Section 905(b) (WRDA 86) Analysis
Eklutna Watershed Study
Eklutna, Alaska

1. STUDY AUTHORITY

This General Investigations study is authorized by the House Public Works Committee Resolution for Rivers and Harbors in Alaska adopted 2 December 1970. The resolution states:

> *Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for River and Harbors is hereby requested to review the report of the Chief of Engineers on Rivers and Harbors in Alaska, published as House Document Number 414, 83d Congress, 2d Session; … and other pertinent reports, with a view to determine whether any modifications of the recommendations contained therein are advisable at the present time.*

Funding for this section 905(b) Eklutna Watershed Study was established in the 2003 fiscal year Omnibus Appropriations (PL 108-7).

2. STUDY PURPOSE

The purpose of this study is to determine whether there is a Federal interest in conducting feasibility level watershed studies of the Eklutna River Watershed. ER 1105-2-100, 22 April 2000 states: "Watershed studies are planning initiatives that have a multi-purpose and multi-objective scope and that accommodate flexibility and collaboration in the formulation and evaluation process. Possible areas of investigation for a watershed study include water supply, natural resource preservation, ecosystem restoration, environmental infrastructure, recreation, navigation, flood management activities, and regional economic development. The outcome of a watershed study will generally be a watershed resources management plan which identifies the combination of recommended actions to be undertaken by various partners and stakeholders in order to achieve the needs and opportunities identified in the study." A Federal interest in the resolution of identified water resource problems is contingent upon there being probable environmentally acceptable and technically feasible solutions to identified water resources problems. The solutions must be cost-effective. Identification of a local sponsor who intends to cost-share a watershed feasibility study is also required.

3. LOCATION AND CONGRESSIONAL DISTRICT OF PROJECT

The Eklutna River watershed is in Southcentral Alaska, approximately 17 miles northeast of Anchorage. The Eklutna River drains into the Knik Arm of Cook Inlet. The Eklutna River is a degraded anadromous stream of glacial origin with a large glacial lake near its headwater. Eklutna River flows through an eroded canyon up to about 350 feet deep, and has one significant tributary, Thunderbird Creek. Thunderbird Creek enters the south bank of Eklutna River about a half mile upstream from where Eklutna River exits the canyon and forms a sediment fan. Due to water impoundments on the Eklutna River, Thunderbird Creek is currently the main source of water in the river.

The village of Eklutna is inhabited by Athabascan Indians of the Danaina branch and is located at the head of the Knik Arm of Cook Inlet, adjacent to the mouth of the Eklutna River. It is within the boundaries of the Municipality of Anchorage. Eklutna is in the Anchorage Recording District. Village property encompasses 12.4 square miles of land and 5.7 square miles of water (State of Alaska Department of Commerce, Community and Economic Development web page, http://www.dced.state.ak.us/dca/commdb/CF_COMDB.htm). The village lies on the highway between Anchorage and Palmer and has ready access to a variety of transportation services in those communities. Two privately owned airstrips and the Alaska Railroad system are located in the area.

The 2003 population within the Eklutna was estimated to be 427 by the State of Alaska. A total of 13.2 percent of the population is Alaska Native or part Native. According to the 2000 U.S. Census, the majority of non-Native residents are employed in Anchorage, with incomes averaging $31,679 per capita. Eklutna's Danaina residents, however, have significantly lower incomes averaging $19,494 per capita.

The study area is in the Alaska Congressional District. The Congressional delegation is composed of:

Senator Ted Stevens (R)
Senator Lisa Murkowski (R)
Representative Don Young (R)

4. WATERSHED STAKEHOLDERS

4.1 Eklutna River Watershed Council. The mission of the Eklutna River Watershed Council (ERWC) is to serve as a forum to facilitate stewardship and conservation in the development of the Eklutna River watershed for its long-term health. ERWC membership is open to organizations and individuals with significant land, water or other resource ownership or rights, management responsibility, or user interests in the Eklutna River Watershed.

4.2 Anchorage Water & Wastewater Utility. The Anchorage Water & Wastewater Utility (AWWU) provides potable drinking water for a customer base of 216,799 in the Anchorage area. Eklutna Lake is the main source of drinking water for the utility, accounting for almost 76 percent of the total production of 9.7 billion gallons in 2001. The AWWU operates the Eklutna Water Treatment Facility within the Eklutna watershed.

4.3 Native Village of Eklutna. The Native Village of Eklutna (NVE) is located entirely within the Eklutna River watershed and is the project proponent for this watershed. They would be the most likely cost-sharing partner for any further recommended studies. Goals for the Eklutna River developed by NVE are (Native Village of Eklutna, 2002):

- Preserve, restore, and enhance the Eklutna River watershed and surrounding coastal zone habitat for salmonids, waterfowl, other wildlife, and other traditional natural resource and environmental values.
- Develop Eklutna’s capacity for traditional natural resources stewardship.
- Realize subsistence and economic gains for Eklutna.

NVE is further discussed in Section 3 of this report.

4.4 Eklutna Incorporated. According to their web page, Eklutna Inc. was incorporated in 1972 under the Alaska Native Claims Settlement Act (ANCSA). Eklutna Inc. has played a vital role in the economic landscape of the Anchorage area. Eklutna Inc. is the largest private landowner in Anchorage and in the Eklutna watershed, owning or entitled to receive more than 90,000 acres of land from Eagle River to Palmer. Today, the corporation represents more than 150 shareholders and manages a variety of investments, including shopping centers, office buildings, and residential developments. Eklutna Inc. states that their vision is to benefit the corporation and shareholders by managing assets and business ventures to maximize return. "Our success inspires community pride, unity and self-respect among our shareholders." Eklutna Inc. also states that their mission "is to protect and expand Eklutna's assets and business ventures through orderly diversified growth, utilizing sound management and financial policies. We benefit and endeavor to provide opportunities to assist shareholders with their own self-determination." (Information from http://www.eklutnainc.com)

4.5 Alaska Railroad. The Alaska Railroad Corporation is a self-sustaining, full-service railroad serving ports and communities from the Gulf of Alaska to Fairbanks. Owned by the State of Alaska since 1985, the Railroad is overseen by a seven-member Board of Directors appointed by the Governor of Alaska (http://www.alaskarailroad.com). A portion of the railway between Anchorage and Fairbanks passes through the Eklutna Watershed and over the Eklutna River.

4.6 Chugach State Park. Chugach State Park manages all lands in the upper watershed of the Eklutna River. The park manages Bureau of Land Management (BLM) and Eklutna Inc. lands in this watershed under formal agreements. The BLM lands are power withdrawal lands that extend from Eklutna Lake north to the Eklutna Power Plant. The Eklutna Inc. lands are managed under an agreement called the North Anchorage Land Agreement and include most of the land near and around the lake. All Chugach State Park lands in the watershed, including those under these agreements, are managed for recreation under the Chugach State Park Master Plan. The goal of the plan is to continue recreational use, develop facilities to enhance recreation, and to protect the resources for long-term enjoyment.

4.7 Municipal Light and Power. Municipal Light and Power (ML&P) provides electricity to over 30,000 residential and commercial customers in a service area of 20 square miles in the Anchorage area. Within this service area is the state's commercial, industrial, medical, and transportation centers, as well as over half of Anchorage's residential population. ML&P is the majority shareholder (53.3 percent) of the jointly owned Eklutna Hydroelectric Power Plant. Chugach Electric Association and Matanuska Electric Association own the remainder of the facility, which has 44 megawatts of installed capacity (http://www.mlandp.com). The plant generates hydroelectric power using the water stored in Eklutna Lake behind the Upper Eklutna Dam. The Matanuska Electric Association provides electricity in the Eklutna area.

4.8 Eklutna Valley Community Council. The Eklutna Valley Community Council (EVCC) generally encompasses the Eklutna Valley above the Eklutna Water Treatment Facility. Most of the people who live or own land in this area participate in the EVCC. While the EVCC has not

developed any positions as a community council with regard to the Eklutna Watershed Council, the members have expressed three general interests (Reagan, pers. comm.):

- To protect the watershed.
- To understand the positions taken by the watershed council.
- To influence the watershed council.

5. EXISTING INFRASTRUCTURE

5.1 Existing Infrastructure. In 1927, the City of Anchorage entered into a contract with the Anchorage Light and Power Company to construct the Old Eklutna Hydroplant. Construction included a low-head storage dam at the outlet of Eklutna Lake and a 68-foot-high concrete arch diversion dam (referred to as the Lower Eklutna Dam in this study) in the Eklutna River canyon 8 miles downstream of the lake. The diversion dam diverted water through a ¼-mile-long tunnel to a turbine house near the Eklutna Village. Since its construction, the Lower Eklutna Dam has been a barrier to fish movement upstream.

In 1948 the Bureau of Reclamation recommended construction of a new dam to raise the level of Eklutna Lake to an elevation of 875 feet above sea level with a tunnel intake at 830 feet. Construction was completed in 1955. The new system replaced the aging storage dam at the lake outlet with a new dam that diverted water through a 4.5-mile-long, 9-foot-diameter concrete lined tunnel with a capacity of 640 cubic feet per second (cfs) to a turbine house on the south bank of the Knik River This new plant used essentially the entire storage capacity of Eklutna Lake and no water was made available to operate the existing plant at Eklutna. The existing plant was shut down as a result and the Lower Eklutna Dam was allowed to fill with gravel. This dam is no longer operational and is currently completely backfilled with sediment to a depth of approximately 68 feet at the upstream face of the dam (Photo 1).

In March 1964, a severe earthquake that caused widespread damage and destruction hit the Anchorage region. Because of the severity of damage to the dam, it was decided to construct a new storage dam downstream from the existing storage dam at the lake outlet. The new Eklutna Dam (referred to as the Upper Eklutna Dam in this report) is an earth and rockfill structure 815 feet long and 51 feet high containing 85,000 cubic yards (yd^3) of material. The spillway is a rectangular concrete conduit through the dam with an uncontrolled overflow crest. The maximum capacity of the spillway is 3,315 cfs. There are no outlet works in the dam as the power tunnel serves in that capacity (http://www.usbr.gov/history/eklutna.htm).

The Glenn Highway passes through the watershed. The modern Glenn Highway bridge, the original Glenn Highway bridge upstream of the current highway bridge, and an Alaskan Railroad bridge downstream of the highway bridges cross the lower portion of the watershed.

The Alaska Railroad operated a gravel pit at rail mile 140 (Fuglestad 1986). The railroad crosses the Eklutna River at rail mile 140.8, while Eklutna Station is at rail mile 141.8. The pit is clearly marked on the USGS Anchorage B-7 NE, 1:25,000 scale, 1979 topographic map.

The U.S. Army used Eklutna glacier for training through the 1970's and built a 13-mile-long road along the north shore of the lake. This road now serves as a hiking and ATV trail to the head of the

lake where there are several other trials and a small airstrip. There are about 30 miles of maintained hiking trails at Eklutna Lake.

Currently, Chugach State Park operates the Eklutna Lake Campground adjacent to the northwest end of Eklutna Lake. The campground consists of 50 campsites with picnic tables, fire pits, water, latrines, and ranger station. There is an overflow camping area with 15 sites. The park also maintains trails for hiking, all terrain vehicles, bicycles, snowmachines, skis, dogsleds, and horses as well as infrastructure to support boating and fishing. Chugach State Park also manages public use cabins in the vicinity of Eklutna Lake.

In 1988 the Municipality of Anchorage completed construction of the Eklutna Water Treatment Facility located about 2 miles up the Eklutna Lake Road from Eklutna. Water stored in Eklutna Lake was reallocated to supply the water needs of Anchorage in addition to power generation. The AWWU operates the treatment plant to ensure that waters from Eklutna Lake meet all drinking water quality standards before being distributed to end users. The plant has a capacity of 35 million gallons per day and is designed to double this capacity, if needed, via an expansion of facilities.

Photo 1: Backfilled Lower Eklutna Dam

According to the 2000 census, a total of 141 housing units (134 occupied) were in Eklutna. Many of these homes are in the Thunderbird Heights subdivision located to the southwest of the confluence of Thunderbird Creek and the Eklutna River.

The following aerial photo (Photo 2) from 1996 shows much of the development in the lower watershed.

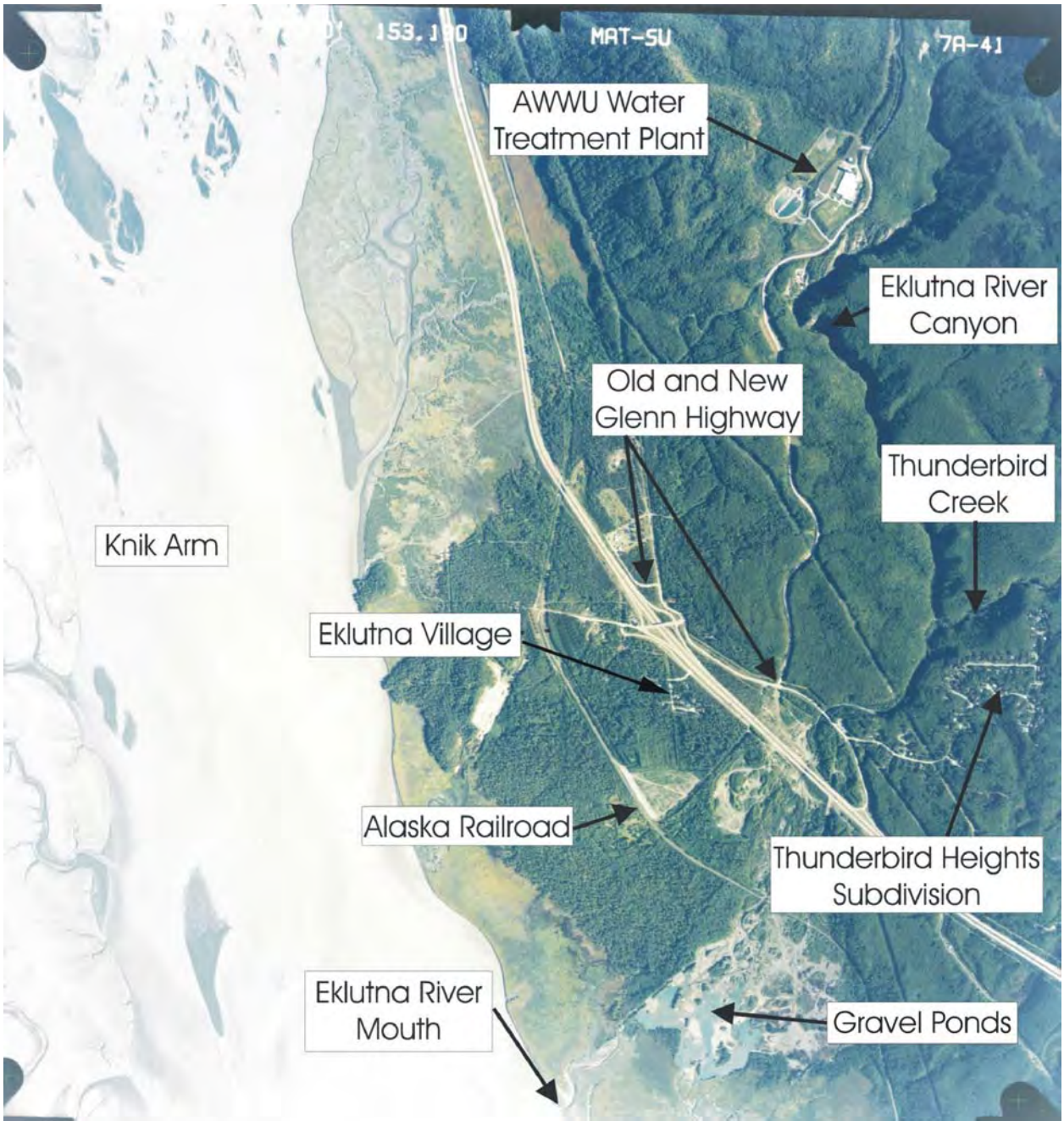

Photo 2: Aerial Photograph of Lower Eklutna River Watershed

6. PLAN FORMULATION

6.1 Identified Problems and Opportunities. A public watershed meeting facilitated by Natural Resource Conservation Service personnel was conducted on April 20, 2004. Representatives of all the stakeholders identified in Section 4 attended the meeting as well as Corps personnel and members of the public. Nine issues of concern were identified during this public meeting. For the sake of this report, the nine issues are divided into two categories: habitat concerns and management concerns.

This report concentrates on addressing the identified habitat concerns. Suggestions to address some of the identified management concerns may be made, but their execution is beyond the legal mission of the Corps. The key to resolving many of the management concern lies in the restoration and subsequent management of impaired habitat within the watershed. Therefore, the recommendations of this report will be a key component in adequately addressing both habitat and management concerns.

6.1.1 Habitat Concerns

● *Current Eklutna River water quantity and stream system quality restricts habitat potential for resident and migratory fish.* The Upper Eklutna Dam has eliminated all flows from Eklutna Lake into the Eklutna River. The only means to convey water to the upper Eklutna River is via an uncontrolled spillway at the crest of the dam during extreme flood events. This dam brought any existing Eklutna River sockeye runs to extinction and severely impacted remaining pink, Chinook, and chum salmon. Remaining salmon populations are severely impacted by the removal of all Eklutna Lake water from the Eklutna River. Resulting low flows have led to loss of over-wintering habitat, poor sediment transport, excessive siltation of stream channels, gravel starved stream channels, and insufficient water depth for Chinook salmon spawning.

● *Overall quality of fish and wildlife habitat for all users is low and should be improved.* Various impacts within the watershed below the Lower Eklutna Dam have resulted in excessive habitat degradation and habitat loss. The river has been diverted from its historical path and surrounding wetlands are seasonally isolated from the river resulting in loss of thousands of salmon smolt each year. De-vegetation of the stream banks and ponds has resulted in reduced productivity, nutrient levels, macroinvertabrate populations, moose browse, and beaver habitat in the system. The near elimination of water and sediment available from the upper watershed due to the two dams also limits spawning and rearing habitat. The Lower Eklutna Dam blocks fish migration to the upper watershed, effectively isolating any available habitat. A major portion of upper watershed habitat is buried beneath the backfill of the Lower Eklutna Dam.

● *Subsistence resource needs are not being met due to inadequate habitat conditions for fish and wildlife in the watershed area.* Fish resources are probably the most important subsistence food resource for the Eklutna people.

6.1.2 Management Concerns

● *Current area resource users and residents have competing or conflicting needs for available resources.* Conflicting needs for resources include hydropower, municipal water supply, fish and wildlife habitat, subsistence, and recreation.

● *There is a need to pursue economic development opportunities for area residents and interests, while minimizing negative impacts to cultural and natural resources.*

● *There is expanding demand for land and natural resources from permanent and daily/seasonal sources. How can potential impacts be managed or prepared for, to attain high-sustained watershed health and quality of the environment?* A comprehensive watershed management plan for the watershed is lacking.

● *Private property trespass, illegal dumping, and other vandalism occur now and may increase in the future. The area is largely unmonitored and the public seems unaware or disregards issues of ownership or allowable uses.* Illegal dumping and operation of vehicles in stream channels have impaired habitat and water quality. Trespassing is common and the amount of fish taken from the river, legally or illegally, is unknown.

● *Cultural resources and traditional use area are being degraded or lost.* Dumping, vandalism, and trespassing also impacts cultural resources and traditional uses.

● *The watershed area lacks a coordinated management plan, which should help protect sensitive features and natural resources as well as guide future development.* A goal of the Eklutna River Watershed Council is to facilitate the adoption of a coordinated management plan. This report is in response to their efforts to do so.

6.2 Existing Conditions

6.2.1 Climate. Eklutna is on the northern edge of the maritime temperate zone typical of South-central Alaska. The average temperatures range from 6 to 14 ºF in January and from 47 to 67 ºF in July. Annual precipitation is 16.5 inches. Surface freshwater at Eklutna typically freezes from about mid November through April, and ice forms on the brackish water of Knik Arm from about December through April. There appears to be adequate flow and sufficient backwater conditions to keep gravels of the Eklutna River thawed throughout the winter months. Freezing of some spawning gravels may occur in some of the smaller channels (Ron Rickman, USGS, personal communication).

6.2.2 Geology. Eklutna is almost directly on a border range fault that formed the steep west face of the Chugach Mountain Range. This massive fault was active from the Cretaceous to about 300 years before present (Updike and Schmoll 1985). Other more active faults include the Castle Mountain fault about 30 miles north of Eklutna (Bruhn 1998). Rose (1966) describes the several lesser tectonic faults that bisect the ultramafic intrusion in the Eklutna area. The Eklutna area has a high geologic hazard rating typical of Southcentral Alaska and subsided approximately 2 feet during the 9.2 magnitude earthquake in March 1964. Subsidence from this strong earthquake is most noticeable on the Knik River delta a few miles north of Eklutna. Extending west from the border

Range fault and away from the Chugach Range is a thick layer of tertiary clastic sedimentary rocks that contain coal, oil, and natural gas deposits.

Knik Arm is a marine intrusion along the west boundary of Eklutna. Bedrock and overlying glacial deposits under Kink Arm are mantled by a thick layer of glacial silt that is carried downstream by the Matanuska, Knik, Eklutna and Eagle rivers that enter Knik Arm north and south of Eklutna.

6.2.3 Tides and Currents. Strong tidal currents and diurnal tides with a range of up to 30 feet and with velocities of up to 12 feet per second characterize Knik Arm. The water of Knik Arm is extremely turbid because these strong currents mix and hold in suspension the glacial silt sediments deposited by the glacial rivers.

A study investigating the hydrology and sedimentation of a nearby tidally influenced river delta in Knik Arm (Lawson, et al, 1995) found that the sediment laden tidal waters of Knik Arm dominated sedimentation in the lower, tidally influenced reaches of the delta. Relatively high sedimentation rates of 0.8 to 1.6 in/yr were measured in the study.

6.2.4 Eklutna River Hydrology and Geomorphology. Eklutna Lake occupies a significant portion of the Eklutna watershed. Eklutna Lake's drainage comprises approximately 119 square miles of the total 174 square miles of the overall Eklutna watershed. The Eklutna River watershed downstream of Eklutna Lake, including 38 square miles within the Thunderbird Creek subwatershed, account for the remaining 55 square miles of the watershed.

Eklutna Lake is 6.5 miles long and 1.2 miles wide. The average depth is 120 feet and the maximum depth is between 200 and 250 feet. It has 3,162 surface acres and the volume, at an elevation of 860 feet, is estimated at 366,048 acre-feet. The lake was formed when a recessional terminal moraine of the Eklutna Glacier dammed a U-shaped glacial valley eroded by the Eklutna Glacier. The USGS maintains a lake elevation gage at Eklutna Lake.

Approximately 80 percent of the water that enters Eklutna Lake is from the east and west forks of Eklutna Creek. The east fork drains a 38.2-square-mile watershed that is 20 percent glacially covered, and the west fork drains a 25.4-square-mile watershed that is 50 percent glacially covered. The yearly sediment transport of these two creeks is estimated to range from 69,000 to 91,100 tons (Brabets 1993).

The USGS has periodically operated stream gages on the east and west forks of Eklutna Creek (Eklutna Lake tributaries), Eklutna River near the Upper Eklutna Dam, and most recently, on the Eklutna River at the Old Glenn Highway Bridge and above Thunderbird Creek.

Sediment bedload in the Eklutna River is high. Studies through 1948 estimated that an average of 300,000 yd^3 of gravel accumulated behind the Lower Eklutna Dam annually (Bu. Rec. 1948, Lesondak 2002). This accumulation was routinely flushed through a sluice gate in the bottom of the dam where it was deposited on the Eklutna River delta downstream of the canyon. This volume of gravel apparently filled the dam to near its crest most years (F. M. Reed Sr., personal communication) and may approximate the volume of gravel held behind the dam today.

There is no estimate of the volume of suspended sediment that is transported through the river canyon by the Eklutna River. Sediment input from the glaciers that feed the east and west forks of Eklutna Creek is captured by Eklutna Lake, and under all but flood conditions, no water is released from the lake to the Eklutna River. It is likely that a majority of any turbidity in the river comes from erosion of the glacial and colluvial deposits that make up the canyon walls and floor.

The Alaska Railroad (Fuglestad 1986) speculates that the entrapment of sand and gravel behind the Lower Eklutna Dam may have caused Knik Arm shoreline erosion that required the Alaska Railroad rail bed to be moved in 1968. Blockage of the sediment to the river delta may have caused a change in tidal currents that subsequently led to bank erosion along the shore of Knik Arm.

6.2.5 Water Quality. Water quality data has been collected at 12 USGS sampling locations throughout the watershed. The amount of data and parameters measured vary from station to station. The smallest data set contains data from one sampling event, while the largest contains data from 43 sampling events. Data was collected at various times between 1948 and 2002.

6.2.6 Physical Limnology of Eklutna Lake. Two detailed studies on physical limnology and sediment transport characterize Eklutna Lake and the inflow streams (R&M Consultants 1986; Brabets 1993). These studies show that Eklutna Lake has a turbid environment with little light penetration during the warmer summer months. Turbidity is highest during the summer when the contributing glaciers are melting and lowest during the winter when the glaciers are frozen.

6.2.7 Land Status. Excluding the village of Eklutna, a few homesteads, and mining claims, most of the land in the Eklutna River watershed was public land through the 1950's. Passage of the Alaska Native Land Claims Settlement Act of 1971 moved significant acres of land from the public domain to Eklutna Inc. Remaining land in the area is owned by the Federal, State, and Municipal governments or held privately. A watershed map produced by the NRCS shows the extent of land owned by Eklutna Inc. and is included as an attachment.

Chugach Electric Association (CEA), Municipal Light and Power (ML&P), and the Matanuska Electric Association (MEA) have jointly owned the Eklutna Power Plant and facilities, including the Upper Eklutna Dam, since 1995. Eklutna Inc. became owner of the Lower Eklutna Dam sometime after it was no longer in use. The Municipality of Anchorage owns the Eklutna Water Treatment Facility.

6.2.8 Biological Resources

6.2.8.1 Wildlife. Wildlife resources in the Eklutna area include terrestrial birds and mammals, marine mammals, and freshwater and anadromous fish. The principal terrestrial mammals include brown and black bears, moose, Dall sheep, and occasionally a mountain goat. Extensive areas of regenerating felt leaf willow saplings in the Eklutna River delta provide ample moose browse. The wetlands along Knik Arm serve as winter refuge habitat, where dozens of moose can be observed congregating, especially during heavy snow winters, sometimes coming from as far away as the Susitna River.

These species are managed by the Alaska Department of Fish and Game. Restricted hunting for moose and Dall sheep on public land in the Eklutna watershed is allowed by permit. The Eklutna

River drainage was an important hunting and subsistence area for Eklutna Natives up through the 1950's. Eklutna Natives hunted sheep, moose, ground squirrels, and bear in the watershed (UAA/CIRI 1987, Kari and Fall 2003). They also picked berries and collected other plants.

6.2.8.2 Wetlands. Wetlands in the watershed have been used as a travel corridor by many species since time immemorial and are important to surrounding habitats, such as those on the Fort Richardson and Elmendorf military installations, in the Palmer Hay Flats State Game Refuge, in the Anchorage Bowl, along the Knik River, and in the Matanuska-Susitna Valley. The watershed is also on the flyway for many bird species, including waterfowl, and large flocks of many species can be found here during their migrations.

6.2.8.3 Flora and Fauna. Avian fauna includes most of the passerine species resident or migratory to the Cook Inlet area. The common raven is perhaps the most conspicuous of the passerine species in the area. Gallinaceous species include willow and rock ptarmigan and spruce grouse. Waterfowl visit the area, but fish-eating species including loons and mergansers are not likely to be abundant because, combined with the high turbidity of the water, fish are not especially abundant in the lake. Visual/auditory observations indicate that six Sandhill Crane pairs nested within the delta region of the watershed in 2002. In addition, there are two identified bald eagle nests in the same area.

The watershed has a large diversity of plant species. Most large southcentral Alaska tree species are found within the watershed, in mixed and varied communities. Some of the largest intact stands of old growth black cottonwood grow near the lower Eklutna River.

6.2.8.4 Fish. Fish are of principal concern in the Eklutna watershed. Five species of Pacific salmon spawn in the Eklutna River. These species in probable order of abundance are: chum salmon, coho salmon, pink salmon, Chinook salmon, and sockeye salmon. Resident Dolly Varden char are also in the Eklutna River. Dolly Varden char and landlocked sockeye salmon are resident in Eklutna Lake. Rainbow trout have been stocked in Eklutna Lake and small numbers may have entered Eklutna River with water spilling over the Upper Eklutna Dam. Although rainbow trout are native to the Susitna River and Little Susitna River on the west side of Knik Arm, they are absent from the Knik River drainage adjacent to Eklutna River, and it is unlikely rainbow trout are native to a short coastal stream of recent geological origin like the Eklutna River.

Fish resources are probably the most important subsistence food resource for the Eklutna people. There are several traditional and currently used Dena'ina set net sites along the shore of Knik Arm near Eklutna. Several are still used by Eklutna Natives under an educational gill net permit. The permit allows use of aboriginal fishing gear in the Eklutna River, such as moose bone tipped spears and willow fish traps.

6.2.9 Watershed Characteristics

6.2.9.1 Corps of Engineers Investigations. Corps personnel conducted multiple site visits to the watershed during the open water season of 2004 in an effort to qualitatively assess the quantity and quality of habitat within the Eklutna River watershed. Expected without-project conditions (no-action alternative) were based upon observations and data recorded during these investigations.

6.2.9.2 Department of Defense Native Lands Environmental Mitigation Program. Department of Defense (DoD) impacts have been assessed in the Eklutna area through the DoD Native Lands Environmental Mitigation Program (NALEMP). The DoD Native American Environmental Tracking System (https://www.naets.info/web/Home.cfm) lists a total of five sites associated with NVE. Two of the sites in the Eklutna watershed were not developed and were found to have no impacts. A site located outside of the watershed known as the Eklutna Army Site (Federal Facility Site ID AK9799F2587) served as a supply and storage area and included four buildings. The Eklutna Army Site was recently (September 2004) found to contain contamination and debris from Formerly Used Defense Sites (FUDS). This site may be eligible for cleanup under the Corps Formerly Used Defense Site (FUDS) program or the DoD Native Lands Environmental Mitigation Program (NALEMP). The remaining two sites are on lands outside the watershed and pose no threat.

6.2.9.3 Other Investigations. In addition to observations from Corps site visits, some relatively recent information on the Eklutna River watershed downstream of the Lower Eklutna Dam is available from field trips associated with training sessions in watershed management. The University of Alaska Fairbanks Alaska Marine Advisory Program and the University of Alaska Anchorage, Environment and Natural Resources Institute participated in a program to train students volunteering with the Native American Fish and Wildlife Society in basic watershed management data collection.

NVE personnel have collected turbidity readings at three locations in the watershed from 2002 until the time of this report. Although a limited data set, this data shows the basic characteristics of turbidity in the Eklutna watershed. Thunderbird Creek is a source of low-turbidity water that under current flow regimes effectively compensates (dilutes) the more turbid, low volume water originating from the Eklutna River upstream. Turbidity levels in Thunderbird Creek appear to be relatively stable throughout the sampling period. Turbidity levels of Eklutna River water upstream of the confluence experiences elevated values in spring (May - June) due to snowmelt peaks and in fall (August – October) in response to large-scale precipitation events.

6.3 Expected Without Project Conditions (No Action Alternative)

High quality rearing habitat for Chinook, sockeye and coho salmon in the lower Eklutna River is limited. Pink and chum salmon fry migrate to saltwater almost immediately after emergence from incubation gravels and quality spawning habitat is more of an issue for these species than is the availability of quality freshwater rearing habitat. Quality freshwater rearing habitat is necessary for Chinook and coho salmon. Some rearing habitat in abandoned gravel pits is available to Chinook and coho salmon, but this habitat is silting in and may continue to degrade under current conditions.

The area of spawning habitat available in the Lower Eklutna River does not appear to be limiting fish production, but the quality of the habitat has not been evaluated to be certain it is not limiting production. Salmon appeared to be using less than 10 percent spawning habitat, but actual measurements were not taken.

Habitat upstream of the Thunderbird Creek confluence reflects a reduction in the flow regime due to the upstream withdrawals for power and water supply. It also reflects the lack of sediment input to the channel due to the diminished flows. Sediment in this reach is mostly silt and cobbles and provides only minimal areas of spawning and rearing habitat. Without increased flows and sediment supply, these reaches will continue to provide minimal habitat.

Reaches upstream of the Lower Eklutna Dam are isolated from anadromous fish by the dam. This will continue without removal of the dam or a means to place fish directly in the river or to transport fish past the dam. Upstream reaches reflect a reduction in the flow regime and lack of sediment input to the channel due to the diminished flows. Sediment in this reach is mostly silt and cobbles and would provide only minimal areas of potential spawning and rearing habitat without restoration efforts. Productivity of the littoral and riparian zones along Eklutna Lake and its tributaries are impacted by water level fluctuations associated with the management of the lake for hydropower and water supply. Lacking a change in management priorities for the lake, these impacts will continue.

Sufficient interstitial flow of high-quality water through the gravel must be maintained to incubate salmon eggs. The incubation from egg to fry is impaired by silt that interferes with the supply of oxygen to and the removal of wastes from the incubating eggs. Levels of sedimentation would continue as they are without increased instream flow or at least annual flushing flows.

6.4 Alternative Plans

Opportunities available in the watershed presented here are divided into four categories: Current Restoration Opportunities, Future Restoration Opportunities, Management Opportunities, and Mitigation Opportunities. Table 1 lists the opportunities by category as well as listing a party or agency perceived to have the expertise to successfully complete it.

6.4.1 Current Restoration Opportunities. These restoration efforts are appropriate for immediate execution under the prevalent conditions currently present in the watershed.

● *Restoration of Spawning and Rearing Habitat in Lower Eklutna River.* The Eklutna River between the New Glenn Highway bridge and Alaska Railroad bridge could be reworked from its highly braided and annually changing morphology into a more productive reach. The Corps recommends the completion of the following watershed assessment opportunities as part of this alternative:

■ *Stock Assessment*. A weir might be installed on the lower Eklutna River to capture salmon as they enter to allow the estimation of species, age, and length class composition.

■ *Determine Quality of Spawning Gravel.* Conducting a Fredle estimate of spawning habitat will evaluate the porosity of spawning gravel and assess its capacity to incubate salmon eggs. The results will quantify the area of available spawning habitat and indicate whether conditioning of spawning gravels might be necessary to enhance production.

Table 1: Opportunities for Restoration of the Eklutna Watershed	Possible Responsible Party[a]
Current Restoration Opportunities	
Restoration of Spawning and Rearing Habitat in Lower Eklutna River	COE, NRCS, USFWS
Stock Assessment	NVE, ADF&G
Determine Quality of Spawning Habitat	USGS BRD
Gravel Pond Enhancement for Rearing Habitat	COE, NRCS, USFWS
Stock Assessment	NVE, ADF&G
Improve Vehicle Crossings	NVE, ERWC
Future Restoration Opportunities	
Gravel Replenishment	COE
Incremental Lowering of Lower Eklutna Dam.	COE
Geotechnical and Environmental Characterization of Lower Eklutna Dam Backfill	COE
Sediment Transport Modeling	COE
Determine Concentration of Marine Derived Nutrients in Eklutna Lake	USGS BRD
Investigation of Selective Withdrawal Technology/Sedimentation Basins	COE
Management Opportunities	
Obtainment of Minimum in-Stream Flows From Eklutna Lake	NVE, ERWC, DNR
Obtainment of Flushing Flows From Anchorage Waste Water Utility (AWWU) Plant	NVE, ERWC, MOA
Reservation of In-Stream Flows For Thunderbird Creek and the Lower Eklutna River.	NVE, ERWC, DNR
Fishery Regulations	ADF&G
Habitat Preservation and Enforcement	NVE, ERWC, ADF&G, MOA
Adaptive Management Approach to Incremental Lowering of Lower Eklutna Dam	NVE, ERWC, COE
Mitigation Opportunities	
Thunderbird Creek	NRCS, USFWS
Stock Enhancement	NVE, ERWC, ADF&G

[a] ADF&G – Alaska Department of Fish and Game
COE – Corps of Engineers
DNR – Alaska Department of Natural Resources
ERWC – Eklutna River Watershed Council
MOA – Municipality of Anchorage
NVE - Native Village of Eklutna
USFWS – United States Fish and Wildlife Service
USGS BRD – United States Geological Survey, Biological Research Division

● *Gravel Pond Enhancement.* Shallow pits produced from gravel extraction activities in the watershed provide marginal habitat connected to the Eklutna River. These pits could be engineered and deepened to provide winter habitat for coho and possibly Chinook salmon. The Corps recommends the completion of the following watershed assessment opportunity as part of this alternative:

■ *Stock Assessment*. A weir might be installed on the lower Eklutna River to capture salmon as they enter to allow the estimation of species, age, and length class composition.

● *Vehicle Crossings*. Downstream of the Glenn Highway an unimproved road crosses the river in several places and uses the riverbed for a road in one or more habitat units. This road might be realigned so no or only minimal stream crossings are necessary for access.

6.4.2 Future Restoration Opportunities. These restoration efforts require the collection of additional information or the completion of additional technical analyses or a change in the prevalent conditions in the watershed.

● *Gravel Replenishment.* Replenishment of gravel, combined with periodic flushing flows, might eventually provide some spawning habitat in the Eklutna River between the Lower Eklutna Dam and the confluence of Thunderbird Creek.

● *Incremental Lowering of Lower Eklutna Dam.* This restoration opportunity requires the collection of additional information to properly assess its potential impacts upon the watershed. The Corps recommends the following technical analyses to help predict the likely impacts of incremental lowering of the Lower Eklutna Dam upon the watershed.

■ *Geotechnical and Environmental Characterization of Lower Eklutna Dam Backfill.* The material that has backfilled the Lower Eklutna Dam needs to be characterized to effectively design and implement potential restoration opportunities involving dam lowering and sediment transport.

■ *Sediment Transport Modeling.* Using the results of the geotechnical characterization of the Lower Eklutna Dam, a sediment transport model can be used to determine minimum stream flows and stream-channel dimensions required to transport needed gravel to downstream habitat and to flush fine-grained sediments out of the system.

■ *Determine Concentration of Marine Derived Nutrients in Eklutna Lake.* Investigate the historical existence of significant sockeye salmon escapement to Eklutna Lake through analysis of the lakebed sediments and riparian soils for marine derived nitrogen[15] (MDN[15]).

■ *Investigation of Selective Withdrawal Technology and Sedimentation Basins.* The possibility of using selective withdrawal technology to discharge water layers with favorable suspended sediment levels downstream to the Eklutna River could be investigated. Likewise, the use of sedimentation basins within the watershed as a means to reduce transport of fine-grained sediment downstream could also be assessed.

6.4.3 Management Opportunities

● *Obtainment of Minimum In-Stream Flows From Eklutna Lake.* Political avenues can be pursued by the local community and watershed council to obtain a legal reservation of water from the Eklutna Lake to maintain minimum in-stream flows in the Eklutna River. Results from sediment transport modeling could be used to determine optimum levels for minimum in-stream flows.

● *Obtainment of Flushing Flows From Anchorage Waste Water Utility (AWWU) Plant.* If minimum in-stream flows from Eklutna Lake are not readily available, flushing flows might come from the AWWU treatment plant located just upstream of the Lower Eklutna Dam. Daily filter

backwash water from the plant might be stored behind the dam or another structure and periodically be released in sufficient quantities to flush silt and distribute gravel downstream.

● *Reservation of In-Stream Flows For Thunderbird Creek and the Lower Eklutna River.* The local community and watershed council can apply with the State of Alaska to obtain a legal reservation of water from Thunderbird Creek to maintain minimum in-stream flows in the lower section of Eklutna River.

● *Fishery Regulations*. A proposal to institute a moratorium on all forms of sport fishing, including catch and release, might be drafted and submitted to the Board of Fisheries for adoption. The moratorium might last the duration of any restoration efforts.

● *Habitat Preservation and Enforcement.* Habitat damage and the destruction of fish production from ATV's and other vehicles operated in the riverbed and on the riparian banks should be managed through realignment of access away from the riverbanks and enforcement of State fishery and habitat protection statutes.

● *Adaptive Management Approach to Incremental Lowering of Lower Eklutna Dam.* If the technical analyses recommended in *Incremental Lowering of Lower Eklutna Dam* proves to be financially or logistically infeasible to complete, an alternate option is to take an adaptive management approach to the incremental lowering of the Lower Eklutna Dam.

6.4.4 Mitigation Opportunities

● *Thunderbird Creek.* Thunderbird Creek might be engineered to provide additional quality spawning habitat and some summer rearing habitat to mitigate impacts upon the Eklutna River.

● *Stock Enhancement*. Enhancement of salmon stocks in the Eklutna River could be a means to mitigate impacts upon the existing stocks.

6.5 Preliminary Evaluation of Alternatives

6.5.1 Current Restoration Opportunities. These opportunities are appropriate under the continued current conditions that all available water in Eklutna Lake is currently allocated for the generation of electricity and drinking water. These restoration projects attempt to make the best use of the amount of water and sediment readily available to the lower watershed. These restoration projects do not require increases in instream flow or occasional flushing flows and are appropriate for immediate implementation within the watershed.

● *Restoration of Spawning and Rearing Habitat.* The Eklutna River braids into several small rivulets almost immediately upstream of the Alaska Railroad bridge. The channels of these rivulets run through dense trees and appear to change course almost annually. The largest of the rivulets is suitable for adult passage, while passage through the smaller rivulets might strand fish in a maze and tangle of trees and roots. There is almost no spawning habitat in the rivulets, but the rivulets have some rearing habitat. This section of the river could be restored into a more productive channel that incorporates engineered spawning habitat, large woody debris, dam lowering debris, and backwater

summer rearing areas that would not impound rearing juveniles. The Corps recommends the completion of the following watershed assessment opportunities as part of this alternative:

■ *Stock Assessment*. A weir might be operated for several consecutive years during run timing of the target species on the lower Eklutna River. Data collected could include abundance of all species, and age and length of Chinook and coho salmon. The freshwater life history of Chinook and coho salmon might be used to engineer restoration efforts for maximum benefit to these species.

■ *Determine Quality of Spawning Gravel.* Much of the Eklutna River between the delta and Thunderbird Creek appears to be, at least on the surface, relatively higher quality-spawning habitat, but in some places clouds of fine gray silt discolors the water behind redd-digging females. The quality of spawning gravel might only be confirmed by assessment of its porosity by conducting a Fredle estimate of spawning habitat. If the gravel is clogged under the surface with fines to where the survival of salmon eggs is questionable, selected habitat units might be conditioned or rejuvenated mechanically to increase incubation success.

● *Gravel Pond Enhancement.* The Eklutna River has limited natural rearing habitat for coho salmon, but the available habitat could likely be improved to enhance the natural production of coho salmon. Juvenile salmon use the ponds that border abandoned gravel pits near the river mouth for overwinter rearing (Lamoreaux unpublished a). Gravel pits might be enhanced to provide a better quality winter rearing habitat for coho salmon (Byrant 1988). These ponds are connected to the Eklutna River and are silting in. Rearing habitat could be improved through restoration of the ponds near the mouth of the river. Restoration of the ponds would mostly benefit coho salmon by providing improved overwintering habitat. Without increased flows, however, improvement of overwintering habitat is limited to deepening of ponds. Some Chinook salmon would also benefit from restoration and improvement of rearing habitat. The Corps recommends the completion of the following watershed assessment opportunity as part of this alternative:

■ *Stock Assessment*. A weir might be operated for several consecutive years during run timing of the target species on the lower Eklutna River. Data collected could include abundance of all species, and age and length of Chinook and coho salmon. The freshwater life history of Chinook and coho salmon might be used to engineer restoration efforts for maximum benefit to these species.

● *Vehicle Crossing.* Development of a trail system plan could minimize the impacts of vehicles upon the riparian area. A trail network could include environmental education signs informing the public of their potential impacts upon the resources of the Eklutna watershed. Specifically, downstream of the Glenn Highway, an unimproved road crosses the river in several places and uses the riverbed for a road for a distance. This road might be realigned so no or only minimal stream crossings are necessary for access.

6.5.2 Future Restoration Opportunities. These opportunities require further study and/or increases of instream and/or flushing flows to provide adequate habitat and to transport fine-grained sediments away from spawning gravels. These opportunities can be implemented as part of a long-term restoration plan for the watershed.

● *Gravel Replenishment.* Replenishment of gravel, combined with periodic flushing flows, might eventually provide some spawning habitat between the Lower Eklutna Dam and Thunderbird Creek. Replenishment gravel might come from the gravel held behind the dam. Other potential sources of gravel are from a large mound of gravel stockpiled along the stream bank in the delta and from a colluvial sediment fan located immediately downstream of the Lower Eklutna Dam. Sufficient flushing flows are required for this option to be beneficial (see management opportunities).

● *Incremental Lowering of Lower Eklutna Dam.* An estimated 300,000 yd^3 of gravel are held behind the Lower Eklutna Dam. The areas downstream of the dam lacking spawning gravels could benefit from the incremental release of this material from behind the dam. Sediments held behind the dam could be released by incrementally lowering the dam or (less probable) through the existing sluice gate formerly used to flush material downstream during high flow events.

Gradual release of the impounded sediment to down-stream reaches would eventually nourish impoverished reaches downstream of the dam and across the delta downstream of the canyon. Re-building the delta might help re-establish former current patterns in Knik Arm and reduce erosion described by Fuglestad (1986). Under current streamflow conditions, this would be a very slow process. Eventually, the quantity and quality of spawning habitat downstream of the Lower Eklutna Dam would likely increase as a result of this project. Turbidity levels in the Eklutna River downstream of the diversion dam would likely be elevated during and for an undetermined period after the release of sediments from behind the dam.

Releasing large amounts of sediment to down-stream reaches is not recommended under current conditions. The amount of material supplied to down-stream reaches should be optimized based upon the results of sediment modeling. Under current and possible future increased streamflows, the sediment carrying capacity of the river may be surpassed by the amount of sediment impounded behind the Lower Eklutna Dam.

Successfully assessing the outcomes of dam removal depends on taking into account water, sediment, nutrient, and biologically related processes operating on a watershed scale (Graf 2002). The Corps recommends completion of the following technical analyses to help predict the likely impacts of incremental lowering of the Lower Eklutna Dam upon the watershed:

■ *Geotechnical and Environmental Characterization of Lower Eklutna Dam Backfill.* How the dam and sluice gate were operated once it was abandoned is an important factor to consider when determining the likely composition of the dam backfill. The make-up of the material stored behind the dam may be directly related to its operation. If the dam's sluiceway and emergency draw down outlet were left closed, the material behind the dam could contain a very high silt fraction. If the sluiceway and outlet were left open, much of the silt could have passed through the dam and the sediment deposited behind the dam might be predominantly sands and gravels.

Unless the composition of the Lower Eklutna Dam backfill material can be estimated with sufficient accuracy through other methods, the obtainment of drilling core samples or other appropriate geotechnical methods is recommended to determine the composition of the sediment behind the

Lower Eklutna Dam. Samples should also be collected to test for contaminants within the backfill material.

■ *Sediment Transport Modeling.* The ultimate fate of sediment and the contaminants it contains is a critical planning issue that depends on the ability of planners to predict transport processes and ultimate deposition locations for sediments released when dams are removed (Graf 2002). Using the composition of the material behind the Lower Eklutna Dam and likely prevalent streamflows in the Eklutna River, a sediment transport model can be utilized to optimize potential restoration efforts. Dimensions of stream channels both upstream and downstream of the Lower Eklutna Dam can be designed to optimize the transport of gravel downstream.

If stream channels downstream of the Lower Eklutna Dam were too wide, the large-grained component of the released sediments would settle out quickly. If the amount of sediment released from the dam surpasses the transport capability of the river, the riverbed between the canyon mouth and the Glenn Highway bridges could aggrade, forming a higher elevation stream channel. Elevation of the riverbed in this area could change the course of the Eklutna River and threaten the bridge abutments and highway.

The sediment transport model can also determine the minimum streamflows that would be needed to effectively transport gravel downstream from the dam. If these minimum streamflows cannot be secured (see management opportunities), then incremental lowering of the dam may not be warranted.

Continued operation of stream monitoring USGS station 15280200 Eklunta River at Old Glenn Highway, and the upgrade of USGS station 15280100 Eklutna River above Thunderbird Creek to a recording stream flow monitoring station would provide data needed for the sediment transport model.

■ *Determine Concentration of Marine Derived Nutrients in Eklutna Lake*.
Hypothetically determining historical levels of sockeye salmon is not straight forward due to the inherent characteristics of Eklutna Lake. Current spawning habitat upstream of the lake may be limited and historical spawning areas may not have been sufficient to have supported large numbers of spawning anadromous salmon. Water quality in the lake could result in limited opportunities for spawning in the littoral zone of the lake. Fully 80 percent of the water entering Eklutna Lake comes from two glacial streams, which are characteristically not conducive to the consistent survival of sockeye salmon.

Many significant sockeye systems in Alaska, however, are predominantly glacial fed similar to Eklutna Lake. Physical limnology studies of Eklutna Lake suggest that the turbidity in Eklutna Lake is not conducive to significant primary production during much of the year. However, in some instances, sockeye have been found to spawn and rear at great depths in glacial systems. While these systems are more turbid and not as conducive to significant primary production, they do support stable fish runs. Many glacially dominated sockeye systems hold juvenile fish for 3 to 4 years before they enter the marine environment, and at a size similar to a sockeye rearing for 1 year in a productive system.

To accurately determine the numbers of sockeye salmon that may have historically spawned in the Eklutna River drainage an analysis of marine derived nutrient levels in the sediments of Eklutna Lake is recommended.

■ *Investigation of Selective Withdrawal Technology and Sedimentation Basins.* Investigation of the applicability of these technologies can be pursued if marine-derived nutrient concentrations in Eklutna Lake indicate that historical fish populations were limited by the inherent turbidity of the lake. Selective withdrawal and sedimentation basins could be used to minimize the amount of suspended sediment introduced into the Eklutna River from Eklutna Lake, thus improving habitat values in downstream reaches.

Selective withdrawal structures have been installed on Corps dams impounding temperature stratified reservoirs to facilitate passing water of desired temperatures downstream. The structure has multiple intake structures at different elevations allowing it to selectively choose what water and hence temperature is discharged downstream of the dam. Limnological investigations of Eklutna Lake have indicated that density currents may transport sediment plumes across the entire length of the lake. These sediment plumes are sometimes present on the surface at mid water or near the bottom. A selective withdrawal facility at the upper Eklutna Dam could be used to selectively exclude these sediment plumes from being passed downstream.

Sedimentation basins could be designed to detain streamflow long enough to allow sediments to settle out due to gravity. These would require some level of recurring maintenance to maintain their effectiveness and may limit their feasibility.

6.5.3 Management Opportunities

● *Obtainment of Minimum In-Stream Flows From Eklutna Lake.* Elevated levels of fine-grained sediments impair many areas of the Eklutna River, both upstream and downstream of the Lower Eklutna Dam. A major source of this sediment is likely the erosion of glacial and colluvial deposits upstream of the Lower Eklutna Dam. Without any additional streamflow, it is unlikely that major reductions in the amount of fine-grained sediment will occur. Fine-grained sediments would continue to settle in areas of low water velocity. Some suspended sediments would continue to be trapped in salmon redds and impair development of the eggs through suffocation and accretion of metabolic wastes. An increase in streamflow within the Eklutna River will increase the capacity of the river to transport these fine-grained sediments downstream and eventually will remove them from the watershed.

● *Obtainment of Flushing Flows From Anchorage Water and Waste Water Utility (AWWU) Plant.* Periodic, higher magnitude, flushing flows can be utilized to facilitate the transport and removal of fine-grained sediments from the Eklutna River. It might be possible to utilize water from the AWWU treatment plant used to back flush sand filters for this purpose. The quality and quantity of this water would need to be determined to assess the feasibility of this opportunity.

It is likely that to obtain sufficient flows water will need to be impounded somehow until enough volume exists to ensure adequate velocities for sediment transport. This could require a new structure, or the use of the Lower Eklutna Dam for this purpose could be investigated. It might be

possible to excavate a sufficient amount of material from behind the dam to provide the needed volume of impoundment area. This excavated material could be placed downstream of the dam and subsequently be transported downstream by the flushing flows. The water impoundment basin may require periodic maintenance to maintain its storage capacity.

The structural integrity of the Lower Eklutna Dam to once again store water must be determined if this opportunity is to be further considered. According to Lesondak (2002), the dam has deteriorated but retains its structural integrity. The Lower Eklutna Dam may not, however, be able to store water without considerable repair because apparently the sluice gate leaked from 5 to 20 cfs during its operation.

● *Reservation of In-Stream Flows For Thunderbird Creek and the Lower Eklutna River.* The water provided by Thunderbird Creek to the lower Eklutna River is its only reliable source of clean, high quality water. Without this input of high quality water, the lower Eklutna River would be further degraded to the point that it would provide essentially no quality habitat. Obtaining a legal reservation of water from Thunderbird Creek to maintain minimum in-stream flows in the lower section of Eklutna River will protect this source of water and the habitat and resources that depends upon it.

NVE submitted three In-stream Flow Reservation applications to the Department of Natural Resources (DNR) in June 2003. The applications were for Thunderbird Creek downstream of Thunderbird Falls and for two segments that comprise the Eklutna River downstream of the Lower Eklutna Dam. NVE is currently collecting flow rate data to quantify a quantity request for the reservation. NVE has 3 years to supply DNR with this supplementary application information. The additional information will need to be received before DNR can take the applications to the next step.

● *Fishery Regulations.* Alaska statutes currently allow a sport harvest of salmon from the Eklutna River with stipulations of length restrictions and that permission to trespass on private lands is obtained. The actual number of salmon legally harvested from Eklutna River is not known because the Alaska Department of Fish and Game Statewide Harvest Survey combines Eklutna River with "other streams." The number of salmon taken illegally from Eklutna River is also unknown and in the case of Chinook salmon, might even be higher than the legal harvest. Escapement numbers in Eklutna might not support a legal sport and illegal fishery and restoration efforts. A moratorium on sport fishing would allow time for fish populations to respond and stabilize to restoration efforts within the watershed.

● *Habitat Preservation and Enforcement*. Corps personnel observed many human induced impacts upon the Eklutna River arising from illegal activities during this study. Observed impacts include vehicle river crossings, littering, dumping, trespassing, illegal fishing, and operation of ATV's in the Eklutna River. Active enforcement of State fishery and habitat regulations and statutes would reduce these impacts on the Eklutna watershed. The full potential of fish production might not be reached until illegal and destructive activities on the Eklutna River are stopped.

● *Adaptive Management Approach to Incremental Lowering of Lower Eklutna Dam.* In an adaptive management approach to the incremental lowering of the Lower Eklutna Dam, an emphasis

will be placed on the monitoring of dam lowering impacts as opposed to their prediction. After an initial lowering of the dam, monitoring results will be analyzed to determine if, when, and how the dam should be lowered further.

This approach is more risky than those options that predict likely dam lowering impacts. Incremental dam lowering could degrade as well as improve the quantity and quality of downstream habitat. If high concentrations of fine-grained sediment are introduced to the reaches below the dam, spawning gravels and rearing pools could be degraded.

Likewise, if the amount of sediment introduced to the reaches below the dam exceeds the sediment transport capability of the prevalent streamflows, the Eklutna River channel could become an aggrading system (elevated streambed elevations). Stream channel abandonment and the formation of multi-channel, braided systems are characteristic of aggrading systems. Care will need to be exercised to ensure that dam lowering does not cause additional reaches to assume the braided character of the river upstream of the Alaska Railroad bridge that is proposed for restoration. In addition, an aggrading system with variable, fluctuating stream channels could threaten any bridge abutments and the Glenn Highway.

Improvements realized from other restoration efforts in the watershed could be negated as well as improved by this approach. Because of the uncertainties inherent in this option, a conservative approach is highly recommended. The establishment of an adequate monitoring plan is essential to ensure the best results of this adaptive management approach.

6.5.4 Mitigation Opportunities

● *Thunderbird Creek*. Although it possess high quality water, Thunderbird Creek has limited spawning and almost no rearing habitat. Thunderbird Creek could be engineered to provide additional quality spawning habitat and some summer rearing habitat to mitigate management impacts upon the Eklutna River. Mitigation efforts in Thunderbird Creek are limited to the areas below the barrier falls located approximately 1/3 mile upstream from its confluence with the Eklutna River.

● *Stock Enhancement*. Enhancement of salmon stocks in the Eklutna River could be a means to mitigate impacts upon the existing stocks. If development of a quality recreational fishery is the goal, then the logical target species might be primarily coho and secondarily Chinook salmon. Salmon stocks might be enhanced through development of brood stocks in cooperation with the ADF&G or a private non-profit hatchery association. Enhancement might be with live releases of smolt or with *in-situ* egg planting if preservation of genetic robustness is a desire. NVE plans to initiate an in-situ egg planting project in 2005.

7. FEDERAL INTEREST. Since restoration of aquatic habitat and the functionality of watersheds are outputs with a high budget priority, there is a strong Federal interest in conducting the feasibility study. Based on the preliminary screening of alternatives, there appears to be multiple potential project alternatives that would provide potential benefits consistent with Army policies, costs, benefits, and environmental impacts that warrant proceeding into a feasibility study phase. In addition, alternatives have been identified that, while outside current Corps of Engineers mission areas, may be suitable for completion under the programs of other Federal, State, and local agencies.

8. PRELIMINARY FINANCIAL ANALYSIS. As the local sponsor, the Native Village of Eklutna will be required to provide 50 percent of the cost of continuation of the watershed study into the feasibility phase. Alternately, the Native Village of Eklutna will be required to provide 35 percent of the cost of the feasibility phase of those alternatives appropriate for completion under the Corps Section 206 (Aquatic Restoration) of the Continuing Authorities Program. In-kind services provided by the local sponsor will be credited towards their cost sharing obligation for the project.

A letter of intent from the local sponsor stating a willingness to purse the feasibility study and to share in its cost, and an understanding of the cost sharing that is required for project construction, is required to continue to the feasibility phase of this watershed study.

9. SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS. It was assumed that the quality and quantity of habitat available within the Eklutna watershed would continue to be limited by the diminished amount of water in the Eklutna River as well as by the isolation of much of the potential habitat and spawning gravel of the watershed by the Lower Eklutna Dam. If these conditions were to change drastically, portions of this study would need to be revised.

10. FEASIBILITY PHASE MILESTONES.

- Begin To Negotiate Project Management Plan — Jan 2005
- Sign Feasibility Cost Sharing Agreement — Mar 2005
- Feasibility Scoping Meeting — Apr 2005
- Alternative Formulation Briefing — Nov 2006
- Draft Watershed Feasibility Report — Feb 2007
- Final Watershed Feasibility Report — Mar 2007

11. FEASIBILITY PHASE COST ESTIMATE. Estimates of the cost of the feasibility phase are based upon the completion of identified alternatives that are most suitable for completion under this Corps authorization. These alternatives include determining the geotechnical and environmental characterization of Lower Eklutna Dam backfill, sediment transport modeling, and the synthesis of other related studies and investigations in the support of predicting the most likely impacts of incremental lowering of the Lower Eklutna Dam. These estimates are very preliminary in nature and will be revised as the scope of the feasibility phase becomes more defined.

Feasibility Phase Task Description	Estimated Cost
Surveys and Mapping except Real Estate	25,000
Hydrology and Hydraulics Studies/Sedimentation Model	70,000
Geotechnical Studies/Report	40,000
Engineering and Design Analysis Report	20,000
Socioeconomic Studies	10,000
Real Estate Analysis/Report	10,000
Environmental Studies/Report (Except USF&WL)	30,000
Fish and Wildlife Coordination Act Report	7,500
HTRW Studies/Report	15,000
Cultural Resources Studies/Report	15,000
Cost Estimates	$10,000
Cost Effectiveness/Incremental Cost Analysis	$10,000
Public Involvement Documents	5,000
Plan Formulation and Evaluation	40,000
Final Report Documentation	5,000
Technical Review Documents	5,000
Washington Level Report Approval (Review Support)	$50,000
Project Management and Budget Documents	15,000
Supervision and Administration	26,775
Contingencies	81,855
Project Management Plan (PMP)	20,000
Total	**$511,130**

12. RECOMMENDATIONS. It is recommended that, based upon the information in this report and other resources and the availability of project funding, the Native Village of Eklutna in consultation with the Eklutna River Watershed Council prioritize the opportunities identified in this report. Depending upon the specific opportunity, consultation and coordination with varying agencies will be required to learn of their specific program policies and procedures.

Alternatives suitable for immediate completion were identified as well as long-term alternatives that require additional technical analyses or a change in prevalent conditions within the watershed. Ideally, a combination of both immediate and long-term alternatives will best address the concerns and goals of the watershed stakeholders.

Alternatives for the restoration of spawning and rearing habitat in the lower river and gravel pond enhancement for rearing habitat are appropriate for immediate completion under the Corps Section 206 (Aquatic Restoration) of the Continuing Authorities Program (CAP 206). This program is intended for smaller scale studies and projects and requires a 35 percent cost sharing commitment from the local sponsor.

Recommended technical analyses and alternatives related to the incremental lowering of the Lower Eklutna Dam could be completed under the feasibility phase of this watershed study. This program is intended for larger scale studies and projects and requires a 50 percent cost sharing commitment from the local sponsor.

13. POTENTIAL ISSUES EFFECTING INITIATION OF FEASIBLITY PHASE. Continuation of this study into the cost-shared feasibility phase is contingent upon an executed Feasibility Cost Sharing Agreement (FCSA). Failure to achieve an executed FCSA within 18 months of the approval date of the Section 905(b) Analysis will result in termination of the study.

Planning Guidance Notebook (PGN), ER 1105-2-100, at §2-5, requires that all non-Federal sponsors meet the requirements of §221 of the Flood Control Act of 1970. Section 221 is codified at 42 USC 1962d-5b. That law states: "A non-federal interest shall be a legally constituted public body with full authority and capability to perform the terms of its agreement and to pay for damages, if necessary, in the event of failure to perform." A tribal government may be authorized to be the local sponsor if it possesses the capability to provide cost sharing funds and to provide all required lands, easements, rights-of-way and relocations.

14. VIEWS OF OTHER RESOURCE AGENCIES. Many, if not all, of the various resource agencies that have any jurisdiction or interest in the watershed (USFWS, NRCS, ADF&G, USGS) have been contacted by the ERWC for their support and available resources. All resource agencies support the study and completion of feasible (environmental, economic, engineering, and legal) restoration and mitigation projects within the Eklutna watershed.

15. PROJECT AREA MAP.

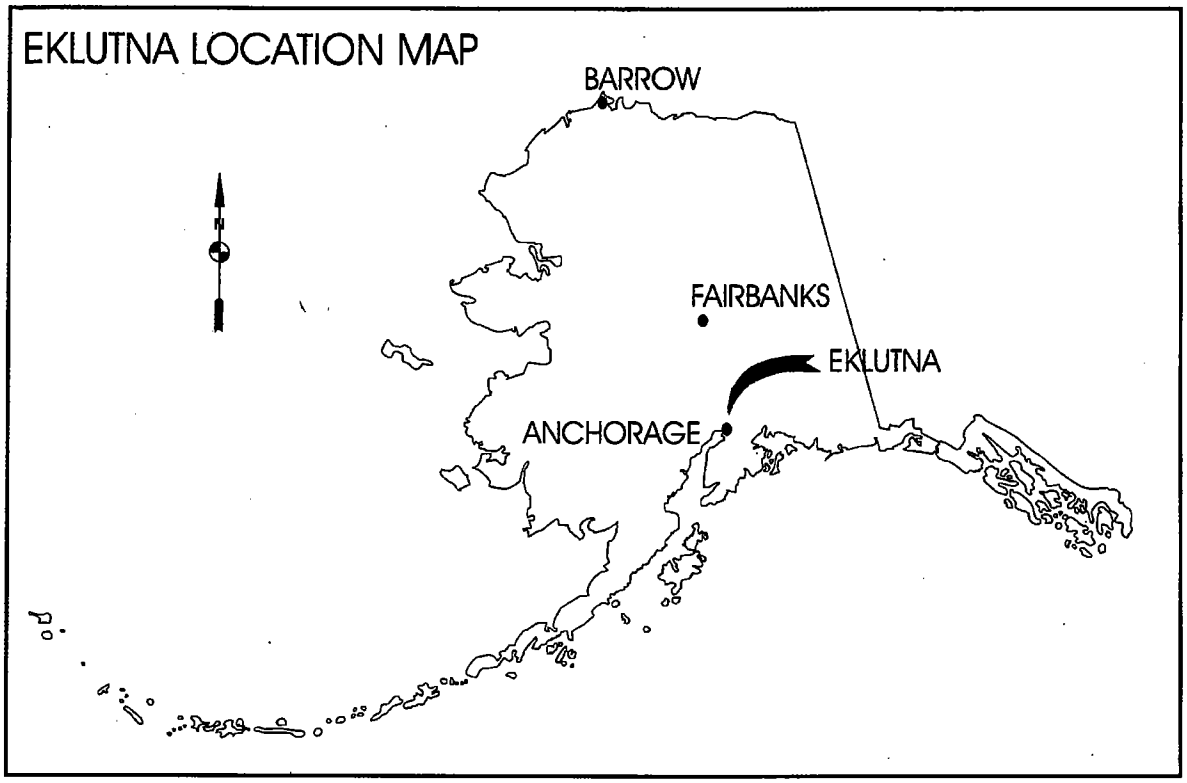

Figure 1: Eklutna Location Vicinity Map

Timothy J. Gallagher
Colonel, Corps of Engineers
District Engineer

3 Dec 2004
Date

Encl

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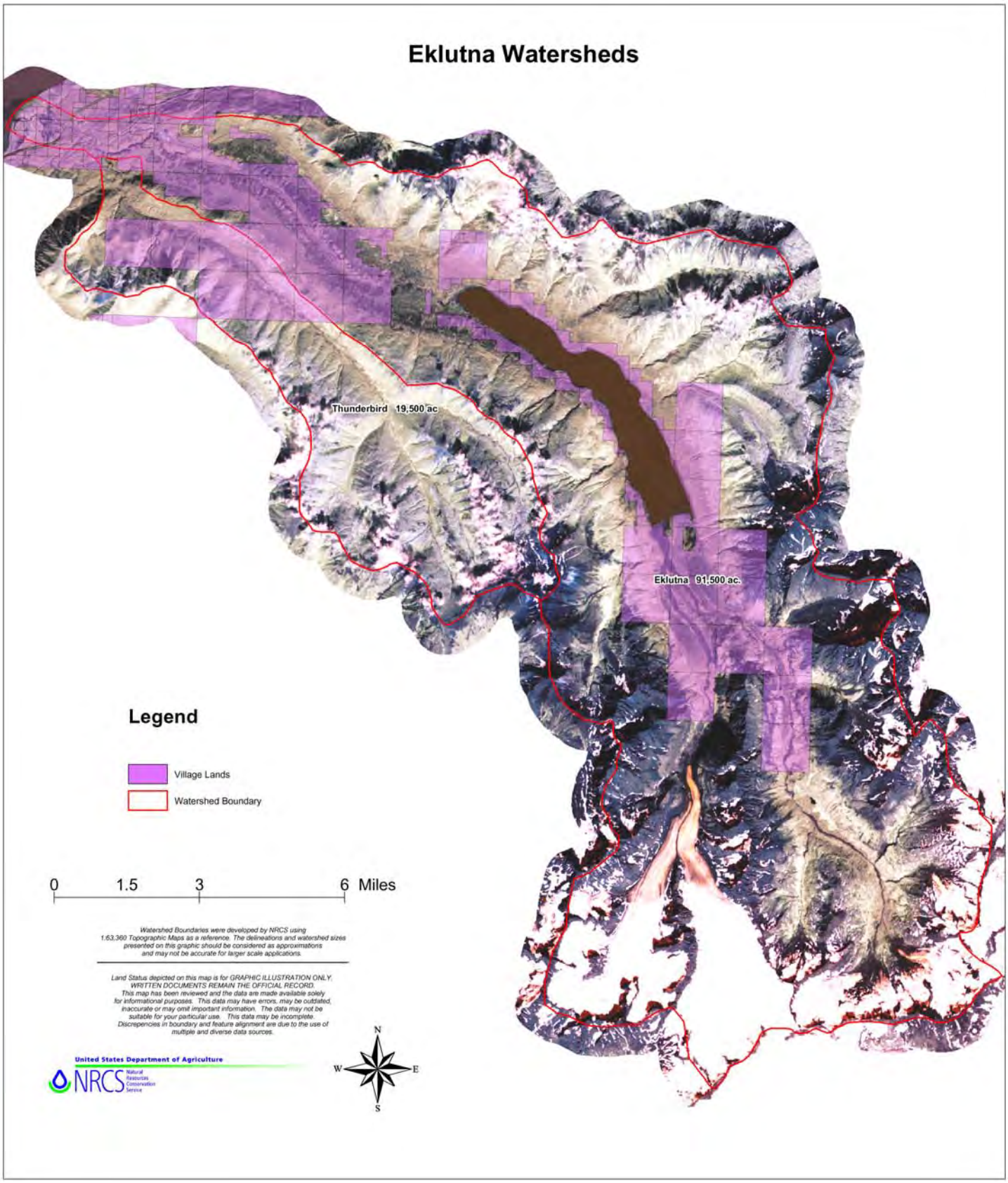
Eklutna Watersheds
Thunderbird 19,500 ac
Eklutna 91,500 ac.
Legend
Village Lands
Watershed Boundary
0 1.5 3 6 Miles
Watershed Boundaries were developed by NRCS using 1:63,360 Topographic Maps as a reference. The delineations and watershed sizes presented on this graphic should be considered as approximations and may not be accurate for larger scale applications.
Land Status depicted on this map is for GRAPHIC ILLUSTRATION ONLY. WRITTEN DOCUMENTS REMAIN THE OFFICIAL RECORD. This map has been reviewed and the data are made available solely for informational purposes. This data may have errors, may be outdated, inaccurate or may omit important information. The data may not be suitable for your particular use. This data may be incomplete. Discrepencies in boundary and feature alignment are due to the use of multiple and diverse data sources.
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