1993 through 1997 five-year average high summer temperature was 61.9°F, the average low summer temperature was 42.2°F, and the average summer precipitation was 12.5 inches. In August 2000 about 14 inches of rain was recorded at the Eielson Visitor Center (13 air miles from Spruce Creek), which was a 30-year record resulting in area floods.

In general, the study area is known for its cool, wet summer weather. Summer precipitation generally comes as frequent light drizzles and showers due to surface heating during the day and the influence of the mountainous terrain. Snow cover usually remains into late May or early June, and drifts in sheltered areas may last much later. Freezing temperatures may be experienced during any month.

Calm days are more characteristic of the summer, and turbulence is more common in the fall and winter. During the summer, surface winds resulting from daily temperature fluctuations are prevalent and range from 5 to 14 mph (8 to 24 km/h) (U.S. Department of Commerce 1970). Cloud cover greater than 70% can be expected on about 40% of summer days (Heebner 1982).

3.3 Study Area

The primary study area is the upper Moose Creek drainage within the new park additions to Denali National Park and Preserve. The area lies between latitudes 63° 25' north and 63° 40' N and longitudes 150°30'west and 151°W. The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) added this part of the park. The Denali Park Road terminates at the Kantishna Airstrip, about 93 miles from the park entrance. The primary study area is in the Kantishna Hills, an active gold mining area around the beginning of the twentieth century, which was less active at the time of Mount McKinley National Park establishment in 1917. The most active mining occurred during the first two decades of the century (see section 3.6.1.1 for history of the Kantishna area). Four commercial overnight lodges, one NPS campground, and one NPS ranger station are in the area. Moose Creek, an important clear water stream, runs through the heart of the study area. The essential parts of the alternative routes and means of access to the Spruce #4 parcel are in the study area (figure 2.1.)

3.4 Physical Environment

3.4.1 Geological Resources

The Spruce #4 parcel was patented as a mining claim because of its favorable geology with gold placers rich enough for mining. This section describes pertinent geology and geomorphology of the Kantishna Hills, potential gravel source sites, and soil conditions. Conditions of these resources could affect the access project.

3.4.1.1 Kantishna Hills Geology

Kantishna Hills are mostly composed of very old metamorphosed sedimentary rocks that have been highly folded and faulted. The Birch Creek Schist makes up the majority of the hills. The schist if very friable and rapidly decomposes into fine particles of clay or mud. This formation is made up of thin-bedded schists and hard quartzites (Capps 1918). The crest of the Kantishna Hills is composed of the Spruce Creek Sequence that is composed of marble, quartzite, graphitic phyllite, meta-felsite, meta-andesite, and diorite.

The geology of this region remains dynamic. The Spruce Creek valley and the Kantishna Hills are in a region that is seismically very active. Earthquakes rattle the area frequently and are likely uplifting it. Wahrhaftig (1958, p. 22) postulated that during the last 2-3 million years the uplift of the Alaska Range is in the order of 5,000 to 6,000 feet. The Kantishna Hills appear to have been uplifted as much as 3,000 feet above the Nenana Gravel surface in that time.

The stream drainages have tried to adjust their gradients to compensate for the uplift by rapid erosion. Weathering and erosion have attacked the hills, wearing them down into small particles that were washed into the valley floor and into Spruce Creek. The lower slopes of the hillsides are covered with frozen colluvium known as permafrost. Stream erosion of the colluvial materials deposits them into alluvium, which forms the valley floors.

Deposits in the Spruce Creek area are in two landforms: the presently active alluvium and older higher alluvium called benches or terraces. Two types of benches are noted around Spruce #4. They are

Moose Creek benches, such as those that flank the Moose Creek valley floor, and alluvial fan benches in the lower Spruce Creek valley. Alluvial fan benches merge with the active alluvium on Spruce #4, but they become more noticeable just downstream.

The Moose Creek side of the Kantishna Hills has been repeatedly glaciated, but the evidence for the older glaciers has been buried or eroded by the younger glaciers. The shifts to and from the ice ages have had a dramatic effect on the landscape in this area. The glaciers scoured some areas, while simultaneously burying other areas. As the Muldrow Glaciers melted back, they dumped huge volumes of gravel into the Moose Creek valley. The melt water streams did not have the carrying capacity to move so much material, so the stream channels became clogged with gravel, making Moose Creek a braided stream. With gravel filling the Moose Creek valley, Spruce Creek also slowed, back-filled, and built its large well-developed alluvial fan. During that time strong winds winnowed the unvegetated outwash materials and carried the fine particles away. Some wind-blown silt settled on the benches of Moose, Spruce, Glen, and Rainy Creeks as loess deposits.

After the Muldrow Glacier receded completely from the valley, Moose Creek and Spruce Creek began cutting down through their valley floors. Remnants of the old overloaded streams on the benches line the valleys.

Alluvium is often a suitable landform on which to build structures. Active alluvium can have a high water table locally and be subject to flooding from runoff and overflow ice, depending on its height above the stream and other variables. Benches normally have well-drained soils and are high enough to be above flood threat, so they are excellent landforms for construction. Locally there may be loess that overlies the benches and causes a frozen perched water table and permafrost layer. In these areas, frost heave problems would adversely impact road smoothness. Frost action would cause heaving, and subsequent thawing would create dips.

3.4.1.2 Potential Gravel Source Sites

The active alluvium and the benches in the Moose Creek valley are composed of medium to coarse gravel with lesser percentages of sand and silt. The placer mining in the Spruce Creek valley has focused on removing gold particles from the alluvium. The remaining tailings could provide suitable material for an access road. The primary sites for gravel would be mining tailings along the ROW and on Spruce #4. Figures 2.2a and 2.2b indicate some of the larger tailings in the Spruce Creek valley. These gravel sources are described below.

3.4.1.2.1 Spruce #4

Spruce #4 contains alluvium and gravel that may be a suitable materials source. As noted in geology sections above, extensive gravel is likely to underlay the vegetation and soil. Small tailing piles and exposed gravel exist on Spruce #4. These tailings, if in the defined ROW corridor, may provide sufficient volume for the proposed road or alternative routes.

3.4.1.2.2 Lower Spruce Creek Tailings

Five or more discrete tailings piles exist on Spruce #1 and #2 mining claims that could be utilized for borrow material. The piles are irregular furrows or wedges that vary from 50 to 175 feet on a side, and from 5 to 25 feet high. The tailings consist of large, coarse fragments of alluvial gravel that were screened off during placer mining operations. The material size appears to average about 4 inches. Five of these piles were surveyed for their volume during the 1998 field season, ranging in size from 400 cu yd to 5,000 cu yd and totaling an estimated 10,250 cu yd.

The material volumes available from these sources could be less than 10,250 cu yd because some volume of material would likely be required for stream reclamation work to enhance post mining recovery. The volume of material to be used for reclamation is unknown, but a general rule is that at least 70 % of the tailings are needed for reclamation.

3.4.1.3 Soils

Soils of the Kantishna Hills and Moose Creek area are in the zone of discontinuous permafrost described by Pe'we'(1975) and within the Alaska Range Taiga Province described by Nowacky and Brock in the Ecoregions and Subregions of Alaska Map (1995). Soil survey investigation in the region during 1997-1998 by the Natural Resources Conservation Service provides detailed soil maps at a scale of 1:63,360 and associated descriptions of soils. A map of the physiographic subsection at a scale of 1:250,000 provides an additional level of detail to the Ecoregions Map. These products describe the unique assemblage of landforms, parent materials, and soils in the Kantishna Hills and North Fork of Moose Creek area.

A subsection within the Alaska Range Taiga Province occurs along the North Fork of Moose Creek. Lying north of the North Fork are the steep schist-cored mountains included within the Kantishna Hills Subsection. To the south are the glaciated hills and plains of the Interior Mountains and Valleys Subsection. Because construction for the access alternatives would all take place north of the North Fork of Moose Creek, only soils in the Kantishna Hills Subsection are described below.

3.4.1.3.1 Alaska Range-Kantishna Hills Subsection

A thin veneer of colluvium derived from schist is a few centimeters thick where it mantles summits and ridges. The colluvium thickens to two meters or more on back slopes and foot slopes. Slopes range from about 12 % to 80 % on mountain positions.

Soils on forested mountain back slopes with white spruce-willow woodland or forest (*Picea glauca, Salix lanata, Salix planifolia*) are generally formed in silty loess and gravelly colluvium with fractured schist within two meters depth. Seasonal saturation over relatively impermeable subsoil materials and bedrock during spring snowmelt and again following high precipitation events is common in late summer and fall.

Soils on toe slopes and stream terraces range in slope from 0 % to 8 %. Toe slope soils are typically shallow to permafrost with a perched water table and consist of a mixture of silty and gravelly schist colluvium and alluvium parent materials with bog birch and sedge shrub (*Betula glandulosa and Carex spp*.) and tussocks in ericaceous meadows (*Eriophorum spp*.). These gently sloping features grade to nearly level stream terraces with bog birch shrub (*Betula glandulosa*) or lichen and bog birch shrub and deep, excessively drained soils formed in sandy and gravelly glaciofluvial materials (about 40 % of the landform).

Floodplains are nearly level and consist of sandy and gravelly alluvium with the depth to apparent water table and flood frequency dependent on relative terrace height above active floodplain and local groundwater table. Soils on low flood plains consist of sandy and gravelly alluvium to the surface with water tables that fluctuate to near the surface in response to water level changes in the streams. These soils typically have willow shrub (*Salix alaxensis*). Soils on mid-level flood plains are well-drained and have a mantle of stratified loamy alluvium that ranges in thickness from a few centimeters to about a half meter. These soils have tall mixed alder-willow shrub (*Salix alaxensis, Alnus spp.*) and balsam poplar (*Populus balsamifera*) forest. High floodplains are also well drained with soil properties similar to the mid-level floodplain soils, but with white spruce-willow *(Picea glauca, Salix planifolia*) forest. Also included within these landscapes are small areas of very poorly drained soils with willow-alder/sedge shrub (*Salix planifolia, Alnus spp.,* and *Carex spp.*), typically associated with beaver ponds.

3.4.2 Natural Quiet

Background sound levels are attributed to natural environmental sounds that normally are present in the park, such as wind (both alone and stirring vegetation), running water, precipitation, and animals. Sound levels in remote portions of Denali National Park and Preserve generally are low, with most sounds originating from natural sources. Sound levels depend on the location of the source, weather conditions and air mass characteristics, and local conditions that may attenuate or amplify the sound level. Sound data were collected using a Larson-Davis Model 700 dosimeter and a Model 870 sound monitor in the Moose Creek drainage in July 1998. Instantaneous measurements resulted in readings of 30.5-33.0 dBA (on a calm evening with no precipitation) and average measurements (hourly L_{eq}) of 30.8-38.7 dBA over a 34-hour period. "Natural quiet" at the existing Glen Creek airstrip in a location relatively shielded from creek noise (but subjected to rain and light wind.) These levels are consistent with low background sound levels in other parks, such as Rocky Mountain (14-33 dBA in tundra, 28-38 dBA in meadows, and 26-42 in forest; Miller 1998). Running water and wind-stirred vegetation caused higher instantaneous sound levels (45-55 dBA) at various locations in riverine shrub habitats within 50 m of Moose Creek in July 1998.

Existing sources of sound in the study area (including the larger Kantishna area) vary seasonally. Summer (June-September) sources are wind, water, animals, hikers and backpackers, vehicle traffic to and from existing lodge operations and inholdings, including occasional vehicle passes up the existing Moose Creek mining access route, and aircraft overflights, primarily to and from the Kantishna airstrip. About 600 aircraft flights (landings and takeoffs) occurred at the Kantishna airstrip in 1997 (based on NPS concession and administrative records). Winter (November-April) noise sources include wind, wildlife, dog teams, occasional aircraft overflights (estimated at 10 per month) and less than 10 snowmachine trips into Kantishna annually. The Moose Creek drainage currently has no permanent (year-round) human-generated noise sources. Transient noises sources occur in the drainage from visitor access and activities (mostly west of the first crossing of Moose Creek on the proposed access route), from construction and maintenance activities at private inholdings on Rainy and Spruce creeks (including occasional flights to and from the Glen Creek airstrip by small aircraft), and from activities associated with travel to and from Kantishna (primarily by small aircraft). Human activities at the former NPS field camp at the Glen Creek airstrip generated additional sounds in summer, but the camp was taken down in fall 1999.

3.4.3 Visual Resources

3.4.3.1 Methods

The study area was described using an approach customized for the Spruce Creek Draft EIS (NPS 1999) derived primarily from the U.S. Forest Service publication entitled *Landscape Aesthetics: A Handbook for Scenery Management (1995)*. Each alternative was described using the publication's elements of landscape character, visual sensitivity, and viewshed. Together, the three determinants provide an overall description of the visual resources in the study area. Those descriptions pertinent for the access alternatives in this EA are used.

Landscape character is described to indicate the particular attributes, qualities, and traits of a landscape that give it an image and make it identifiable or unique. For purposes of describing the Spruce #4 access alternatives, a range of characteristics that include vegetative types as derived from *Alaska Trees and Shrubs* (Viereck and Little 1972) are applied to landscape settings, which are natural undisturbed, transitional, or disturbed/developed.

Visual sensitivity is described using three inventory factors. They include slope, vegetation, and geology. These factors can ultimately be used to measure the "visual absorption capability"[1] of each alternative.

Viewsheds are described to indicate the cumulative visibility from the perspective of multiple viewer positions along the alternative corridors. Viewer position, viewshed type, and view distance are included.

3.4.3.2 View Descriptions of Alternatives

View descriptions of alternatives in this EA are excerpted from the Spruce Creek Access draft EIS. Photographs of representative sections of the access routes are provided in figures 3.1 through 3.7.

3.4.3.2.1 No Action Alternative (Existing Access)
The first three miles of this route are on a bench perched above the south side of Moose Creek. Beyond that, this access alternative is mostly within the floodplain of Moose Creek and Spruce Creek. Predominantly, the route consists of shrub thicket in an area disturbed by past mining activities. The view of flowing water is almost constant.

The landscape is generally flat to gently sloping, with vegetation somewhat dense and diverse in the creek bottoms. Those sections with less dense and more homogenous vegetation are located in the first two miles east of the North Face Lodge, near the Glen Creek landing strip, and on the bench east of Spruce Creek.

The viewer from the route almost always has a level and relatively low vantage point, or inferior position. Views from this access alternative are mostly blocked or tightly framed by vegetation. The exceptions are the first two miles from the North Face Lodge, the Glen Creek landing strip, and a limited section on the tundra east of Spruce Creek. The latter two segments have expansive views of the Alaska Range and surrounding Kantishna Hills. They are the only locations along the entire route that have background views more than four miles away.

3.4.3.2.2 Proposed Access – Modified Route up Spruce Creek
The viewshed descriptions along this alternative are essentially the same as for the existing access, except the road along Spruce Creek stays on a tundra bench for about 300 hundred more feet. This access route also avoids more instream travel in open gravelly segments along Spruce Creek.

[1] Visual absorption capability is a classification system used to denote relative ability of a landscape to accept human alterations without loss of character or scenic quality.

Fig. 3.1 - Existing and proposed access at second ford of Moose Creek, mile 3, SW view

Fig. 3.2 - Existing and proposed access along Moose Creek, mile 4, in dense brush

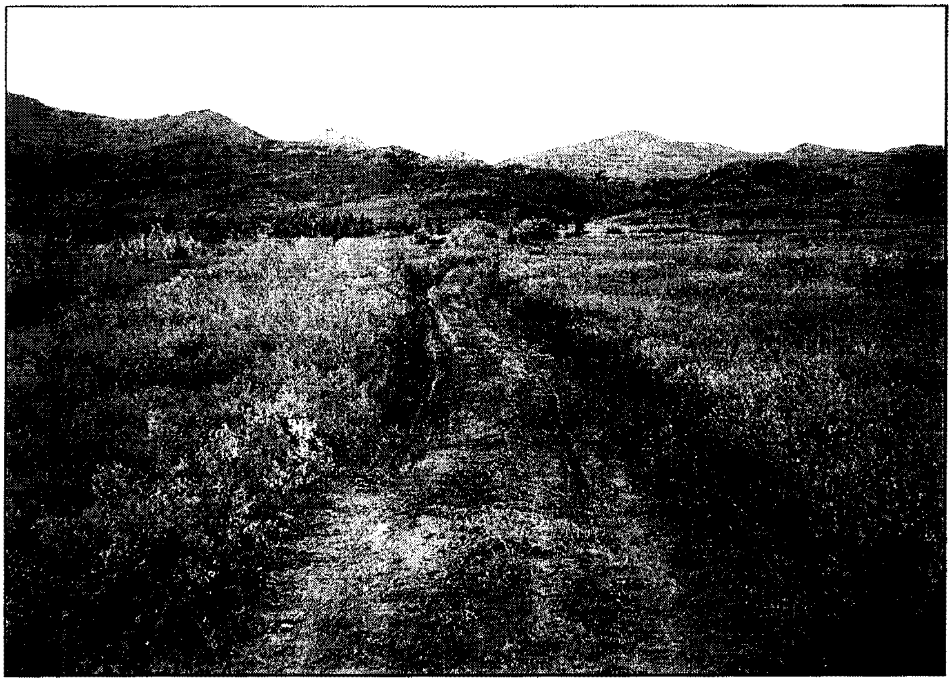


Figure 3.3 – Proposed access over tundra near Spruce Creek, view to North.

Figure 3.4 – Proposed access through alders near Spruce Creek, view to East.

Fig. 3.5 – Glen Creek Bench Route on tundra above airstrip, mile 7.5, view south

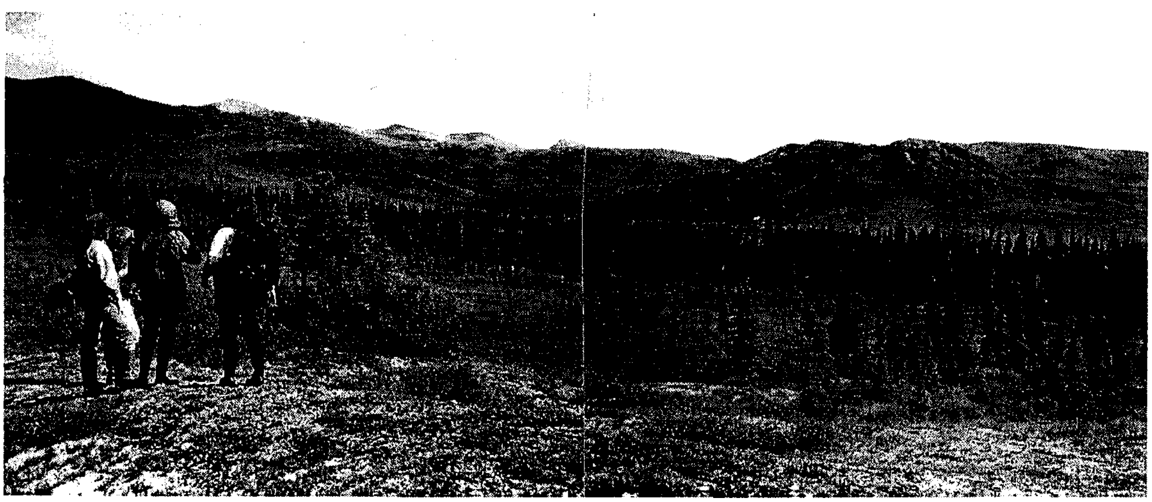


Fig. 3.6 – Glen Creek Bench Route near Spruce #4, mile 8.5, view east toward Spruce #4

Figure 3.7 Aerial view of Glen Creek Airstrip and spur roads before removal of NPS camp, view to south

3.4.3.2.3 Fly and Drive Alternative
The Fly and Drive would occupy the same viewshed as the proposed access minus the first 6 miles up the Moose Creek drainage from the Denali Park Road. This access would involve more airplane travel than the other alternatives.

3.4.3.2.4 Glen Creek Bench Route
The Glen Creek Bench alternative has the most diverse landscape character of the four alternatives. For the first 6.6 miles east of the Denali Park Road to the Glen Creek landing strip, this route uses the existing access. From there this alternative ascends to a mostly open south-facing plateau on its way to Spruce #4. Although much of the route is set in a disturbed landscape (primarily due to views of the Glen Creek airstrip and exposure to localized mining tailings) there are some natural, undisturbed visual opportunities. Except for a short segment of spruce forest at Spruce #4, most of the last two miles are entirely in alpine and low shrub tundra. Viewer position is elevated above the immediate surroundings, or superior, along the two miles west of Spruce #4. Here there are sweeping, panoramic views of the Alaska Range.

3.4.4 Water Resources

3.4.4.1 Watershed Description

Moose Creek is a clear-water, non-glacial stream that originates in the eastern portion of the Kantishna Hills. It comprises two drainages: Moose Creek (main fork) and North Fork. Moose Creek originates west of the Eielson Visitor Center and flows 62.1 miles to the Bearpaw River, which is the primary drainage of the Kantishna Hills. The North Fork originates at a small lake west of Mount Galen and flows 11.8 miles before joining Moose Creek. The total drainage size is 92,033 acres, 14,576 acres for the North Fork, including Willow Creek, and 77,475 acres for Moose Creek, including some minor side drainages. The gradient averages only 1 % on Moose Creek and about 2 % on the North Fork.

About 1.5 miles of 11.8 total stream miles of the North Fork of Moose Creek have been directly disturbed by past mining activities. Upstream from the confluence with the North Fork, the main fork of Moose Creek (known by some as the South Fork) is not affected by past mining activities. A naturally eroding stream bank on the upper main fork of Moose Creek contributes sediment to Moose Creek during storms. Between the mouth of the North Fork and Kantishna, about 187 acres along 4 miles of the stream course have been disturbed by mining activities. The area upstream of Eureka Creek was mined before 1938. Stream banks there are moderately revegetated; but the channel is straight, uniform, and relatively unproductive.

On Moose Creek and its tributaries, past mining has indirectly affected 51.8 miles of Moose Creek downstream of Willow Creek. The primary impacts to this section of Moose Creek are a result of extensive mining that has occurred on the tributaries to Moose Creek. Point and non-point sediment loading to Moose Creek has occurred over 80 years, including non-point loading during the time when active mining was not underway. Fine sediment has accumulated in slack-water areas in the reach between the Glen Creek and Kantishna. Periphyton growth (see section 3.5.1.3) is limited because suspended sediment has scoured the substrates. Extensive beds of sediment have accumulated along stream banks and gravel bars in the reach from Kantishna to the mouth. The low gradient makes Moose Creek particularly susceptible to sedimentation.

The Moose Creek drainage served as the primary access route to the upstream tributary mines; and therefore, stream crossing conditions from Kantishna upstream to Spruce Creek differ from natural conditions.

3.4.4.1.1 Reach Descriptions
Moose Creek can be divided into several distinct reaches based on adjacent landmarks and similarity of stream characteristics. A brief description of these reaches in the vicinity of the proposed access and alternatives follows.

North Fork Confluence Upstream - The gradient of the North Fork upstream from the confluence averages 1.7%. Stretches upstream of the confluence are wide with frequent gravel islands and bars that divide the flow. The upstream reach of the main fork of Moose Creek is occasionally braided and has a gradient average of 1.4%. The total drainage area at the confluence is about 81.7 square miles (mi^2), which includes about 19 mi^2 and 63 mi^2, respectively, for the North Fork and Moose Creek.

North Fork Confluence Downstream to Bridge - From the confluence of the North Fork and Moose Creek, Moose Creek continues downstream 5 miles to a series of beaver ponds. The stream meanders along this stretch, and there are numerous gravel islands and bars that divide the stream flow. Reaches with large boulders and riffles occur along this reach, which has an average gradient of 0.9%.

From the beaver ponds 1.5 miles downstream to the bridge, the stream is more confined and its gradient steeper. Water velocity increases as the stream enters a narrow, steep-sided canyon known as the Upper Canyon. The total drainage area above the bridge is 122.1 mi^2.

The existing mining access trail follows Moose Creek closely in this reach. It is generally located in the floodplain, and crosses the stream 13 times. The total drainage area at the first (lowest) crossing is 106.5 mi^2.

Moose Creek Tributaries - Smaller tributaries join Moose Creek and North Fork over Moose Creek's run to the bridge over Moose Creek Bridge. The tributaries include the following named creeks: Lake, Rainy, Dry, Jumbo, Glen, Spruce, and Willow Creeks (North Fork Moose Creek). These tributaries have small watersheds, short stream lengths, low usual summer stream flows, and steep gradients (except Jumbo Creek, which has a low gradient). Descriptions of the tributaries from Spruce Creek to the park bridge follow.

Spruce Creek - Spruce Creek begins in a highly mineralized area on the southwest side of Spruce Peak and flows generally south for 4.3 miles before joining North Fork Moose Creek. The stream drains a watershed of 1,963 acres (3.1 mi^2). Average discharge at the mouth during low flow is about 4 cubic feet per second (cfs). The gradient is high in upper sections, greater than 7%, and averages just over 3 % in lower sections. At these gradients, riffles and pools dominate the stream morphology. The riffles and pools dissipate the stream energy, thus preventing unchecked acceleration of the currents, which cause streambed and bank erosion.

Spruce Creek developed incised meanders on the claims below Spruce #4. This area has been disturbed by mining, which exposed bedrock in the floor of the shallow mine pits in the lower valley. Approximately 37 acres of aquatic and riparian habitat in lower sections of the stream, comprising 1.4 stream miles, have been disturbed by mining activities. These sections are now channeled and lack riparian vegetation.

An access road runs in and adjacent to the stream from the mouth for about 2 miles upstream. A mineralized seep originating in a disturbed area contributes iron to the stream system.

Glen Creek - Glen Creek originates as two forks, south and east of Glacier Peak, in a highly mineralized area. The east fork flows about 0.7 mile and the west fork flows about 1.5 miles to their confluence. Then the stream flows 3.5 miles before joining North Fork Moose Creek. The stream and its tributaries total 7.3 miles and drain a watershed of 4,353 acres (6.8 mi^2). Average discharge at the mouth during low flow is about 10 cfs. The gradient above the confluence of the forks is steep at about 8 %, but it is only about 3 % below the confluence.

Mining has extensively disturbed the entire west fork. The headwaters of the east fork have not been disturbed by mining activities; this reach consists primarily of rapids and cascades. The lower portion of the east fork has been disturbed.

Nearly the entire drainage below the confluence of the two forks, comprising approximately 207 acres of aquatic and riparian habitat or 5.7 stream miles, has been disturbed by mining activities since the turn of the century. The National Park Service reclaimed much of this area during reclamation activities in 1989, 1991, and 1992. Reclamation activities included the flattening and contouring of tailings piles, the construction of hydraulic-designed channels and floodplains, the installation of bio-revetment to prevent bank erosion, and the planting of several thousand alder seedlings and willow cuttings (Karle and Densmore, 1994).

In areas not reclaimed, the original stream channel and all riparian vegetation on the valley floor have been lost. The stream channels are devoid of pools and cover. These sections consist of fairly straight, shallow riffles and rapids.

Rainy Creek - Rainy Creek arises in a highly mineralized area on the high ridges in the Kantishna Hills and flows south for 3 miles to Moose Creek. The stream drains a watershed of 1,724 acres (2.7 mi^2). Average discharge at the mouth during low flow is about 3 cfs. The gradient is high, averaging 7 %.

Approximately 8 acres of aquatic and riparian habitat, comprising 0.9 miles of the stream have been disturbed by mining activities. These disturbed sections are channeled and devoid of streambank vegetation.

Jumbo Creek - The Jumbo Creek watershed is located in a non-mineralized area on the south side of the Moose Creek drainage. Because of the different geologic setting, this stream was not mined heavily, and as a result, is one of the few undisturbed tributaries to Moose Creek in the upper reach. The drainage area is 7,168 acres (11.2 mi^2), and the stream has a 2.5 % slope. Streambank vegetation is dense. Average low summer flow is less than 3 cfs.

3.4.4.2 Stream Discharge

The annual ice-free period of flow for Kantishna Hills streams usually begins by mid-May and lasts until mid-October, when the streams usually freeze up for the winter. Snowmelt, rain, and base flow provide clear water for the Moose Creek drainage. Higher flows commonly occur during the spring snowmelt period (mid-May to mid-June) and during summer when runoff from precipitation events is common. Due to the presence of a shallow organic layer and discontinuous permafrost, Moose Creek may be considered a "flashy"stream". In other words, stream discharge increases immediately following a precipitation event and begins to recede without continued rainfall. During winter, stream discharge is at its lowest. Streams freeze on the surface but continue to flow at greatly reduced rates beneath the ice and via sub-channel discharge. At this time, streams are fed by ground water. Because there is little recharge into the frozen surface, minimum flow is reached in February or March as the groundwater supply is depleted.

Like most streams in Alaska, no permanent stream gaging stations have been established on Moose Creek or any other nearby drainage. However, occasional discharge measurements have been made on Moose Creek at numerous locations during various studies

The U.S. Geological Survey has developed methods to estimate the magnitude and frequency of floods at ungaged sites on streams in Alaska, using multiple-regression analyses from 260 gaged locations in Alaska and 72 gaged locations in Canada (USGS, 1993). The state of Alaska and conterminous basins of Canada were divided into five flood-frequency areas having similar flood characteristics on the basis of statistical cluster analyses and regional regression analyses. A set of equations for estimating peak discharge (Q) having recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years was developed for each flood-frequency area. Significant basin characteristics in the equation are drainage area, mean annual precipitation, percentage of lakes and ponds, and mean basin elevation. Table 3.1 summarizes the magnitude of flood flows for three locations along Moose Creek: confluence with the North Fork, first ford, and Moose Creek Bridge.

Table 3.1 Magnitude (cubic feet per second) and frequency (years) of floods for three locations on Moose Creek, Denali National Park and Preserve, Alaska (USGS, 1993).

Flood frequency	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{200}	Q_{500}
Confluence	764	1285	1645	2124	2455	2795	3094	3519
First crossing	927	1536	1954	2512	2895	3291	3640	4138
Park road bridge	961	1582	2008	2581	2977	3391	3758	4285

3.4.4.3 Water Quality

The following is a description of water quality in the upper Moose Creek watershed, based on an NPS water quality survey conducted from 1994 to 1996. Several surveys were also conducted during the 1980s, in support of mining-related reports and studies (NPS 1990).

Five sites are used to describe the water quality of Moose Creek and North Fork Moose Creek. 'Lower Moose Creek' is located adjacent to the Kantishna Airstrip. 'Moose Creek at bridge' is located at the bridge near mile 89 of the Denali Park Road. 'Upper Moose Creek' and 'Lower North Fork' are located in their respective streams just upstream of the confluence. 'Middle North Fork' is located upstream of its confluence with Glen Creek and a short distance downstream of the confluence with Spruce Creek.

Overall, most pH values were in the pH 7.5-8.00 range. Some of the samples in upper Moose Creek were strongly alkaline (pH>8.00). Alkalinity values ranged from 54 to 85 mg/l, indicating that Moose Creek is a moderately buffered system. Sulfate and calcium had the highest ion concentrations in Moose Creek, and magnesium concentrations were also generally substantial. These results indicate that calcium sulfate and magnesium sulfate are the dominant ion pairs present in Moose Creek (Meyer and Kavanagh 1983).

Water temperatures in Moose Creek are naturally low, with measured values for the 1994-1996 study ranging from 4° to 14.7° C. Dissolved oxygen levels are generally high, usually 10 to 12 mg/l of oxygen, which is considered saturated.

3.5 Biological Environment

3.5.1 Aquatic Resources

3.5.1.1 Fish Populations and Distribution

Nine fish species have been observed or collected within the Kantishna Hills and surrounding area: arctic grayling, slimy sculpin, round whitefish, northern pike, lake trout, sheefish, chinook salmon, chum salmon, and coho salmon (table 3.2). Comparative population estimates are available for arctic grayling by lake and stream, because it is the most popular and accessible fish species sought by sport fishers visiting the region (Meyer and Kavanagh 1983, supplemented by recent observations of park staff).

Table 3.2 Fish species presence and arctic grayling density in selected lakes and streams in and adjacent to the Kantishna Hills, Denali National Park and Preserve.

	Arctic Grayling	Slimy Sculpin	Lake Trout	Round Whitefish	Northern Pike	Sheefish	Chinook Salmon	Chum Salmon	Coho Salmon
Wonder Lake	[c]X	X	X						
Lake Creek	[c]X	X	X						
Bearpaw River	[c]X	X			X	X	X	X	X
Caribou Creek	[b]X	X					X		
Glacier Creek	[b]X	X					X	X	
Moose Creek	[c]X	X		X				X	X
North Fork Moose Creek	[d]X	X		X				X	
Friday Creek									
Eureka Creek	[a]X	X							
Eldorado Creek Below Slate Cr.	[b]X								
Eldorado Creek Above Slate Cr.	[d]X								
Slate Creek	[a]X								
Rainy Creek	[a]X	X							
Jumbo Creek	[d]X	X							
Glen Creek	[a]X	X							
Spruce Creek	[b]X	X							
Willow Creek	[c]X								

[a]Low to very low density of arctic grayling
[b]Low to moderate density of arctic grayling
[c]Moderate density of arctic grayling in favorable locations
[d]High density of arctic grayling in favorable locations

Significant runs of chinook, chum, and coho salmon are present in the Bearpaw River; however, relatively few salmon enter the Moose Creek drainage. Alaska Interior Region habitat maps indicate Moose Creek (stream no. 334-40-11000-2490-3140-4115-5044) has salmon spawning or rearing areas (ADFG 1999). During the last 5-10 years, it has been rare to observe even a single salmon, usually a chum salmon, above the Moose Creek Bridge. The very few observed salmon above the bridge have been reported to swim upstream as far as the North Fork of Moose Creek to near the mouth of Spruce Creek (Kavanagh, pers. comm.) (figure 3.8).

Freshwater streams having moderate to high densities of arctic grayling and adjacent to the proposed new or improved road corridor include upper Moose Creek, particularly its North Fork; Jumbo Creek; and Willow Creek (lower several hundred feet). The remaining streams tributary to Moose Creek and above the Moose Creek Bridge (Rainy, Glen, and Spruce Creeks) contain relatively few fish, primarily arctic grayling, due to a variety of reasons, including steep gradients, channeled stream sections, low and rapid stream flows, and extensive past mining (figure 3.8.) The Alaska Department of Fish and game retains management oversight of anadromous fish habitat and fish passage.

3.5.1.2 Fish Habitat

The numerous clear water streams originating in the Kantishna Hills are unusual within Denali National Park and Preserve in the sense that most streams in the park's mountainous areas are of glacial origin. On a local basis, the aquatic habitat offered by these clear water streams is important for its role in perpetuating fish populations.

3.5.1.2.1 Bearpaw River
The Bearpaw River, which flows 45.1 miles before joining the Kantishna River, provides good fish habitat and is one of the major salmon spawning streams in the park (ADFG 1999).

3.5.1.2.2 Moose Creek below confluence with North Fork
Past mining activities along lower Moose Creek below the confluence of the North Fork of Moose Creek, and in many Moose Creek tributaries, have substantially altered stream geometry (section 3.4.4.1.1). Riparian vegetation along these stream sections is either lacking or in early successional states. These stream sections have channeled stream courses, altered substrate composition, and increased sediment runoff from disturbed areas. The long-term effects of stream channel alteration (especially straightening) are greater than sediment runoff loads, which now are low. Stream sections that have been extensively disturbed generally contain the lowest-quality fish habitat (Meyer and Kavanagh 1983). Between the mouth of the North Fork and Kantishna, about 187 acres comprising 4.0 miles have been disturbed by mining activities. Nevertheless, there remain some undisturbed stream sections where the aquatic habitat is sufficient to support moderate numbers of arctic grayling. In these undisturbed sections, riparian vegetation is generally dense; and abundant willows extend over water, providing shade and cover.

3.5.1.2.3 North Fork of Moose Creek
Although 1.5 miles of 11.8 total stream miles of the North Fork of Moose Creek have been disturbed by past mining, this stream contains some of the most productive aquatic habitat in the Kantishna Hills. Spawning, rearing, and feeding habitat are excellent, especially for grayling and sculpins. Resident fish may spend the winter in a small, unnamed lake at the headwaters. The

North Fork substrate is covered with a heavy growth of periphyton[2]. Large, deep pools, instream cover, aquatic invertebrates, and riparian vegetation are abundant along nearly the entire stream length. The quality of aquatic habitat changes noticeably below the mouth of Glen Creek; the surface of the streambed there is smoother and consists of more sand and silt than in upstream reaches.

3.5.1.2.4 Moose Creek above confluence with North Fork

The main stem of Moose Creek, that part upstream from the confluence with the North Fork, was not affected by past mining activities. Fish habitat is generally good with abundant streambank vegetation, pools, and instream cover in some reaches. A naturally eroding streambank contributes sediment to the stream during storms.

The following additional information is provided on the aquatic habitats of Rainy, Jumbo, Glen, and Spruce Creeks because they all lie on or adjacent to the path of access route alternatives.

3.5.1.2.5 Rainy Creek

This very small, high-gradient stream offers poor fish habitat, largely because of past mining activities and limited available instream cover for fish. It has a steep, braided stream outlet. Most lower stream reaches contain high-velocity water with few pools available for resting fish.

3.5.1.2.6 Jumbo Creek

This low-gradient, small tributary to Moose Creek has never been mined. Unlike most other streams in the Kantishna Hills, it has a tundra rather than mountainous origin with clear, cold water of high quality. Its aquatic habitat is excellent for arctic grayling and supports comparatively large numbers of these fish. Small pools, with occasional large pools up to one meter deep separate numerous rapids and riffle areas. Bottom substrates are composed mostly of boulders and rubble covered with a heavy layer of slippery periphyton algae and mosses. The banks along most of the stream are covered with a dense growth of willow (Meyer and Kavanagh 1983).

3.5.1.2.7 Glen Creek

This stream is one of the most extensively mined streams in the Kantishna Hills. Though parts of it have been reclaimed by the National Park Service, most of the stream still comprises poor fish habitat with high velocity water; few, if any, pools and eddies; and a lack of instream boulders and woody debris.

3.5.1.2.8 Spruce Creek

Undisturbed sections in the upper parts of this stream provide minimal fish habitat because they are made up entirely of shallow cascades and rapids. The limited undisturbed sections in the lower 2.2 miles appear to be better fish habitat containing a few small pools. A heavy growth of periphyton covers the substrate, and stream vegetation is dense. However, the stream is still very limited in fish productivity in comparison to Jumbo Creek and the North Fork of Moose Creek above the confluence of Glen Creek.

[2] Periphyton is defined as a community of plants, animals, and associated detritus adhering to and forming a surface coating on stones, plants and other submerged objects (Lincoln et al. 1982).

3.5.1.3 Stream Productivity

Where migration barriers are absent, the density of arctic grayling present in Kantishna Hill's streams serves as a good indirect index of overall stream productivity (Dr. Mark Oswood, Univ. of Alaska Fairbanks, pers. comm.).

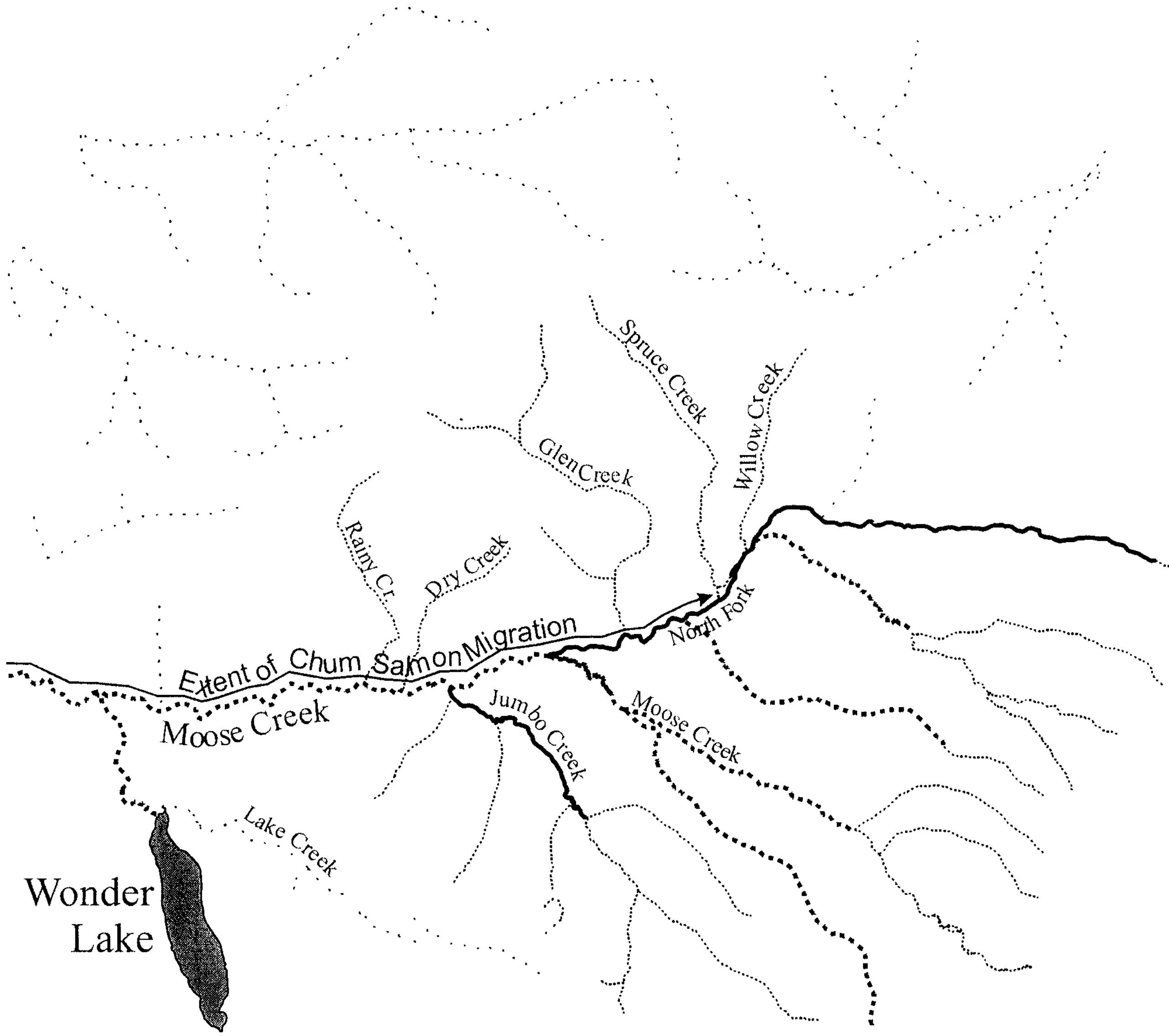
Electro-shocking catch rates for arctic grayling in number/stream/kilometer and number/minute were determined in many Kantishna Hills streams in 1982 (Meyer and Kavanagh 1983). In addition, insect (macroinvertebrate) density was measured in 1984 in those portions of Eldorado Creek above and below the confluence of Slate Creek, in Slate Creek, and in Jumbo Creek (Oswood et al. 1990). A summary of this information is presented in table 3.3.

Arctic grayling are "sight-feeders," requiring clear water to see their prey. They feed primarily on submerged insects (benthic macroinvertebrates) and flying insects. Table 3.3 illustrates a direct relationship between food availability and the density of arctic grayling in Kantishna Hill's streams. For simplicity, the table just indicates whether a stream is mined or not mined. Mined streams contain dramatically less available food for fish in direct proportion to the degree of mining disturbance, and the table reflects the degree of mining disturbance for each stream through the measured catch rates of arctic grayling.

The average density of submerged insects (benthic macroinvertebrates) found in Jumbo Creek (11,142 organisms/m^2) and in Eldorado Creek above the confluence of Slate Creek (40,035 organisms/m^2) were considered to be very high density figures, both for Alaska and for more temperate regions of the North American continent. In fact, a single extreme sample from Eldorado Creek contained 111,142 ogranisms/m^2, then the second highest density submerged insects sample ever recorded in Alaska (Oswood et al. 1990). Both streams have reaches containing a dense layer of moss serving as very high-quality habitat for aquatic insects. Grazing arctic grayling are well fed in such streams.

3.1.5.4 Grayling Life History

Like salmon, grayling faithfully return every year to the same spawning and feeding areas. Grayling spawn for the first time at an age of 4 or 5 years and a length of about 11 to 12 inches. Grayling spawn immediately after spring break up, and adult grayling move to summer feeding areas within one month of spawning. Grayling fry hatch about three weeks after spawning, and they occupy quieter waters near their spawning sites. In early fall grayling migrate leisurely downstream to reach overwintering areas with deeper water (ADFG 1988).



Moose Creek is designated as:
ADGF Stream #334-40-11000-2490-3140-4115-5044

FIGURE 3.8
ARCTIC GRAYLING DENSITY AND EXTENT OF CHUM SALMON MIGRATION

Denali National Park and Preserve
Alaska

Grayling Density

- Undesignated
- Low Density
- Medium Density
- High Density

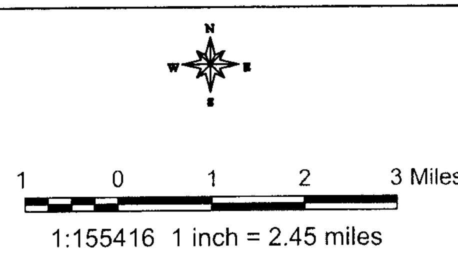


Table 3.3 Catch rates of arctic grayling caught by electro-fishing in Kantishna Hills streams, 1982, and average density of aquatic insects, 1984 (Meyer and Kavanagh, 1983, and Oswood, et al. 1990).

Stream or Reach	Number Caught	Distance Sampled (km)	Electrofishing Effort[c] (min)	Catch Rate (number/km)	(number/min)	Average Insect Density (no./m^2)
Caribou Creek[m]	1	3.6	27.6	0.3	<0.1	–
Glacier Creek[m]	9	2.9	63.0	3.1	0.1	–
Moose Creek[m]	10	2.2	28.3	4.5	0.4	–
North Fork Moose Creek[u]	31	1.9	30.6	16.3	1.0	–
Eureka Creek[m]	3	2.4	14.6	1.3	0.2	–
Eldorado Creek Below Slate Creek[m]	21	4.6	75.4	4.6	0.3	794
Eldorado Creek Above Slate Creek[u]	20	0.6	12.8	33.3	1.6	40,035
Slate Creek[m]	4	1.7	26.4	2.4	0.2	654
Section 27 Tributary to Eldorado Creek[u]	5	0.4	7.0	12.5	0.7	–
Rainy Creek[m]	3	1.8	16.7	1.7	0.2	–
Jumbo Creek[u]	25	. 1.4	25.7	17.9	1.0	11,142
Glen Creek[m]	2	5.2	52.1	0.4	<0.1	–
Spruce Creek[m]	10	2.0	21.6	5.0	0.5	–

[u]Unmined Stream
[m]Mined Stream
[c]Electrofishing Effort = Duration of Shocker Current Output in Minutes

3.5.2 Endangered, Threatened, and Sensitive Species

The American peregrine falcon *(Falco peregrinus anatum)*, the subspecies that nests in the Denali region, was formerly listed as endangered and delisted as of August 25, 1999 (64 FR 46542.) The USFWS treats this subspecies as a species of concern and will monitor it for at least 5 years after delisting (Erv McIntosh, pers. comm. 3/28/00). Most documented eyries are located near the northern park boundary. The proposed access is more than 10 miles from these eyries and outside the maximum probable foraging area for the eyrie birds (S. Ambrose, U.S. Fish and Wildlife Service, pers. comm., NPS 1990). No known threatened aquatic, wildlife, or plant species exist in the primary study area (USFWS Appendix E).

NPS Natural Resources Management Guidelines (NPS-77, p. 276) indicate rare or sensitive species identified by knowledgeable parties, like the Alaska Natural Heritage Program (ANHP), should warrant heightened management concern. The ANHP lists the following species of concern that could occur in the project area: North American lynx *(Lynx canadensis),* northern goshawk (*Accipiter gentilis*), harlequin duck (*Histrionicus histrionicus*), olive-sided flycatcher (*Contopus cooperi),* gray-cheeked thrush *(Catharus minimus)*, and blackpoll warbler *(Dendroica striata).* Low densities of lynx occur in forest communities in the Kantishna Hills area. The northern goshawk inhabits conifer-dominated mixed woodlands where it preys on birds and small mammals. Harlequin ducks use Moose Creek drainages. Gray-cheeked thrushes inhabit primarily riparian tall scrub, coniferous forest, and woodland types. Blackpoll warblers inhabit coniferous forest, deciduous forest, and tall scrub. Olive-sided flycatchers inhabit coniferous forests and bogs.

3.5.3 Vegetation and Wetlands

Because of the wide variety of topographic relief in the Kantishna Hills, most plant communities typical of Alaska taiga are represented. Alpine tundra along ridges and peaks gives way to low shrubs on slopes and tall shrubs in ravines. Tall shrub predominates along drainages and steep slopes in the hills. At lower elevations, upland forest occurs on shallow slopes, and floodplain forest is found along meandering rivers.

Previous studies have classified the plant communities into five major types of vegetative cover (NPS 1990). The acreage and percent of sizes of these vegetation types in the 1990 Kantishna Hills Study Area, including disturbance, are shown in figure 3.2 and table 3.4. These cover types were based on a 1986 revised classification scheme developed for the *Kantishna Hills/Dunkle Mine Final EIS* for Denali National Park and Preserve in 1983 (NPS 1984) and on Viereck's revised Alaska Vegetation Classification (Viereck et al. 1992).

Table 3.4 Estimated acres and % of major types of vegetative cover and of disturbance in the Kantishna Hills wildlife study area

Land Cover Class	**Acres**	**%**
Floodplain forest	1,306	1.5
Upland forest	19,486	22.7
Tall shrub	15,681	18.3
Low shrub	39,982	46.6
Alpine tundra	8,026	9.4
Disturbance	1 254	1.5
Total	85,735	100.0

3.5.3.1 Floodplain Forest

Floodplain forests in the study area grow in drainages that recently were or still are subjected to periodic flooding and deposition of sediments, especially in Moose Creek. The Kantishna floodplain forest is dominated by open-to-closed 60-to-80-foot-tall stands of white spruce, balsam poplar, or both. Open areas along streambanks, where flooding and sediment deposition is frequent, support tall willow and alder thickets of variable density. Feltleaf willow and mountain alder are the most common plants in these areas. On more stable soil in areas where balsam poplar is abundant, tall horsetails, grasses, and other flowering plants including rose, highbush cranberry, and bedstraw form an almost continuous understory. On well-established alluvium under relatively closed stands of white spruce or white spruce and paper birch, the soil can be covered by a thick mat of feathermosses, with scattered horsetails, lichens, forbs (such as rose, bluebells, and wintergreen) and shrubs (such as highbush cranberry, red currant, soapberry, lowbush cranberry, and willow).

3.5.3.2 Upland Forest

The upland forests of the Kantishna Hills study area are mixed deciduous-coniferous forests. The dominant tree species is usually white spruce, sometimes accompanied by paper birch, balsam poplar, willows, and alder, in various combinations. Aspen may be a common associate or the dominant tree on south slopes and cliffs. Open black spruce woodland and dwarf tree scrub occur on benches and slopes in isolated areas. This upland forest tends to be open, except on slopes immediately above major rivers and creeks, and contains trees of low to moderate stature (generally less than 30 to 45 feet tall).

Underlying the tree canopy can be vigorous, tall to moderately tall shrub cover of willows, mountain alder, resin birch, rose, highbush cranberry, shrubby cinquefoil, and red currant. The low shrub cover includes blueberry, crowberry, Labrador tea, lowbush cranberry, and dwarf birch. Lichens and mosses are sparse to abundant on both the forest floor and the trees. Although herbaceous plants are not especially prominent in this community because of the heavy shrub cover, various grasses, sedges, and wildflowers including monkshood and groundsel are widely scattered throughout; sedges and cottongrass tussocks are important in the wetter sites.

3.5.3.3 Tall Shrub

The widely scattered tall shrub cover in the Kantishna Hills study area is a composite of deciduous alluvial tall shrub and upland high brush communities (Neiland and Viereck 1977) and willow shrub community (Valkenburg 1976). Tall shrub characteristically is dominated by alder or willows taller than 5 feet (Viereck et al. 1992), has a tall shrub crown cover of 25 % or more, and has a ground cover that is sparse under pure alder thickets and moderately abundant under open willow patches. Where the ground cover is better developed, it often consists of grasses, ferns, and low shrubs such as willow, rose, dwarf birch, spirea, and blueberry. Mosses and lichens are uncommon.

3.5.3.4 Low Shrub

Low shrub consists of shrub, tussock, sedge-grass, and herbaceous communities (Viereck et al. 1992) that are shorter than 5 feet. Trees provide less than 10 % of the cover, and taller shrubs provide less than 25 % of the cover. The dwarf shrub community is dominated by dwarf birch, low willows, and heath shrubs. A thick ground cover of mosses, lichens, prostrate shrubs, grasses, sedges, and small flowering plants provide complete soil cover. The tussock community occurs in wetter areas and is dominated by 12 to 16-inch tall tussocks of sedges and cottongrass; blueberry, Labrador tea, dwarf birch, crowberry, lowbush cranberry, prostrate willows, and a variety of flowering herbs grow on and between the tussocks. Mosses and some lichen species form an abundant ground cover. The sedge-grass community occurs in the wettest areas and is dominated by turf-forming sedges and grasses with sporadic occurrences of flowering herbs.

3.5.3.5 Wetlands

3.5.3.5.1 Background

Wetlands are distributed throughout the project area. Therefore, a wetland delineation and an individual permit from the U.S. Army Corps of Engineers (USACE) will be necessary for the applicants to comply with Section 404 of the Clean Water Act (CWA) of 1972. To support the EA analyses and the project permit application, the study elements described here include (1) classification and description of the wetland types that occur along the access alternatives and (2) the amount total area of wetlands within the access corridor for each of the alternatives.

3.5.3.5.2 Wetland Mapping

No U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory maps were available for the project area at the time the wetlands were assessed. Thus, preliminary classification and mapping of wetlands in the study area was accomplished by stereoscopic interpretation of black-and-white aerial photographs (1:41,000–1:46,000 scale [1 inch = 3,417 feet to 1 inch = 3,833 feet] taken August 30, 1991). Several sets of smaller scale (1:3,000 scale [1 inch = 250 feet] taken August 29, 1991) color infrared (CIR) aerial photos also were used to assist in classifying wetland types. To quantify the area of wetlands that occur along the access route alternatives, we multiplied the width of the access corridor by the length of the corridor through mapped wetlands. The wetlands were delineated as segments because access modifications and new construction would take place on the surface of the land with minimal fill and side slope.

Wetland boundaries were determined using color and structural characteristics of the vegetation, topography, and drainage patterns, and were delineated on acetate overlays of the aerial photos. Wetland mapping codes followed the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin, et al. 1979). A corresponding vegetation class was assigned to each wetland type according to the Alaska Vegetation Classification (Viereck, et al. 1992). Taxonomic nomenclature of plants follows Hultén (1968), except for willows (*Salix* spp.), which follow Viereck and Little (1972).

After preliminary wetland and habitat boundaries were delineated through photo-interpretation, a field survey was conducted 13–17 July 1998 to verify photo interpretations and boundary delineations. Forty-six ground-truthing sites, ranging from upland forest to lowland scrub–shrub communities, were sampled during the field survey. Subsequent samplings along the proposed route along Spruce Creek were conducted on August 29, 2000.

Wetland field determinations were performed using the three-parameter approach described in the *Corps of Engineers Wetlands Delineation Manual* (USACE 1987). First, the presence of wetland vegetation was determined at each field survey station by visually estimating the ground cover of the dominant plant species and determining their wetland indicator status. Wetland indicator status was determined using the *National List of Plant Species that Occur in Wetlands: Alaska (Region A)* (Reed 1988).

Second, a shallow soil pit (~0.5 m deep) was dug and a soil profile described from each pit to determine if hydric soil indicators were present. Indicators of hydric soil conditions include the presence of an organic soil at least 40 cm thick (Histosol); an aquic or peraquic moisture regime; gleyed, low-chroma, and low-chroma mottled soils; and dark, vertical streaking of subsurface horizons by overlying organic matter (common in sandy hydric soils). Soil color was determined using *Munsell Soil Color Charts* (1994).

Finally, the sites were examined for the presence of wetland hydrologic indicators. These indicators include the presence of standing water, soil saturation within 30 cm of the surface, or evidence suggesting periods of past inundation, such as water marks, drift lines, soggy or mucky surface conditions, surface-scoured areas, and surficial water-borne sediment deposits on vegetation or other land features.

Final mapping of wetland types was based on field revision of preliminary maps and on information obtained from the field survey. The polygons of each wetland type were digitized using *ARCVIEW GIS* (© Environmental Systems Research) software. Minimum mapping size was 0.5 acres, except for small waterbodies and rivers and streams, which were mapped at a smaller scale (0.1 acres) because of their distinct boundaries.

3.5.3.5.3 Wetland Types in the Project Area

Twenty wetland types, four complexes, and one disturbance type were identified in the project area (table 3.5, figure 3.3). Complexes consisted of areas where two or more wetland types or wetlands and non-wetlands formed a mosaic that was mapped as one unit. Many streams had a narrow band of riparian shrub wetland (NWI class PSS1C) along the stream margin that was too narrow to delineate as a separate polygon. This wetland type was joined with the NWI (National Wetlands Inventory) class code for river (R3UBH). Disturbed areas consisted of past mining and other developed areas; these areas were barren or had less than 30% vegetation cover.

The dominant wetland types among the access alternatives were shrub lowlands, which are composed of dwarf birch (*Betula nana*), Labrador tea (*Ledum palustre* ssp. *decumbens*), willows (*Salix* spp.), cranberry (*Vaccinium vitis-idaea*), blueberry (*Vaccinium uliginosum*), and Bigelow sedge (*Carex bigelowii*). Along Moose and Spruce creeks, needleleaf forested lowlands also were fairly common (7–12%). This category is composed of open stands of black and white spruce (*Picea mariana* and *Picea glauca*) with an understory of dwarf birch, willows, *Vaccinium* spp., bluejoint grass (*Calamagrostis canadensis*), and Bigelow sedge. Rivers, ponds, and riparian and marsh wetlands are generally uncommon.

Areas disturbed by human activities (HD) are common along Moose, Glen, and Spruce creeks. These areas generally were not classified as uplands or wetlands because of the extensive sampling that would be required to assess their hydric status. In most instances, however, these areas were composed of mine tailings or were cleared areas with well-drained soils.

Many non-wetland communities along Moose Creek probably had been seasonally flooded wetlands in the past. Deposition of mine tailings in these areas has resulted in well-drained, coarse soils that now are flooded once every several years, if at all. The well-developed herbaceous understory in these areas suggests flooding is infrequent. In some cases, small wetland inclusions are still present within the shrub and forest stands, but they have been reduced to areas less than 0.1 acre.

Although wetland and non-wetland boundaries are fairly easy to distinguish throughout the project area, at least one area with a mosaic of non-wetland and wetland communities could not be delineated separately. This mosaic occurred in the Spruce Creek valley, where closed willow shrub wetlands are interspersed within upland open white spruce forest (U—PSS1B).

The principal functions of wetlands in the project area include flood flow alteration, ecological production support, and wildlife habitat (including fisheries). Many of the wetland types in the study area received low ratings because, although certain wetlands may have the capacity to perform a particular function, little or no opportunity exists to perform that function. For example, none of the wetlands rated high for nutrient removal and transformation because they are not exposed to heavy nutrient loading (e.g., from agricultural runoff). Similarly, wetlands in the study area are not subject to extensive sedimentation (e.g., slope erosion).

Flood flow alteration is accomplished primarily by seasonally flooded, riparian wetlands. The extensive mining activity that occurred in the past in the Moose Creek drainage (particularly in the vicinity of Glen and Spruce Creeks) has eliminated many of the original wetlands in those drainages. Evidence also indicates flooding over creek banks and tributaries is limited.

Table 3.5 Wetland types identified in the Spruce Creek access project area, Kantishna Hills, July 1998.

Wetland Type	NWI[a] Class	Physiognomic Vegetation Type[b]	Dominant Plant Species
Rivers and Streams	R3 UB H		
Intermittent Stream	R4 SB C		
River Flat/ Bar/Open Water	R3 UB/US	Barren (cover < 30%)	
River Flat/Bar	R3 US C	Barren (cover < 30%)	
Pond	P UB H		
Sedge Marsh	P EM 1 H	Subarctic lowland herb bog meadow	*Eriophorum angustifolium*, *Oxycoccus microcarpus*, *Andromeda polifolia*
Sedge–Grass Marsh	P EM 1 F	Subarctic lowland grass–sedge bog	*Calamagrostis canadensis*, *Carex* and *Salix spp.*, herbs
Shrub Bog	P SS/EM1 F	Open low willow–graminoid shrub bog	*Salix planifolia*, *S. barclayi*, *Carex* and *Equisetum* spp.
	P SS 1 F	Closed tall shrub swamp	*Salix planifolia*, *S. barclayi*
Riparian Shrub	P SS1 C P SS1 E	Closed tall willow shrub	*Salix alaxensis*, *S. planifolia*, *S. glauca*, *Alnus* spp.
Riparian Broadleaf Forest	P FO/SS 1 C	Open balsam poplar	*Populus balsamifera*, *Salix* spp., *Equisetum* spp., *Calamagrostis canadensis*
Scrub Shrub Lowland	P SS/EM 1 B	Mixed shrub–graminoid meadow	*Betula nana*, *Salix planifolia*, *S. barclayi*, *Vaccinium* spp., *Eriophorum vaginatum*, *Carex bigelowii*
	P SS1 B	Closed tall shrub	*Betula glandulosa*, *Salix planifolia*, *S. lanata*, *Ledum palustre* ssp. *decumbens*, *Vaccinium* spp., *Heracleum lanatum*, *Equisetum* spp.
	P SS 1/3 B	Mesic shrub birch–ericaceous shrub	*Betula nana*, *Ledum palustre* ssp. *decumbens*, *Vaccinium* spp.,
	P SS 4/1 B	Open dwarf black spruce	*Picea mariana*, *Betula nana*, *Vaccinium* spp.
	P SS 4/3 B	Open dwarf black spruce	*Picea mariana*, *Ledum palustre* ssp. *decumbens*, *Betula nana*, *Salix spp.*, *Vaccinium* spp.

Table 3.5 Continued.

Wetland Type	NWI[a] Class	Physiognomic Vegetation Type[b]	Dominant Plant Species
Needleleaf Forested Lowland	P FO 4/SS1 B	Open mixed spruce	*Picea mariana*, *P. glauca*, *Betula nana*, *Alnus crispa*, *Vaccinium* spp.
	P FO4/SS 3 B	Open mixed spruce	*Picea mariana*, *P. glauca*, *Ledum palustre* ssp. *decumbens*, *Vaccinium* spp.
Complexes	P SS1 C—R3 UB H		See above descriptions
	P SS 1/3 B—PEM1F		See above descriptions
	P SS/EM 1 B—P SS 1 B		See above descriptions
	U—P SS 1 B		See above descriptions
Non-wetlands	U		
Human Disturbed	HD	Barren (cover < 30%)	

[a] National Wetlands Inventory (Cowardin et al. 1979).
[b] Level IV of the Alaska Vegetation Classification (Viereck et al. 1992).

Thus, the ability of riparian communities to absorb floods is not a critical wetland function in the project area. Nevertheless, the riparian shrub and scrub shrub lowlands that occur along Moose Creek help to ameliorate the effects of high floods from ice jams or high rainfall. Scrub shrub lowlands also are important for recharging groundwater, as is demonstrated by the considerable amount of slope drainage that occurs in the Moose Creek watershed.

Wetlands that are important for ecological production support include rivers, marshes, shrub bogs, and riparian shrub and forested wetlands. All of these wetlands support both primary producers and consumers through nutrient transport and transformation.

Almost all of the wetlands in the study area receive moderate to high ratings for wildlife diversity and abundance. As is described in detail in the aquatic resources section, Moose Creek supports arctic grayling and slimy sculpin, as do a number of its tributaries (including Spruce Creek). Round whitefish and chum and coho salmon also occur in Moose Creek (Aquatic Resources, section 3.5.1). Water birds use the slower-moving waters of streams and the small number of marshes and ponds that occur in the project area. The seasonally flooded mudflats that occur along Moose Creek are important habitat for shorebirds, although these unvegetated wetlands are limited because Moose Creek (and its tributaries) lacks a large, well-developed floodplain. Large mammals such as moose and caribou forage in the willow-dominated shrub wetlands, and grizzly bears forage for berries in the mixed-shrub graminoid meadow and mesic shrub birch--ericaceous shrub wetlands.

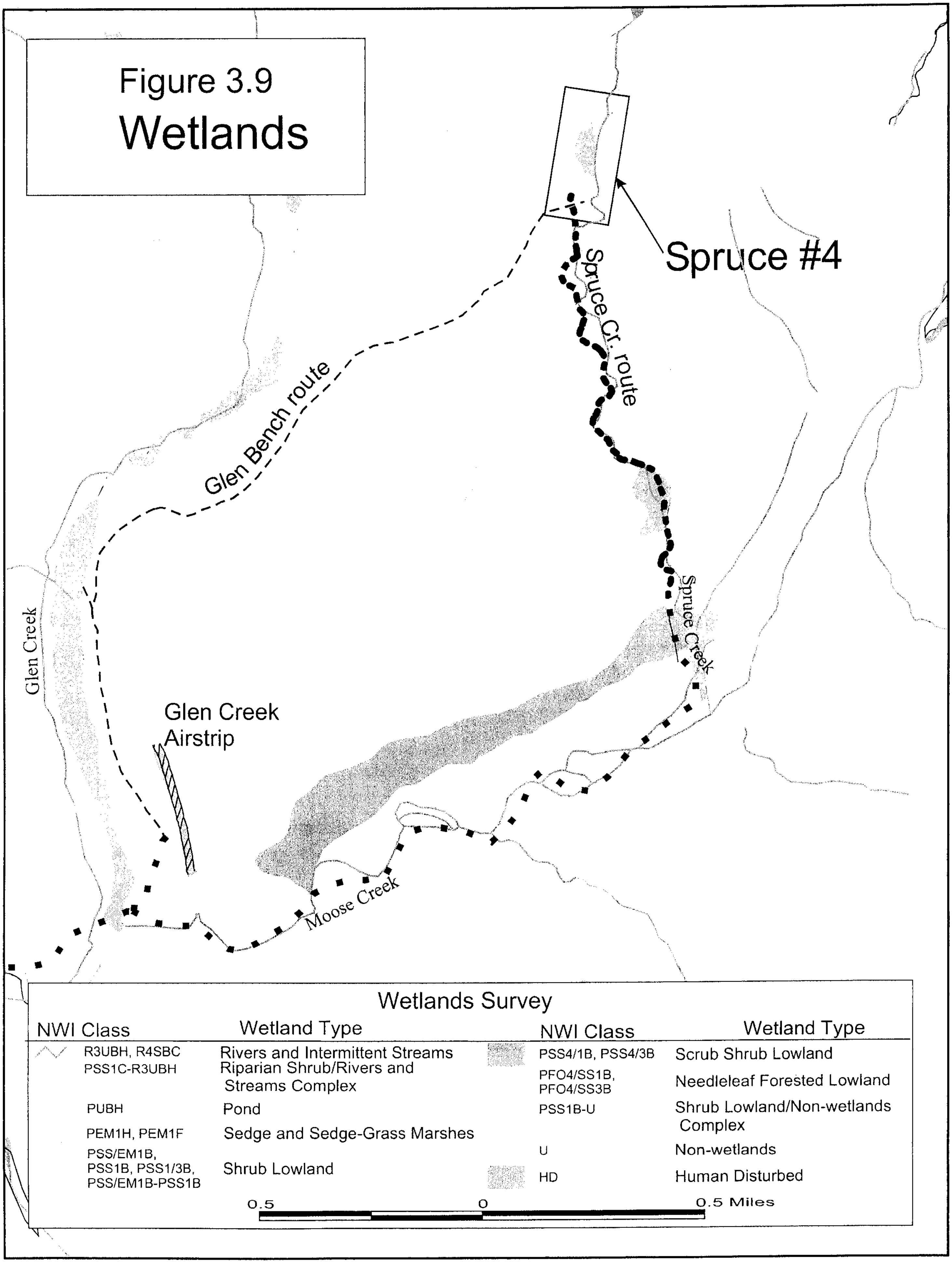


Figure 3.9
Wetlands
Spruce #4
Spruce Cr. route
Glen Bench route
Spruce Creek
Glen Creek
Glen Creek
Airstrip
Moose Creek
Wetlands Survey
NWI Class
Wetland Type
R3UBH, R4SBC
Rivers and Intermittent Streams
PSS1C-R3UBH
Riparian Shrub/Rivers and Streams Complex
PUBH
Pond
PEM1H, PEM1F
Sedge and Sedge-Grass Marshes
PSS/EM1B, PSS1B, PSS1/3B, PSS/EM1B-PSS1B
Shrub Lowland
NWI Class
Wetland Type
PSS4/1B, PSS4/3B
Scrub Shrub Lowland
PFO4/SS1B, PFO4/SS3B
Needleleaf Forested Lowland
PSS1B-U
Shrub Lowland/Non-wetlands Complex
U
Non-wetlands
HD
Human Disturbed
0.5
0
0.5 Miles

Subsistence and recreational uses of the project area are described in sections 3.6.2.8 and 3.6.3. The importance of wetlands to wildlife in the area is directly related to the importance of wetlands for human resources, as they provide hunting and viewing opportunities for subsistence and recreational users, respectively. These wetlands generally were given low ratings for these functions because these user groups currently use the area at low levels. Potential increases in these uses are discussed in their respective sections of chapter 4.

3.5.4 Wildlife and Habitat (Mammals and Birds)

3.5.4.1 Moose

The overall population of moose in Denali National Park and Preserve north of the Alaska Range has remained relatively constant since 1986 (Meier 1987, Meier et al. 1991, Fox 1997, Belant and Stahlnecker 1997). Autumn density estimates in various regions of the park have ranged from <0.1-1.4 moose/mi^2 (Meier 1987, Meier et al. 1991, Fox 1997), with overall autumn densities of 0.4-0.5 moose/mi^2 (Meier 1987, Fox 1997). Autumn density estimates in the Kantishna Hills region were 0.69 and 0.64 moose/mi^2 in 1986 and 1981, respectively (Meier 1987, Meier et al. 1991). There was a tendency for moose to be aggregated in a few drainages (Meier 1987, Meier et al. 1991). Based on habitat and previous aerial surveys, >90% of the affected area is considered to have low moose density (<0.3/mi^2) in autumn and <10% of the affected area is considered to have high moose density ($\geq$0.3/mi^2) in autumn (J. L. Belant, unpubl. data).

Moose habitat in Denali National Park is typically vegetated areas below 4,000 feet elevation. Within this elevational restriction, moose are distributed throughout the Kantishna Hills, including the affected area. Habitat use by moose in the eastern portion of Denali from May to September is ranked in descending order as follows: open shrub, closed shrub, conifer forest (open-closed canopy), deciduous forest, herbaceous, and bare ground (Belant, unpubl. data). The diet of moose in the eastern portion of Denali is predominantly willow during summer and winter (Risenhoover 1987, Van Ballenberghe et al. 1989)

3.5.4.2 Caribou

The Denali Caribou Herd numbers approximately 2,000 caribou and ranges over approximately 10,000 km^2 of area, including most of Denali National Park north of the Alaska Range, and areas south of the range and east of Mount McKinley. Historically, the Denali Herd may have exceeded 20,000 animals from the turn of the century to the early 1940s (Murie 1944). The herd declined to about 10,000 caribou in the mid-1940s and maintained that size until the mid-1960s. Along with many other Alaska caribou herds, the Denali Herd again declined after the mid-1960s, reaching a low of about 1,000 caribou in 1975 (Troyer 1977). This latter decline resulted from poor recruitment and lowered adult survival during a period of relatively severe winters (Adams et al. 1989). Researchers have conducted intensive studies on the dynamics of the Denali Herd since 1984 (Adams et al. 1995a,b; Adams and Mech 1995; Adams 1996; Adams and Dale 1998). They found high losses of calves to predation are an important factor in limiting the growth of this caribou population.

For the last decade, approximately half of the cows in the Denali Herd have calved in the foothills of Mount McKinley from the Muldrow Glacier to the Straightaway Glacier, while the remaining cows are spread throughout the range of the herd (Adams et al. 1995b). By mid-summer, when cooler temperatures and increased rainfall reduce insect harassment, caribou disperse widely to forage throughout the mountains and foothills of the park. With the onset of the breeding season in mid-September, caribou aggregate into rutting herds. These rutting groups can be found from the foothills of Mount McKinley, north through the Upper Moose Creek drainages and into the Toklat, East Fork, and Sushana River drainages. In general, rutting occurs further to the north and at lower elevations with increased autumn snowfall.

Since 1986, the period of intensive study, caribou have predominantly wintered on the tussock flats north of the Outer Range and the associated foothills. In years of high winter snowfall, caribou are restricted to wind-blown alpine ridges of the Outer Range, Kantishna Hills, and the Stampede Hills.

Caribou make use of the study area in the Kantishna Hills, and may be found there at any time of the year. This area exhibits no particular significance for caribou. Caribou are most common in this area during the fall rutting/migration period and the spring migrations. These migrations tend to occur through the area bounded by Stony Creek on the east and Moose Creek and the Clearwater Fork of the Toklat River on the west. Most of the caribou travel through the eastern half of this migration corridor.

3.5.4.3 Dall Sheep

The Kantishna Hills are considered low-quality sheep habitat (J. Putera, pers. comm. 1998). Since 1995, sheep and/or sheep tracks have been reported in the Kantishna Hills on 3 occasions (NPS files). Two young adult male sheep were observed on Friday Creek Ridge on 12 June 1997. Sheep or sheep tracks were also observed at the Kantishna airstrip on 2 occasions during late June to early July in 1995.

3.5.4.4 Wolves

The study area surrounding Spruce Creek and the possible access corridors are regularly utilized by wolves, as is all of Denali National Park and Preserve below about 6,000 feet elevation (Mech et al. 1998). Since the beginning of wolf radio-telemetry research in 1986, we have annually monitored one or more packs utilizing the area. Since 1996, the study area has been within the territory of the Stony pack (L. Adams, USGS Biological Resources Division, personal communication). This pack arose from the dispersal of a young female from the adjacent Turtle Hill pack in winter 1994-1995. This female and her mates produced pups in 1996 and 1997, reaching a pack size of 7 in Fall 1997. As of March 1998, the Stony Pack comprised 5 wolves.

Since 1986, wolves have denned in the study area in only 1 year. In 1995, the Turtle Hill pair denned about 1 mile upstream from the mouth of Spruce Creek and to the west of the creek channel. The breeding female, who was radio-collared, was regularly located in that vicinity during mid-May to late-July and pups were observed in late July. In other years of the study, wolf packs that included this area in their territories were radio-collared, but denned elsewhere.

3.5.4.5 Bears

Two species of bears occur in the study area, the grizzly bear (*Ursus arctos*) and the American black bear (*Ursus americanus*).

Grizzly bears range throughout the park and preserve, but generally prefer high-elevation tall shrub, low shrub, and alpine tundra communities. Grizzlies are omnivorous, opportunistic feeders and move to areas when foods become seasonally available. Roots, sedges, early herbaceous plants, and over-wintered berries constitute the bulk of their diet after they emerge from dens in late April (Stelmock 1981). Denali grizzly bears prefer pea vine *(Hedysarum alpinum americanum)* roots, which grow on low slopes and valleys (Murie 1981). They also prey on moose and caribou calves. By mid-summer grizzly bears turn from digging to grazing and feed on grasses and sedges growing on upper hillsides. Near autumn, grizzly bears turn to a diet of berries, especially soapberries *(Shepherdia canadensis),* that grow on floodplain gravel bars. This diet is supplemented by ground squirrels and, where available, salmon.

The vegetative communities of primary importance to grizzly bear habitat in the Kantishna Hills study area are tall shrub, low shrub, and alpine tundra. The Kantishna Hills area is important to grizzly bears because it supports the only large amount of alpine habitat in the northern additions of the park/preserve (Valkenburg 1976). Darling (1987) found that in the central portion of the park adult females (sows) with their young used more alpine habitat (the more rugged terrain at higher elevations) than single bears. The survival of adult female grizzly bears is important for preserving a natural and healthy population. The loss of a sow also means the loss of her current and potential offspring. Most family sightings in 1986 were near drainage headwaters above 2,000 feet.

Grizzly bears have been observed to den in Denali between 1,000 and 7,000 feet (Keay 1995). Dean (1987) estimated grizzly bear density for the 2,500 km^2 area from Riley Creek to the Muldrow from the Alaska Range to just north of the Outer Range. The density estimate for all bears expanded for estimated sighting efficiency was 32.3/1,000 km^2 (1 bear/12 mi^2-all bears.)

Keay (1995) estimated bear density in a 1,707 km^2 study area from the Muldrow glacier west to the Herron River. Density estimate for all bears was 37.0/1,000 km^2 (1 bear/10.4 mi^2-all bears). Bear density in the Kantishna Hills has never been estimated, but is expected to be similar.

Meier et al. (1991) estimated moose density in four regions of the Alaska Range between the Nenana and Swift Fork Rivers. These areas also represent bear habitat north of the Alaska Range, with the exception of habitat west of the Swift Fork. The area of the Kantishna Hills region is 1,605.3 km^2. Applying the density estimates of Dean and Keay suggests 52 to 60 bears in that area.

In the Kantishna Hills, black bears are probably more abundant than grizzly bears; however, no estimates of population sizes or densities are available for the park and preserve. Little is known about black bear population characteristics in Interior Alaska (Kertell 1984).

In contrast to grizzly bears, black bears prefer upland forest and floodplain forest communities below 2,000 feet in elevation (ADFG 1987). Black bears den in all types of habitats in holes, brush piles, or simply under a blanket of snow (Smith et al. 1994). After emerging from their den in the spring, black bears seek new plant growth. They are opportunistic feeders and will readily eat whatever food they encounter, including carrion. Salmon, where available, may be substituted for herbaceous vegetation. Berries are an important part of their diet in late summer and early autumn. Black bears are considered bolder than grizzly bears and have a high potential to be adversely affected by human activity (NPS 1990).

A grizzly bear research project has been underway in an area adjacent to the Spruce Creek study area since 1991. Radio-collared grizzly bears from this project have been located within the Spruce Creek study area. These bears have been observed at elevations ranging from 2,000 ft. to

4,600 ft. Behaviors exhibited by these bears include traveling, resting, digging, and denning. A young male grizzly bear denned in the winter of 1992 at Twenty-two Gulch, a tributary of Glacier Creek. On 2 September 1992, observers in a flight over the Kantishna Hills saw seven black bears. This total included one single bear, one sow with 2 cubs of the year and one sow with 3 yearling cubs.

On 23 June 1998, approximately 20 minutes of flight time was spent in the Spruce Creek study area. The majority of the time was spent in the upper reaches of the Spruce, Glen, and Rainy Creek valleys. Effort was concentrated on habitat where bears or signs of them were most likely to be evident. No bears were sighted, but evidence of digging was obvious on the hillsides.

The applicants reported seeing a bear on a moose carcass at the junction of Spruce Creek and Moose Creek, and NPS employees confirmed the sighting while flying over the area on July 1, 1998 (Twitchell and Rice, pers. comm.).

3.5.4.6 Other Mammals

The following mammals are also known to occur in or near the affected area. Little detail is known about their populations, habitat use, or life histories in the study area. These species include: Wolverine *(Gulo gulo)*, Marten *(Martes americana)*, Mink *(Mustela vison)*, River otter *(Lutra canadensis)*, Beaver *(Castor canadensis)*, Red fox *(Vulpes vulpes)*, Coyote *(Canis latrans)*, Lynx *(Felis lynx)*, Short-tailed weasel *(Mustela erminea)*, Least weasel *(Mustela nivalis)*, Snowshoe hare *(Lepus americanus)*, Arctic ground squirrel *(Spermophilus parryii)*, Red squirrel *(Tamiasciurus hudsonicus)*, Porcupine *(Erethizon dorsatum)*, Red-backed vole *(Clethrionomys rutilus)*, Yellow-cheeked vole *(Microtus xanthognathus)*, Tundra vole *(Microtus oeconomus)*, Arctic shrew *(Sorex arcticus)*, Masked shrew *(Sorex cinereus)*, Dusky shrew *(Sorex monticolus)*, Pygmy shrew *(Microsorex hoyi)*, Northern flying squirrel *(Glaucomys sabrinus)*, Bog lemming *(Synaptomys borealis)*, Brown lemming *(Lemmus sibiricus)*, Meadow vole *(Microtus pennsylvanicus), and* Singing vole *(Microtus abreviatus)*.

3.5.4.7 Amphibians

Only one amphibian species, the wood frog (*Rana sylvatica*) is known to occur in or near the affected area. This species occurs throughout Interior and Southern Alaska. Little is known about the population or distribution of the wood frog in the Kantishna Hills.

3.5.4.8 Birds

Birds in the southern part of the Kantishna Hills are not well described. The available information is descriptive; data on relative abundance of species and bird-habitat relationships are not available. Information on the avian resources in the Moose Creek and Spruce Creek area is limited to data collected by Kertell (1984) in 1983 and McIntyre (unpubl. data) from 1988 to 1993. McIntyre's surveys were limited to cliff nesting raptors and did not include the Moose Creek riparian corridor. The Alaska Bird Observatory conducted on-road and off-road point counts along the Denali Park Road and Moose Creek just west of the affected environment from 1993 to 1997 (Payton and Springer 1998, Springer, unpubl. data). Additionally, Nan Eagleson made observations of birds in the area during the North American Migration Count in May in 1994-1997 (McIntyre 1996).

Kertell (1984) observed 85 species of birds in the Kantishna Hills study area in. All species, except for Hammond's flycatcher (*Empidonax hammondii*), were previously recorded in Denali National Park. Records of Hammond's flycatchers in the Kantishna Hills represent a southern extension of the previously known range of the species in Alaska (Kertell 1984). His observations of surfbirds (*Aphriza virgata*) are notable because their breeding range is largely restricted to the mountains of Southcentral Alaska. Northern wheatear (*Oenanthe oenanthe*) and arctic warbler (*Phylloscopus borealis*), observed by Kertell (1984) are two species of primarily Asiatic distribution, which in North America breed only in Alaska. Olive-side flycatchers (*Contopus cooperi*) are abundant in the Moose Creek area (N. Eagleson, S. Springer pers.comm.). The U.S. Fish and Wildlife Service recognized this species as a national species of management concern (FWS 1995) and by the Alaska Department of Fish and Game as a species of special concern (J. Wright, pers. comm.). Northern goshawk (*Accipiter gentilis*), alder flycatcher (*Empidonax alnorum*), gray-cheeked thrush (*Catharus minimus*), and blackpoll warbler (*Dendroica pinus*), which occur in the area, are also recognized by U.S. Fish and Wildlife Service as national species of management concern in Alaska (FWS 1995).

There were no significant densities of waterfowl or other economically important game birds in the 1983 study area (Kertell 1984). Numbers of waterfowl were very low because of the lack of lakes and ponds. However, Moose Creek probably supports breeding harlequin ducks (*Histrionicus histrionicus*). Few data are available on the population status of harlequin ducks in Interior Alaska. The species is listed as a species of special concern by many states in the western United States (D. Zwiefelhofer, pers. comm.).

Alaska Bird Observatory personnel (Springer, unpubl. data) observed 26 species of birds on the off-road point counts just west of Camp Denali from 1993 to 1997. These observations were close to the affected area and provide additional data on the avian resources in the area.

Migrating birds use this area each spring and fall. In spring, shorebirds are commonly seen in riparian and upland areas. Waterfowl and passerines also pass through the area in large numbers (N. Eagleson, pers. comm.). Nan Eagleson observed 66 species in the Wonder Lake and Moose Creek area during the North American Migration Count in 1994 to 1997 (McIntyre 1996). Eagleson's observations provide good information on the species that migrate through the affected area in spring. Notable is the number of species of shorebirds that pass through the area. In autumn, thousands of sandhill cranes (*Grus canadensis*), Canada geese (*Branta canadensis*), greater white-fronted geese (*Anser albifrons*), and trumpeter swans (*Cygnus buccinator*) migrate through the area. Sandhill cranes and geese may use lowland areas for feeding and resting during migration.

A total of 104 species of birds have been recorded in the Kantishna Hills. This represents about 70% of the number of bird species recorded in Denali National Park and Preserve.

3.5.4.8.1 Raptors

Raptor surveys were conducted in the Kantishna Hills in 1983 (Kertell 1984) and from 1988 to 1993 (McIntyre, unpubl. data). These surveys were conducted to provide data on raptors in mining areas and to minimize disturbance of raptors during studies associated with the environmental impact studies in the Kantishna Hills. These surveys were initiated because raptors are sensitive to disturbance, especially during the breeding season (Fyfe and Olendorf 1976, Newton 1979). Kertell (1984) located two active raptor nests in the Kantishna Hills in 1983. Based on the number and distribution of empty nests, Kertell (1984) suggested that cliff-nesting raptors were more abundant in previous years. Kertell (1984) observed subadult golden eagles (*Aquila chrysaetos*) twice using empty nests as perch sites. Bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk (*Buteo jamaicensis*), golden eagle, American kestrel (*Falco sparverius*), merlin (*Falco columbarius*), and gyrfalcon (*Falco rusticolus*) were observed in the Kantishna Hills in 1983. Breeding pairs of golden eagles, American kestrels, merlins, and gyrfalcons were observed in the Kantishna Hills in 1983.

McIntyre (unpubl. data) found at least 16 individual golden eagle nesting areas in the Kantishna Hills. She did not find cliff-nesting raptors in the Moose Creek or Spruce Creek drainage. Golden eagles and gyrfalcons nest in Rainy Creek and Glen Creek, near Spruce Creek. These nesting areas are at the head of the drainages; the golden eagle nesting area in Rainy Creek is less than 0.25 km from the old Red Top Mine Road. McIntyre (unpubl. data) also found at least six gyrfalcon nesting areas in the area. Finally, peregrine falcons (*Falco peregrinus*), a species that was listed federally as endangered, nested near the confluence of Little Bear Creek and Toklat River (about 20 miles northeast of the study area) from 1989 to 1993. Data have not been collected on other raptors nesting in the Moose and Spruce Creek areas. Based on the habitat available in the area the following species probably breed in the area: northern harrier, sharp-shinned hawk, northern goshawk, red-tailed hawk, merlin, and American kestrel.

No data are available on the breeding status of owls in the area. Based on the habitat available in the area, the following species probably breed in the area: Short-eared Owl (*Asio flammeus*), great horned owl (*Bubo virginianus*), northern hawk-owl (*Surnia ulula*), and boreal owl (*Aegolus funereus*). Short-eared owl, great horned owl, and northern hawk-owl are commonly seen in the area in summer (N. Eagleson, pers. comm.).

3.5.4.8.2 Habitat

Moose Creek is one of the largest clear-water streams on the north side of the Alaska Range in Denali National Park. This area provides riparian habitat for many species of breeding birds. Riparian habitat is important for resting, feeding, and breeding birds, and is generally associated with greater bird diversity and abundance than nearby upland areas (Spindler and Kessel 1979). The value of riparian habitat for birds is thought to be a function of its vegetative complexity (Anderson and Ohmart 1977). Spindler and Kessel (1979) identified tall shrub in riparian areas as the most important vegetative type for birds in Alaska, and water and detritus as important components. According to Spindler and Kessel (1979), streamside habitats in Interior Alaska often support over 250 birds per 100 acres during the breeding season. Anderson and Ohmart (1977) have shown that avian abundance in the riparian ecosystem is primarily a function of the complexity of vegetation. Similarly, MacArthur (1964) correlated high bird species diversity with a large number of vegetation layers. Birds also use streamside habitats extensively during migration (Stevens et al. 1977). See section 3.5.3 for a description of the vegetation types in the area.

The study area encompasses a variety of vegetative communities ranging from riparian along Moose Creek and other watercourses to forested areas in the Kantishna Hills. The study area has great potential to provide habitat for many species of birds because of the diversity of vegetative communities in the area. Of particular interest are habitats for olive-sided flycatchers (open coniferous forests with bog ponds, marshy streams, and woodland/dwarf forest) (Wright 1997), harlequin ducks (clear-water streams), and neotropical migrants. Of particular interest in the winter are the riparian areas and willow thickets that may provide food and shelter for ptarmigan and forested areas that may be important for wintering birds.

The habitat in the area probably supports the prey base for many species of raptors. This prey base includes resources for resident raptor species, including gyrfalcon, great horned owl, and boreal owl. Wintering willow ptarmigan (*Lagopus lagopus*) provide an important food resource for wintering raptors and for breeding raptors, such as Golden Eagles, in spring. Willow ptarmigan often use willow thickets associated with riparian areas in winter (Weeden 1965, St. Georges et al. 1995). These areas provide ptarmigan with food and shelter during the long winter months.

3.6 Social Environment

3.6.1 Cultural Resources

3.6.1.1 Kantishna Area History

Little was known about the area when Judge James Wickersham attempted the first climb of Mt. McKinley in 1903. Although unsuccessful in reaching the summit of Mt. McKinley, on his return to Fairbanks Wickersham found a little gold in Chitsia Creek in the northern Kantishna Hills and staked four claims. Wickersham's discovery spread rapidly, and by 1904 numerous prospectors were picking and panning the creeks draining the Kantishna Hills.

Relatively simultaneous gold discoveries on Eureka Creek by Joe Dalton and on Glacier Creek by Joe Quigley resulted in the Kantishna stampede. Both streams are tributaries of Moose Creek in the heart of the Kantishna Hills. News of these discoveries in June 1905 brought thousands of prospectors into the area. Access into the Kantishna District was along the rivers and trails to the north. The miners usually came up the Kantishna River then overland into the district. Towns were quickly established. Eureka, "a settlement of considerable size" at the confluence of Moose and Eureka creeks, became the hub of the district. By fall 1905 most of the creeks in the Kantishna Hills were staked from beginning to end (Capps 1918).

Prospectors combed the drainages of tributaries in Upper Moose Creek including Glen, Rainy and Spruce Creeks. Although the distribution of gold was uneven on Glen and Spruce Creeks, mining continued on the creeks throughout the 1906 season. Lumber in the Kantishna District was sparse, but Glen and Spruce Creeks had some of the best stands of timber needed by the miners for sluice boxes, cabins, and fuel. Several of the miners built cabins and wintered over on Spruce and Glen Creeks. Late in the 1906 mining season three men reportedly worked 2.5 miles upstream from the mouth of Spruce Creek. They mined three-foot thick gravel deposits, finding coarse gold over a width of 12 feet.

Before long all those who rushed into Kantishna realized that the only areas showing a profit were claims on Eureka and Glacier Creeks, which were held mostly by Dalton and Quigley. As fast as it grew, Eureka's population diminished during spring 1906. Eureka remained the center of activity over the next few years, and a recording office was established there in 1909.

Though the primary goal of the mining activity, gold was not the only mineral found in quantity. Galena and stibnite, ores containing lead and antimony, were also discovered. Lode mining of these ores, silver, zinc, and copper, and placer mining for gold, continued throughout the district.

During the early years of mining 1906-1920, Glen Creek continued to be the most worked creek in the Upper Moose Creek drainage. Charley McGonagall, Billy Taylor, and Tom Lloyd (the famous miners who made the pioneer climb of Mount McKinley's North Summit in 1910) mined this area. Both lode and placer deposits were actively worked during that period.

In the mid-1920s the mining activity in Kantishna was in serious decline. Low metal prices and high costs of transportation drastically reduced the amount of ore shipped to the smelters. Placer mining also decreased. In 1925 only 13 miners were successfully producing gold (Bundtzen 1978).

While hydraulic mining was becoming common place on the Lower Moose and Caribou Creek drainages, small pick and shovel operations remained the norm for the Upper Moose drainages of Glen, Spruce, and Rainy Creeks. During the 1920s both the right and left forks of Glen Creek were mined. Stendall and Lillidale mined the right fork, while Charles Trundy worked the left fork. In the late 1920s the small post office building in Kantishna was moved to Spruce Creek and became the local recording office. This log structure was moved to the Kantishna Roadhouse by Dan Ashbrook during the 1982-83 winter (Steve Carwile, pers. com.).

Mining in the Kantishna area continued to decline until the mid-1930s. Two events occurred that boosted production of both gold and the various ores from the lode mines. In 1934 the U.S. went off the gold standard, raising the price of gold to $35.00 an ounce making gold mining much more profitable. In 1937 the Alaska Road Commission (ARC) finally completed the road to Kantishna from the Alaska Railroad at McKinley Park Station, greatly diminishing the transportation problems and making Kantishna much more accessible. As a result, over the next few years, the Kantishna District produced more gold, both lode and placer, than any previous time (Buzzell 1989).

Although 1937 is generally accepted as the completion date for the park road, Route 46D (McKinley Park Trail) is noted in the 1923 Annual Report of the ARC as being an 86-mile long trail. The trail was a new project in 1923; it was brushed out and shelter tents were constructed at about 10-mile intervals (Alaska Road Commission 1923). According to the ARC reports, 207 persons traveled the trail by sled between January and April 1925 and the reports also show an increase in trail use in 1926 with 2,323 people traveling in 1,195 autos and 88 wagons and sleds between April and October (Alaska Road Commission 1926, 1927, & 1935). The reports do not, however, detail what portions of the road were traveled.

The ARC also constructed an airstrip in Kantishna as noted in the 1927 report. The landing field was located on the left limit of Moose Creek between the creek and Wonder Lake (Ibid. 1927). The report did not indicate how much the airstrip was used.

Glen Creek continued to produce gold in paying quantities throughout the 1930s, while very little work was done on Spruce Creek. In the 1940s most of the mining operations in Kantishna were suspended because of World War II. No reports of mining activity show up until after 1972, although some mining most certainly took place in the Upper Moose drainage, as Salisbury and Deitz report 2,250 ounces of gold taken from Glen Creek and 1,183 ounces taken from Spruce Creek before 1968 (Salisbury & Dietz 1984).

The rise in gold prices in 1972 created a renewed interest in the Kantishna Hills. Both Glen and Spruce Creeks were worked throughout the 1970s and 1980s. In the early 1970s miners on lower Glen Creek included Gary Golay, Larry Goolsbey, and Ray Hole. During the late 1970s and early 1980s, Eric and Paul Wieler worked claims on upper Glen creek (Gold King #1-15) and leased some claims on lower Glen Creek to Gary Goolsbey and Paul Ziegler. During this time the lower and upper Glen Creek airstrips were constructed. An airstrip on the west side of lower Glen Creek was abandoned because the permafrost melted and the strip sank into a mushy depression that did not drain. Throughout the 1980s Dave Anstette and Larry Goolsbey mined Spruce Creek (Spruce #4-8), and Robert Lister mined the mouth.

3.6.1.2 Archeological Environment

For a more detailed description of the prehistory of Denali National Park, see *An Overview and Assessment of Archeological Resources, Denali National Park and Preserve, Alaska* (Griffin 1990) and *Archeological Investigations of Five Remote Tracts of Land Within Denali National Park and Preserve, Alaska, 1988, 1989* (Lynch 1996).

3.6.1.2.1 Previous Work in the Spruce Creek Project Area
The previous archeological investigations directly pertinent to the Spruce Creek EA were conducted by the staff of the Cultural Resource Mining Inventory and Monitoring Program (CRMIM) surveys of the late 1980s and early 1990s. This program was the result of a National Historic Preservation Act section 106 effort dedicated to the inventory of sites that might be affected by mining activities in the national parks. The CRMIM surveys primarily targeted unpatented mining claims, most located along rivers and streams. This effort resulted in the discovery of 23 prehistoric sites in Denali National Park and Preserve, located primarily in the Kantishna District. The area covered by this survey included a surface reconnaissance examination of most of the land directly affected by the access alternatives to Spruce #4, resulting in the discovery of seven prehistoric and a number of historic archeological sites.

The primary method of the CRMIM survey was surface observation. No subsurface testing was conducted unless surface indications were observed within the CRMIM survey tracts. Prehistoric sites located within the mining tracts were not evaluated for National Register significance. Very little excavation has taken place on sites in the project area.

3.6.1.2.2 Culture History for the Moose Creek Drainage
Considering the information that we now have, prehistoric sites of the Kantishna area in general and the Moose Creek drainage in particular can be characterized as short term, itinerant hunting and overlook sites. They generally overlook river valleys and the migration routes of game. Sites serving other functions, such as longer-term residences, food processing sites, and quarries have not been located in the Moose Creek drainage.

At least seven prehistoric sites in the project area are located along the terraces and overlooks above Moose Creek. Several of these sites contain diagnostic artifacts or charcoal that provided radiocarbon dates. Charcoal was retrieved from two sites in the Moose Creek valley and the samples dated to 2,200 years BP and 2,500 years BP (before present). A third site contains a sideblade associated with the Paleoarctic tradition and the Denali complex of between 3,000 and 10,000 years ago. Artifacts at a fourth site are typical of those found in Athabascan Tradition sites, including a stemmed projectile point, several basalt bifaces, and a schist slab item that had been notched. These items may have been produced and used between 100 and 2,000 years ago. A number of other sites revealed only stone flakes, the product of stone tool manufacture and repair. But other site characteristics, such as a wide variety of stone material types used, good site location, and the existence of buried deposits, offer the potential for new information about the history of Kantishna's prehistoric citizens.

Ethnographic place name and historic research by Dianne Gudgel-Holmes indicates that the southern side of the Kantishna Hills has occasionally been used for traveling and hunting during the summer, though the area is generally lacking in Athabascan place names (Gudgel-Holmes 1991). The southern-most place names associated with salmon fishing in the historic period are located along Moose Creek and Caribou Creeks, approximately 10 to 15 miles to the north of the project area (Gudgel-Holmes 1991:70).

Historic sites associated with twentieth century explorers and miners are also of interest to archeology. The study of the remains of structures, tools and trash left by miners and adventurers, along with documentary evidence, adds a richer and more informed dimension to the everyday history of Kantishna's residents and workers that documents alone cannot provide.

Most of the prehistoric sites found in Denali are located on exposed knobs that were used as hunting lookouts, usually overlooking river drainages. These sites were found because they are located in unvegetated areas and on conspicuous topographic features, often within an easy walk from access roads, or within mining claims investigated by CRMIM program archeologists.

In preparation for an earlier park planning project, D. Gudgel-Holmes and C. E. Holmes designed a predictive model for the location of archeological sites between the Nenana and Savage Rivers, along the east end of the park road corridor (Gudgel-Holmes and Holmes 1989). It is based on ethnohistorical information, topographic features, and access to water. This model suggests that creek terraces have a moderate potential for archeological sites. Overlooks and prominent features of moderate elevation within these drainages are considered to have a high potential for archeological sites (Gudgel-Holmes 1991). Keep in mind that this model is somewhat limited to temporary hunting overlook sites, presumably used during the summer. Sites within the Moose Creek drainage support this model.

The CRMIM survey covered most of the project area at a surface reconnaissance level of investigation. Subsurface testing is necessary along river terrace and ridgetop routes, which have a moderate probability for archeological resources. Surface reconnaissance survey is also recommended for those areas not investigated as part of the CRMIM program.

3.6.2 Public Use

3.6.2.1 Road Access

Access to the interior of the park is via the Denali Park Road from its junction with Alaska Highway 3 to its terminus at the Kantishna Airstrip, Mile 92. Beyond the Savage River Bridge at Mile14.7, a Road Travel Permit or authorization under a Right-of-Way (ROW) Permit is required to operate a motor vehicle during the primary visitor season. Permits are generally required from the Memorial Day weekend to mid-September. Exceptions to road travel permits are the visitor transportation system buses, concessioner tour buses, and emergency vehicles. Vehicles without valid permits may not proceed beyond the Savage River Check Station.

Road Travel Permits may be issued to people in one or more of the following categories:

- Campers driving private vehicles to Teklanika Campground
- Contractors and concessioners
- National Park Service employees
- Other federal and state employees

- Professional photographers/commercial filming/media
- Researchers
- Kantishna landowners, valid occupiers, and guests
- Special populations

ROW permits are authorized under 43 Code of Federal Regulations 36.10 (Park Policy R97-3).

Public access is generally by concessioner-operated shuttle or tour buses. Private businesses in Kantishna operate their own transportation system of buses and vans. Other private vehicles must fall under one of the above categories for access. The NPS limits the number of permits allotted to each Kantishna landowner for its private vehicles as stated in section 1.3.2.1.

3.6.2.2 Vehicle Size Restrictions

Vehicle size limitations are in effect to minimize the potential for hazardous conflict between buses and other large vehicles driven by operators who have not met training standards or other criteria for driving oversized vehicles on the park road.

While road travel restrictions are in effect (generally Memorial Day weekend through the second Thursday after Labor Day), any vehicle that fits the definition of oversized must travel between the hours of 10:00 p.m. and 6:00 a.m. In the case of overweight vehicles, operators must limit total vehicle weight below authorized limits. Oversized vehicles may travel west from the Teklanika Rest Stop or east from the Denali Wilderness boundary only between the above hours or by permit issued by the park superintendent. In that event, other stipulations such as pilot vehicles or NPS escorts may apply.

On the park road, an oversized vehicle is defined as any vehicle larger than eight feet wide (excluding mirrors), and 22 feet long, or taller than 12 feet. Exceptions are shuttle and other buses or National Park Service vehicles that are necessary in maintaining critical park functions.

The authority to establish load, weight, and size limitations is found in Title 36, Code of Federal Regulations, Section 4.11. Violators are subject to legal prosecution (Park Policy M97-3).

3.6.2.3 Kantishna Airstrip

The Kantishna Airstrip is a gravel airstrip measuring 1,800' x 45' located at Mile 92, the western terminus of the Denali Park Road. This public airstrip has trees and brush that rise abruptly along both sides of the runway; this mature vegetation includes 30 to 40-foot high trees. The runway is in a canyon and is subject to strong wind shears. Very limited parking is available for transient aircraft (FAA Alaska Supplement).

The park maintains a 2,000-gallon aviation gas fueling system and ramp on the southeast end of the airstrip and a heliport and fueling facility on the northwest end. Kantishna Air Taxi maintains a tank on the southeast end to support a commercial operation.

The National Park Service does surface maintenance, brushes thresholds, and maintains two windsocks under a memorandum of agreement with the Alaska Department of Transportation and Public Facilities (ADOT/PF). A state road ROW exists for the Denali Park Road from the old boundary of Mount McKinley Park to the Kantishna Airstrip, and ADOTPF maintains this road segment and part of the airstrip.

Commercial use operators must obtain a Commercial Use License to operate out of this airstrip. No other permits are required.

3.6.2.4 Glen Creek Airstrips

Two airstrips are located along Glen Creek. One is located on the east bench above the confluence of Glen Creek and the North Fork of Moose Creek, and the other is located above the forks of upper Glen Creek. The lower airstrip is at about 2,200 feet of elevation, 1,120 feet long, and 30 to 40 feet wide. There is an additional 300+ feet of cleared tundra that doglegs to the west to avoid a hill at the north end of the runway. This airstrip slopes downhill with a steep drop off below it to Glen Creek. There are no permitting requirements to use this airstrip, so it currently is open to any airplanes.

The upper Glen Creek airstrip is at more than 3,000 feet elevation, and is around 1,000 feet long. This airstrip has a side slope in addition to a gentle slope in the long direction. Very few aircraft land here.

3.6.2.5 Winter Access

The Moose Creek drainage can be accessed in winter by snowmobile, dog team, or skis. The common route is via the Stampede Trail to its junction with the Clearwater River. Proceeding to the headwaters of the Clearwater, travelers follow the Willow or Myrtle Creek drainages over passes into Moose Creek. This is a multi-day trip requiring advance preparation and better-than-average traveler skills. Over-flow ice and other rough trail conditions render this route too difficult for the novice winter traveler. There are currently no restrictions on snowmobile access along this route. Dog mushers commonly use this route. Only non-motorized access has been allowed through the original Mount McKinley National Park during winter months.

3.6.2.6 Vehicle Safety

The primary responsibility of every driver on the park road is the safety of their passengers and other visitors. The Denali Park road is a narrow, winding, mostly unpaved primitive road that passes over several mountain passes and through prime wildlife habitat. The gravel portion varies in width and surface character with no appreciable shoulders. Common road hazards include unstable road edges, blind corners, potholes, rock and mudslides, erosion, slippery surfaces, and so on. The road requires constant maintenance during the primary travel season to keep it in a safe and functional condition.

Since 1969 more than 37 reported accidents have involved buses, heavy equipment, or other vehicles. There have been four major, multi-casualty accidents involving buses whose occupants have been injured or killed. Subsequently, the NPS developed a set of driving rules over the years to ensure that vehicle traffic operates in the safest manner possible and that accidents are minimized. These rules include a set of right-of-way procedures for passing on narrow portions of the road; yielding and signaling procedures; special speed restrictions; and other guidelines.

The Denali National Park *Road Use Handbook* has been developed to provide information to bus drivers, employees, and others who frequently drive on the road. This set of guidelines details the procedures and protocols to be used when driving and seeks to standardize driving behavior. In 1996 a video, *Rules of the Road--Your Trip to Safety* was produced by the Ranger Division at Denali National Park and Preserve. This 24-minute video graphically portrays the rules of the road and other situations encountered while driving. It is available to employees, businesses, and others.

3.6.2.7 Airstrip Safety

The Kantishna and Glen Creek airstrips are unmonitored "bush" airstrips. There is limited periodic maintenance on the Kantishna strip, but no maintenance on the lower or upper Glen Creek landing strips.

The Kantishna airstrip is situated in a narrow canyon surrounded by tall trees. Local pilots report erratic winds in the canyon and that the downhill slope and the height of the trees on the west end of the runway increases landing roll out (stopping distance). Because the strip slopes downhill to the west, most pilots have learned it is beneficial to land uphill, even with a tailwind. This decision must be made on approach when the strength and direction of the prevailing winds are determined. Wind shear is also a factor immediately above the runway as the tall trees can mask the relative calm of the runway channel. With the trees close to the runway, there is little room for error.

The lower Glen Creek airstrip is only long enough for small airplanes. Terrain considerations for the traffic pattern are the slope of the area, the small hill at the uphill end, and the steep drop off at the creek end. These three features can make operations at this strip challenging. Because the area is wide open, the potential for strong crosswinds could challenge a pilot.

3.6.2.8 Types of Recreational and Visitor Use

Most visitors use the summer months to enjoy Denali. Winter use is much lower, but it is becoming more popular with local residents. Visitor use has increased steadily from 1972, when the George Parks Highway was completed between Fairbanks and Anchorage. To preserve the unique recreational opportunities that Denali National Park provides and to protect wildlife, the 1986 General Management Plan established a traffic limit of 10,512 vehicles beyond Savage River during the summer allocation period (section 1.3.2.1). All travel, including all bus systems, National Park Service administrative and operations traffic, and Kantishna business traffic must fit within this limit. This established level of use is based on the goals of visitor safety, providing for quality visitor experiences, resource protection, and opportunities to view wildlife. The annual use limit has successfully met these goals.

Kantishna has four overnight facilities (Camp Denali, Denali Backcountry Lodge, Kantishna Roadhouse, and North Face Lodge), but one owner operates two facilities (Camp Denali and North Face Lodge). The level of visitor use in the Kantishna area is not known, but it is estimated that in 1990, about 10,000 visitors (overnight lodge guests, backcountry users, and day-use visitors) entered the Kantishna area for recreational purposes. (Steve Carwile, pers. comm. 1998)

3.6.2.8.1 Summer Activities

Primary summer activities in the Moose Creek drainage of the Kantishna Hills include viewing of wildlife and scenery, hiking, backpacking, mountain biking, flightseeing, and sport fishing. Most visitors come to the area to view wildlife and scenery. Between June and September 1997 park rangers counted a total of 1, 018 people viewing wildlife and scenery in just the Wonder Lake area (*Wonder Lake Monitoring Report 1997*). In 1997 Kantishna area lodge guests participated 11,026 times in guided activities. This is not the same as the total number of lodge guests visiting the area, many of whom participated in more than one guided activity.

Numerous visitors participate in day hiking. All lodge businesses send guided parties to Moose Creek area. Those hiking up Moose Creek generally follow the mining access route to the beaver ponds and beyond, about 1.5 to 2 miles, and back. At least one party per day visits this hiking area, and group sizes average 12-17 people. The lodges coordinate so that usually no more than one group visits a hiking area at any one time. A total of 7,300 people participated in guided hikes in the Kantishna area in summer 1997. An additional 433 people participated in botany walks.

Four backcountry units are potentially affected by the proposed access; these are units 35, 36, 41, and 42 (figure 3.10). NPS records indicate as many as 1,131 people and as few as 787 people backpacked annually into these units from 1993 to 1999. Unit 42, which is nearest Kantishna along the Moose Creek drainage, accounts for about one third to over half of the annual backpackers in this area (373-546 people/year). Unit 36, just east of Wonder Lake in the park's designated wilderness, receives the lowest annual visitation of these four units (103 to 147 people/year).

Mountain biking has become increasingly popular on the gravel roads and trails in the Kantishna area. Three lodge operators rent bikes. Routes include the Moose Creek mining road, the park road, and Skyline Drive. Park rangers counted 432 bike riders in the Wonder Lake area. (Wonder Lake Monitoring Report 1997)

Flightseeing has likewise increased in the area. Between May and September 1997 the Kantishna Air Taxi conducted 413 flightseeing trips, with a total of 1,432 passengers.

Sport Fishing occurs, but is not a primary activity in the area. NPS employees estimate recreational fishing upstream of the North Face Lodge to be about one person or less per day, or fewer than 90 fishing days per year. About 10-15 fishermen use Moose Creek below the North Face Lodge each day of the season or about 900 fishing days per season. No creel data are available. No fishing license is required in the old part of Denali National Park, but a fishing license is required in the ANILCA park extensions, including the Kantishna Hills area (Chris Jones, pers. comm.).

3.6.2.8.2 Winter Activities

Winter activities include cross-country skiing, dog mushing, snowmobiling, and flightseeing. Twenty-five persons visited the area in winter 1998; 12 arrived via the north boundary, and 13 flew in with fixed wing aircraft to the Kantishna airstrip for a total of 151 user nights. Most visitors stayed in the Hawks Nest cabin along the Denali Park Road owned by Camp Denali.

3.6.2.8.3 Lodge-based Visitors[3]

Four lodges are currently operated in the Kantishna Hills area, the oldest being Camp Denali.

[3] Estimated overnight stays at the Kantishna lodges are estimated from the number of cabins/rooms at an average double-occupancy, multiplied by the days in the season (97 or 98), times the average occupancy rate. The actual lodge records are confidential.

Camp Denali and the North Face Lodge are both managed by Denali Wilderness Lodges, Ltd. Guests stayed an estimated 3,232 nights in Camp Denali in 1998, and about 2,852 overnight stays occurred in the North Face Lodge in 1998, for a combined total of 6,084. The occupancy rate has been fairly consistent in recent years. The Kantishna Roadhouse hosted an estimated total of 4,296 overnights by guests in 1997 and about 4,819 overnight stays in 1998. Denali Backcountry Lodge hosted an estimated 5,292 person-nights in 1998. (Their occupancy rate has increased substantially in the last 5 years.)

3.6.2.8.4 Non-Lodge Based Visitors
A total of 113 access permits were issued for other Kantishna landowners in 1997. See sections 3.6.2.1 and 3.6.2.2 for descriptions of the road permits and vehicle restrictions. All other non-lodge-based visitors traveled to the area in the shuttle buses or by airplane.

3.6.3 Subsistence Activities in the Kantishna Hills

No subsistence users permanently reside in the Kantishna area. In recent years subsistence use of the Kantishna Hills has been primarily by residents of McKinley Village and Cantwell for moose-hunting and berry picking. The caribou-hunting season has been closed in this area since 1977 due to the significant decline of the Denali Caribou Herd. Past subsistence use of the Kantishna Hills area has been primarily for hunting moose and caribou in the fall and for trapping during the winter. Occasionally, subsistence users would hunt ptarmigan, fish for grayling, or pick berries incidental to moose or caribou hunting.

On an annual basis, a temporary closure to the discharge of firearms is established for the area within one mile on either side of the park road from the old Mt. McKinley Park boundary at mile 88 to the Kantishna airstrip at mile 93. This temporary closure is based on concern for public health and safety due to numerous developed facilities and high visitor use along the this road corridor. The closure is in effect during the portion of September when the commercial lodge facilities are operating and the fall moose-hunting season is open. Other adjacent, less heavily used parklands in the Kantishna Hills are not affected by this closure.

A limited amount of hunting, fishing, and trapping occur in the Kantishna Hills because of its distance from residence zone communities. At present up to six persons may be expected to hunt or trap annually in the Kantishna Hills from September to April.

3.6.4 Wilderness

Most of the land within the boundaries of Denali National Park and Preserve meets the criteria for wilderness in the Wilderness Act of 1964 (PL 88-577). The park offers superlative opportunities for wilderness recreation in an environment where human influences are minimal.

In 1980, the Alaska National Interest Lands Conservation Act (ANILCA), Section 701, designated most of the former Mount McKinley National Park as wilderness. The more than two million acres of Denali Wilderness is managed under the 1964 Wilderness Act, with special provisions for Alaska wilderness areas under ANILCA. Because of traditional uses and access methods, relatively few roads, great travel distances, areas of vast size, and often severe weather conditions common to most national park system units in Alaska, ANILCA made special provisions for certain types of access and uses in Alaska wilderness that would generally not be permitted in wilderness in the 48 contiguous states. Under reasonable regulations to protect natural and other values, ANILCA specifically allows the use of snowmachines, motorboats,

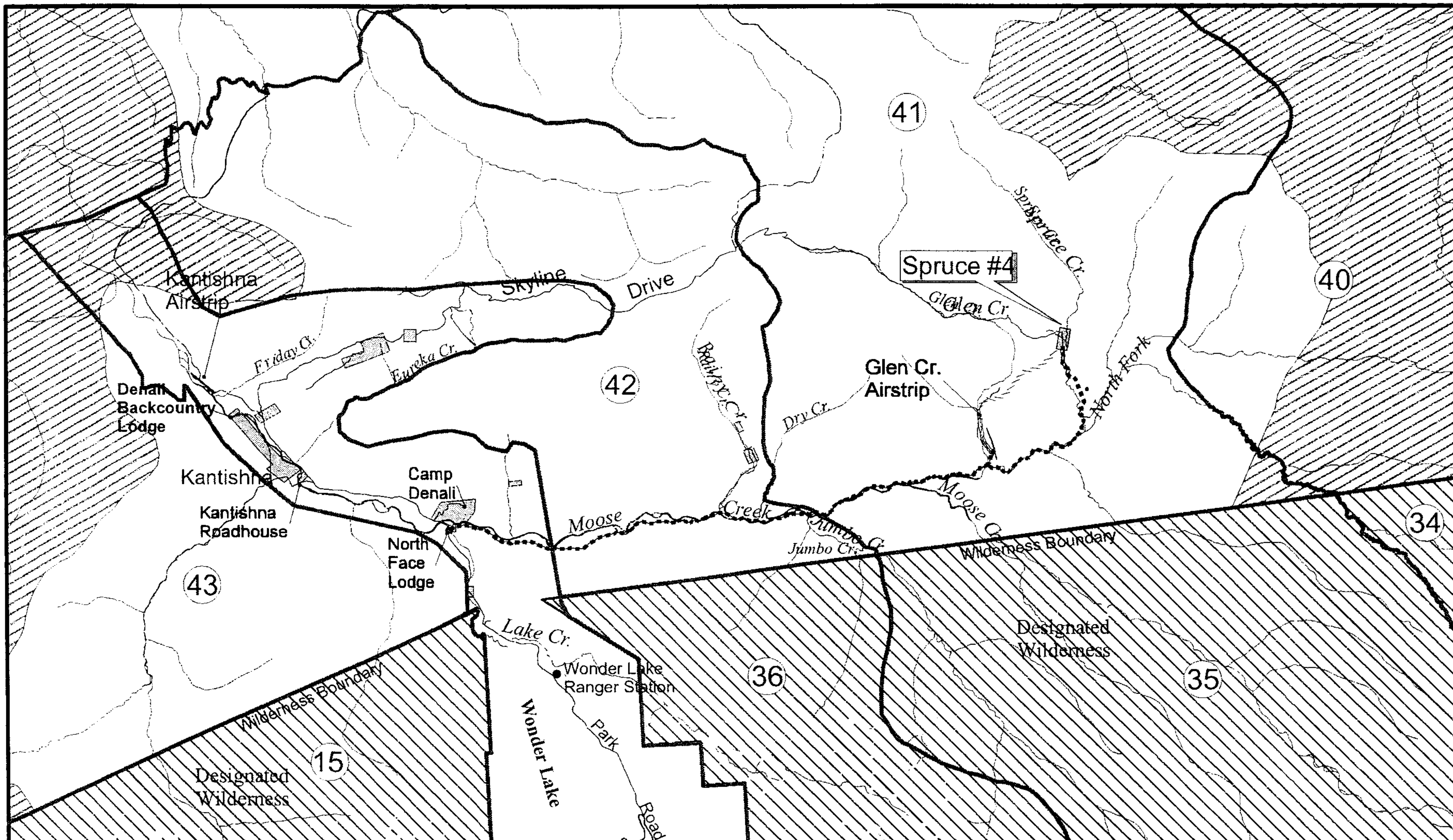


Figure 3.10

Backcountry Management Units in the Project Study Area

Denali National Park and Preserve, Alaska

Legend

Alternatives

Existing and Proposed Access

Glen Bench Route

Private Property

NPS Proposed Wilderness

Designated Wilderness

contour interval = 100 feet

1 0 1 2 Miles

Prepared by: J. Paynter, Denali GIS, 9/28/00 airplanes, and other means of non-motorized surface transportation for traditional activities, including travel to and from villages and home sites, where such activities are permitted by ANILCA.

ANILCA section 1317(a) required a wilderness suitability review, which was included in the 1986 General Management Plan (GMP) for Denali National Park and Preserve (NPS 1986a). This review found about 3.9 million additional acres to be suitable for wilderness. An area within the Kantishna Hills was determined to be unsuitable for wilderness because of disturbance caused by past mining and the road system. There was a mix of developed and undeveloped mining claims in the area, and many old tailing piles were being reworked. Streambeds and gravels in Moose Creek and many of its tributaries had been modified by placer mining. Some lode claims had substantially modified landscapes in their immediate vicinity. The Moose Creek access route parallels the creek bottom, and other mining access routes follow higher ground between tributaries and to lode claims in adjoining drainages (NPS 1984a, FEIS Kantishna Hills/Dunkle Mine Study).

As required by Section 1317(b) of ANILCA, a wilderness suitability review was completed in 1988 with proposed recommendations for lands not already designated as wilderness within Denali National Park and Preserve (NPS 1988, *Final Environmental Impact Statement [FEIS] on Denali National Park's Wilderness Recommendation*). Based on more accurate acreage figures available in 1988, the number of acres determined as suitable for wilderness designation was revised to approximately 3.7 million acres. Of those 3.7 million acres, the preferred alternative identified 2.25 million acres to be recommended for wilderness designation. This 2.25 million acres is referred to as "NPS proposed" wilderness in text and on figures in this document (figures 1.2 and 2.1). The Kantishna area was reevaluated in the 1988 EIS, and it was again determined to be unsuitable for wilderness designation.

Since 1988, numerous changes in land status, land restoration/reclamation efforts, and natural revegetation of mining disturbances have diminished the signs of human activity in the Kantishna Hills area. Although nonfederal lands and lands with encumbrances (unpatented mining claims or other existing private rights) are not immediately eligible for wilderness designation, they can be included within suitable or potential wilderness lands pending resolution of conflicting land uses or ownership. Given the guidance provided by the Wilderness Act and NPS management policies, some of the lands within the Kantishna Hills are technically suitable for potential wilderness designation as they do not bear the permanent "imprint of man's work."

NPS Management Policies for wilderness preservation and management (NPS 2000) require wilderness areas be managed to preserve their wilderness character and resources while providing for appropriate use. Appropriate uses do not degrade the wilderness environment and include activities such as primitive recreation, scientific inquiry, and education. Though the Wilderness Act and ANILCA (Section 1110[b]) "assure adequate and feasible access .... Such rights shall be subject to reasonable regulations issued by the Secretary to protect the natural and other values of such lands." When wilderness has been established within an NPS unit, NPS policies further contend an additional statutory purpose of the park becomes the preservation of wilderness resources and values (NPS 2000). Those values are based in part on the language in the Wilderness Act and the biocentric approach to managing those resources in Denali National Park and Preserve. The biocentric perspective places primary emphasis on preservation of the naturalness of wilderness ecosystems.

The closest designated wilderness boundary (the Denali Wilderness) lies less than one mile south of upper Moose Creek and parallels the drainage from east to west. From some areas in Backcountry Management Units 35 and 36 (figure 3.10) parts of the Moose Creek valley access routes and associated vehicle traffic are visible and audible.

Current vehicle access up Moose Creek is limited to occasional NPS administrative use and inholder access to lands (less than 20 trips per year) during the summer and less than 10 snowmobile trips during the winter. This unmaintained road is being used for hiking away from the Denali Park Road corridor.

Aircraft noise is a primary existing intrusion on solitude in the park and preserve. Regular daily scheduled commercial flights and air taxi services from Healy and the McKinley Park airstrip to Kantishna fly over the area. Flights to and over the Kantishna Hills are estimated at over 600 takeoffs and landings annually from the Kantishna airstrip, with daily flights from June through August. Less than an estimated 20 flights annually are to the Glen Creek airstrip. An increasing number of summer sightseeing overflights go over the area each year.