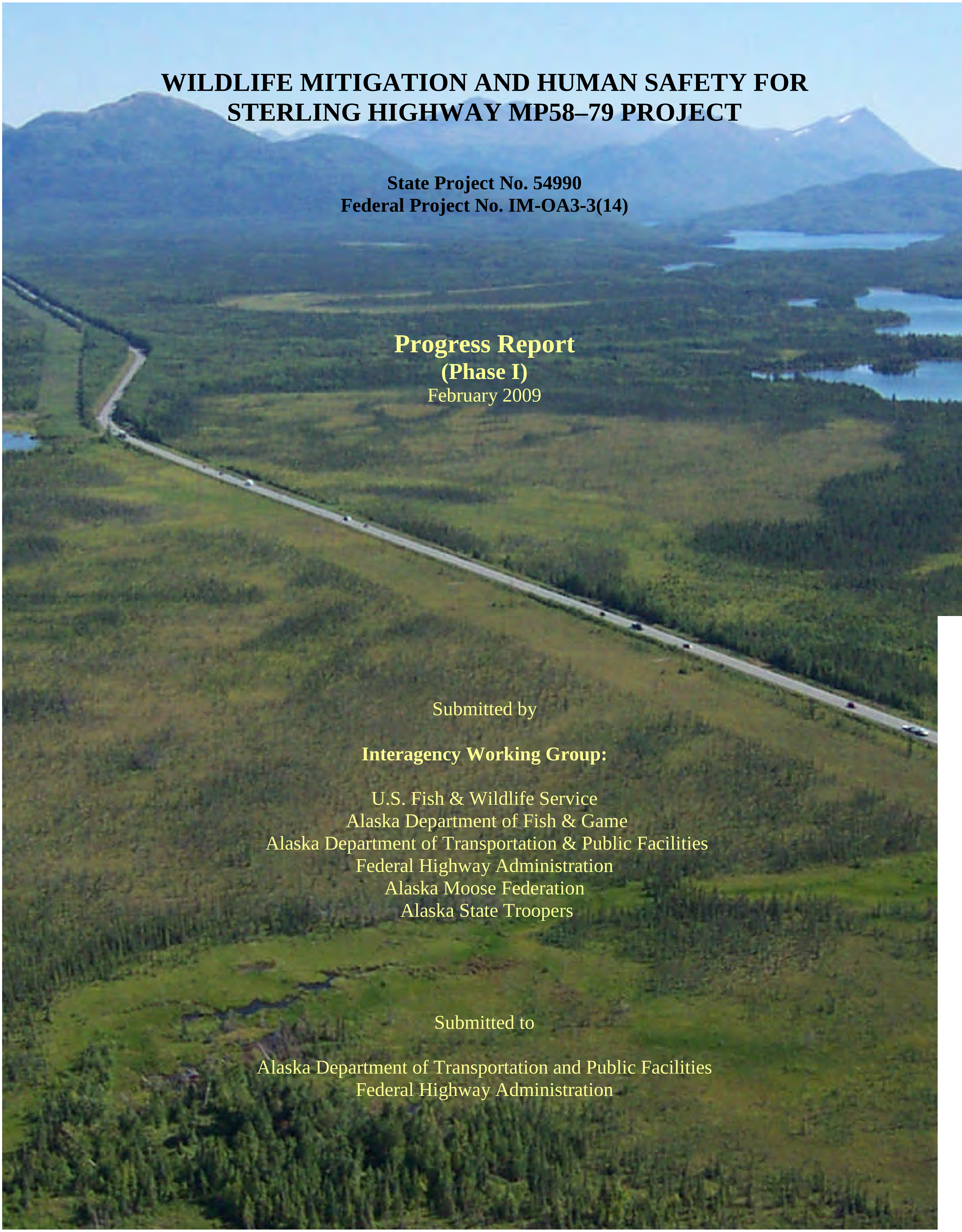

WILDLIFE MITIGATION AND HUMAN SAFETY FOR STERLING HIGHWAY MP58–79 PROJECT

State Project No. 54990
Federal Project No. IM-OA3-3(14)

Progress Report
(Phase I)
February 2009

Submitted by

Interagency Working Group:

U.S. Fish & Wildlife Service
Alaska Department of Fish & Game
Alaska Department of Transportation & Public Facilities
Federal Highway Administration
Alaska Moose Federation
Alaska State Troopers

Submitted to

Alaska Department of Transportation and Public Facilities
Federal Highway Administration

Members of the Sterling Highway MP 58-79 Working Group:

- **Richard Ernst**, U.S. Fish and Wildlife Service, Kenai National Wildlife Refuge
- **Jeff Selinger**, Alaska Department of Fish and Game, Soldotna
- **Jim Childers**, Alaska Department of Transportation and Public Facilities, Anchorage
- **Dale Lewis**, Federal Highway Administration, Juneau
- **Glenn Godfrey***, Alaska Department of Public Safety, Soldotna
- **Gary Olson**, Alaska Moose Federation, Anchorage

* Former member was Lt. Steve Bear, Alaska Dept. of Public Safety, Soldotna

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EXECUTIVE SUMMARY

The Sterling Highway is a rural, paved, two-lane highway linking Alaska's western Kenai Peninsula, to the Seward Highway and Anchorage, the state's largest city. The Sterling Highway bisects the Kenai National Wildlife Refuge and has a high moose (*Alces alces*) vehicle collision rate for a rural highway in the state (State of Alaska, 1994). Alaska Department of Transportation & Public Facilities (ADOT&PF) recently ranked this section of highway in the top 25th percentile for crashes (2000-2005); however, this ranking is conservative due to missing crashes from 2002 and possibly other years. Keeping wildlife off the highway, by fencing for example, makes the highway safer for motorists but leads to ecological problems by creating a physical barrier that blocks natural wildlife movements important for food, water, shelter, mates, calving and gene flow to keep wildlife populations viable. Wildlife crossings help restore connectivity between habitats on both sides of the highway. The ADOT&PF plans to reconstruct a section of the Sterling Highway between mileposts (MP) 58 and 79. Eighteen of the 21 project miles occur within the Refuge. This progress report documents our collective planning effort to reduce wildlife mortality, restore connectivity and improve human safety.

Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife Service (FWS) jointly submitted a study proposal "*Wildlife Mitigation and Human Safety for Sterling Highway Milepost 58-79 Project*" to ADOT&PF and Federal Highway Administration (FHWA) in December 2003. The proposal included both pre- and post-construction phases. It called for collaring 30-40 moose with Global Positioning System (GPS) collars to identify migration corridors across the highway. FHWA and ADOT&PF agreed to fund the study and an interagency working group was formed in 2005 to oversee the project on moose movements and review wildlife-vehicle collisions (WVC). The group consists of representatives from the ADOT&PF, ADF&G, and Alaska Department of Public Safety (ADPS, troopers); the Alaska Moose Federation (non-profit); the FHWA; and the FWS. The purpose of this cooperative effort is to improve human safety by reducing wildlife-vehicle collisions (WVC) along the Sterling Highway corridor through the Kenai National Wildlife Refuge while maintaining permeability and allowing wildlife to freely move across the Refuge landscape.

We implemented the two year pre-construction phase by deploying GPS collars on 31 cow moose in the first year (October/November 2005). Thirty-two cow moose and 5 caribou cows were collared the second year (October/November

2006). We collared an additional 7 caribou cows in October 2007. FWS and ADF&G provided funding for the caribou work as it was outside the scope of the original study proposal. Two moose and two caribou died during the capture operations. In addition two moose collars were never retrieved. Of the 59 moose and 9 caribou collars retrieved, we downloaded 558,239 locations and documented 1107 crossings of the Sterling Highway within the project area. There were 3,519 locations within the 300 foot right-of-way indicating that some moose spent considerable time along the highway, unlike caribou.

Between November 2005 and January 2009, 232 hotline phone calls from the motoring public reported 389 animals observed along the Sterling Highway within the study area. This included 24 black bears (*Ursus americanus*), 11 brown bears (*Ursus arctos*), 117 caribou, 9 lynx (*Lynx lynx*) and 230 moose. The hotline phone number (262-2300) is advertised via highway signs, a radio transmitter (1170 AM) located at MP 62.5, numerous newspaper articles, a brochure (Appendix C) and posters displayed in Kenai Peninsula post offices, food stores, and visitor centers.

WVC data was obtained from ADPS (state trooper dispatch in Soldotna), ADF&G, and ADOT&PF. This combined data set includes not only road-kills but also collisions where wildlife were hit, but not recovered. Between 2000-2007, there were a minimum of 174 WVCs within the study area. This total includes collisions with 24 black bear, 3 brown bear, 5 caribou, and 142 moose. ADF&G estimates that up to 90% of moose killed by vehicles on the Kenai Peninsula are cows and calves. When a cow moose is killed by a vehicle, the intended migration is stopped and her orphaned calves may remain close to the highway corridor. Estimates of unreported WVC can range up to 50%. Three tagged moose were hit and killed by vehicles during this study. Bangs (1989) found that road-kill was the largest source of mortality for adult female moose on the Refuge. Road-kill mortality for adult female moose is likely additive because this sex and age group is believed to be least susceptible to natural mortality and there is limited harvest of cows on the Kenai Peninsula (Loranger 1991).

One of the purposes of the Kenai National Wildlife Refuge is to "conserve fish and wildlife populations and habitats in their natural diversity". In granting an easement to ADOT&PF for the Sterling Highway, the grantee (ADOT&PF) agreed to several terms and conditions. Among which are:

- The manager of the refuge will be provided an opportunity to review plans relative to effects, if any, that all new highway project works as planned will have on the land traversed by the right-of-way and adjoining land.
- Plans shall be revised, modified, or supplemented to meet the approval of the refuge manager… before being placed in effect.
- To protect and preserve soil and vegetative cover, and scenic and esthetic values of the Moose Range on the right-of-way outside the actual highway construction limits.
- Entry to and performance of all of the conditions permitted herein will be subject to the advance approval of the refuge manager.

This report presents sound scientific information on moose crossings, limited caribou crossings as well as transportation infrastructure impacts on wildlife and habitat, and how to best address and minimize those impacts. The interagency working group makes recommendations for reducing the WVCs and enhancing the permeability of the Sterling Highway for wildlife.

The area of highest concern on this project is between MP 69 and 75. This 6 mile section includes 48% of the WVC, 68% of the wildlife hotline sightings, and 83% of the GPS moose and caribou crossings. This is also where passing lanes are proposed in the environmental document for the upgraded highway (MP 71.4 to 73.4). We recommend fencing this section of highway but also include a wildlife overpass near MP 73, a wildlife underpass (bridge over East Fork of Moose River at MP 71.4), and a wildlife "crosswalk" near the ends of the fenced section. Additional crossings for large mammals are recommended at MP 58.1, 58.5, 61.9 and 64.5 but no fencing at this time.

Approved by:

____ Date:______________

Refuge Manager, Kenai N.W.R., U.S. Fish & Wildlife Service

____ Date:______________

Alaska Department of Fish & Game

____ Date:______________

Alaska Department of Transportation & Public Facilities

____ Date:______________

Federal Highway Administration

____ Date:______________

Alaska Department of Public Safety, State Troopers

____ Date:______________

Alaska Moose Federation

INTRODUCTION

Developing highway mitigation is more productive when cooperation between transportation departments, land managers, wildlife biologists, and concerned citizens exists. Gaining trust between different stakeholders takes time and effort. This Sterling Highway MP 58-79 study provided an opportunity to create an atmosphere of trust and collaboration in a team effort to produce the best possible outcome for human safety and wildlife conservation. The FHWA website[1] states "when transportation agencies conduct planning activities equipped with information about resource considerations and in coordination with resource agencies and the public, they are better able to conceive transportation projects that serve the communities transportation needs more effectively. This leads to smaller negative impacts, and incorporates more effective environmental stewardship".

The Sterling Highway is part of the National Highway System and is the only highway connecting the western Kenai Peninsula with Anchorage, the state's largest city (Figure 1).

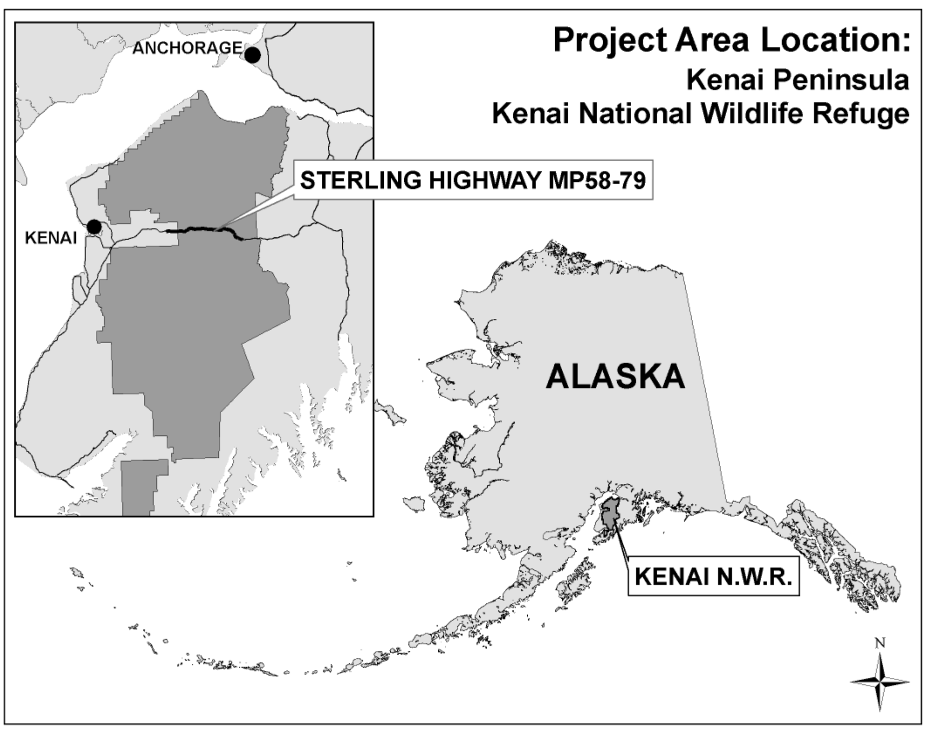


Figure 1. Project location in south central Alaska.

The Sterling Highway between MP 37 (Seward Highway Jct.) and 75 (west entrance to Skilak Lake Road) is designated a State Scenic Byway (North and South Sterling Byways

[1] http://www.environment.fhwa.dot.gov/integ/index.asp

Corridor Partnership Plan 2008). This designation recognizes routes that provide access to our most scenic areas, cultural riches and recreational resources. The North Sterling Byway is the only highway that traverses the Kenai National Wildlife Refuge. It provides significant opportunities to see wildlife, landforms, and vegetation, and to recreate in an outstanding natural environment. Approximately 1.2 million people travel through Kenai National Wildlife Refuge each year on the Sterling Highway enjoying a variety of outdoor activities, including fishing, camping, hunting, hiking, wildlife viewing and photography, and canoeing (U.S. Fish and Wildlife Service 2008).

Vehicle collisions with wildlife, especially moose, are a major problem on the Sterling Highway both on and off the Kenai National Wildlife Refuge (State of Alaska, 1994) based on collision densities per mile and crash rate per million vehicle miles. WVCs have a high cost in vehicle damage, human injuries and deaths, and loss of wildlife. Cows and calves are estimated to make up 90% of the road-killed moose. The high number of females killed may have direct impact on local populations of moose. This impact can become more acute with increasing WVCs and a low moose population.

Much of the area surrounding this section of highway was burned in 1947 when the highway was originally constructed. Following the 1947 burn which covered over 300,000 acres, moose numbers reached a peak density of 3.6/km^2 (9.3/mi^2) in 1971 (Bishop and Rausch 1974, Loranger et al. 1991). Densities declined steadily post burn as the habitat matured and moose forage declined. The Game Management Subunit 15A moose population has declined from its peak in 1971 and is estimated at 1670 (±173, 80%C.I.) with a density of 1.1/km^2 (2.9/mi^2) as of February 2008 (Figure 2).

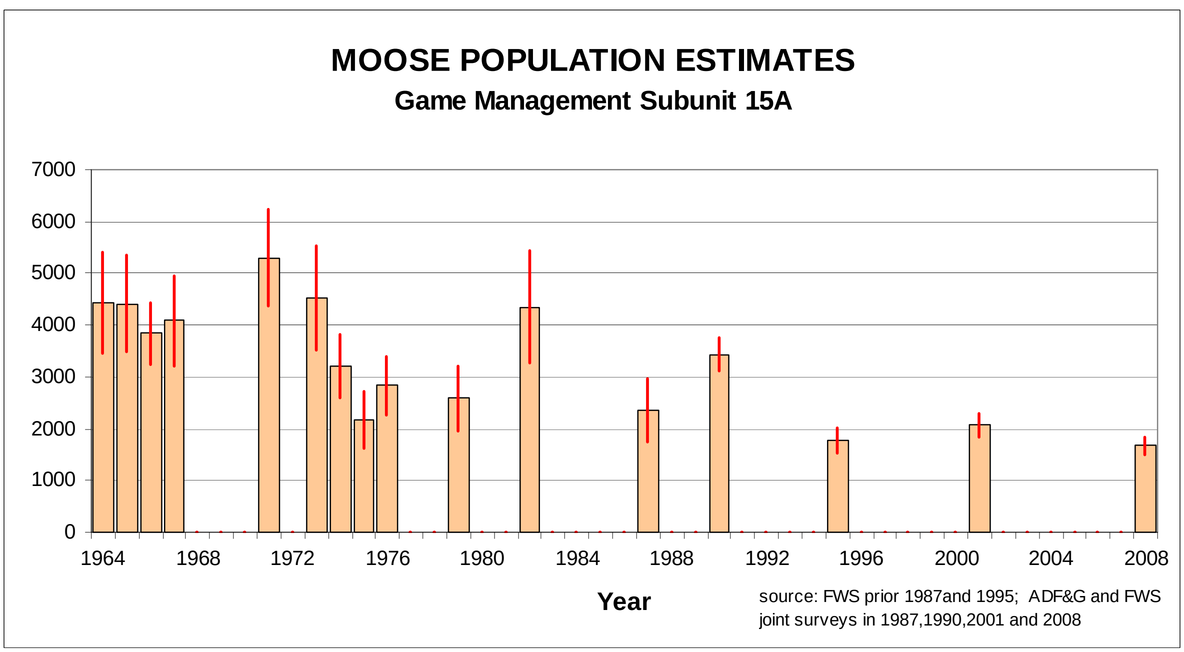


Figure 2. GMS 15A Moose Population Estimates, 1964-2008 (80% confidence intervals in red).

The population estimate in 2001 and 2008 used the Spatial Moose Survey Estimation Method (Ver Hoef 2008). Surveys in 1987, 1990, and 1995 used a stratified random sampling design

(Gasaway et al. 1986). All surveys prior to 1987 used a randomized quadrat sampling (Loranger 1991). The chart in Figure 2 contains estimates of the moose population since 1964. It is important to note that survey techniques have differed over the years. As newer, more robust scientific methods are developed they are utilized in surveys.

Planned improvements to the highway infrastructure include passing lanes, wider shoulders and a smoother surface which will likely result in increased vehicle speeds. Between 1997 and 2005 Refuge law enforcement issued 465 citations for speeding on the Sterling Highway (Chris Johnson, personal communications). Studies show that drivers select speeds based upon roadway conditions and not the speed limit posting. At early scoping meetings the refuge asked if the posted speed limit would remain at 55mph and was told yes. It now seems likely that the posted speed limit will increase (pers. comm. with Michael Hall, ADOT&PF) as the design speed of the reconstructed highway will increase. Higher speeds in conjunction with expected increases in traffic volume may exacerbate the WVC problem as well as making the highway a formidable barrier for natural wildlife movements. Moose numbers could begin to increase due to recent wildfires (Hidden Creek fire 1996, Mystery Hills fire 2001, King County Creek fire 2005). The refuge's Moose/Habitat Management Plan (U.S. Fish and Wildlife Service 1996) directs the refuge to use prescribed fire for enhancing 2-4,000 acres of habitat for moose each year. Burn plans are scheduled in the future for Lily Lake, Skilak, and Mystery Creek. An increase in moose numbers along with increased traffic volume and vehicle speed could result in an increase in WVCs and severity in coming years.

Currently our best moose winter range is on both sides of the highway between MP 72.5 and 74.5 (dark green areas, Appendix A-Map 2). These areas called Skilak and Lily Lake, were crushed and burned by ADF&G in cooperation with the refuge in 1984 and1986 enhancing 1,530 and 800 acres respectively. Creating good habitat on opposite sides of the highway likely contributed to the present MVC problem, but was not foreseen in the 1980's when traffic volume was much lower.

The Kenai National Moose Range was established by Franklin D. Roosevelt on December 16, 1941 for the purpose of

> *"…protecting the natural breeding and feeding range of the giant Kenai moose on the Kenai Peninsula, Alaska, which in this area presents a unique wildlife feature and an unusual opportunity for the study in its natural environment of the practical management of a big game species that has considerable local economic value…*" (Executive Order 8979).

Executive Order 8979 provided for the construction and operation of a highway to connect the area open to settlement with the Seward-Sunrise road by the most practical route. This highway was the Skilak Lake Road. The Moose Range was renamed to the Kenai National Wildlife Refuge and its purposes broadened with the passage of the Alaska National Interest Lands Conservation Act of 1980:

> "*conserve fish and wildlife populations and habitats in their natural diversity including , but not limited to moose, bear, mountain goats, Dall Sheep, wolves and other furbearers, salmonids and other fish, waterfowl and other migratory and nonmigratory birds".*

In May 1949[2], a public land order issued by the Bureau of Land Management withdrew certain lands (three whole townships between present day Soldotna and Sterling) within the present Moose Range boundary for settlement. The Bureau of Sport Fish and Wildlife (precursor to the FWS) posed no objection provided that before the lands reopened for homesteading the Bureau of Land Management would consider recommendations by the Bureau of Sport Fish and Wildlife to provide passageways for the migration of moose across the proposed settlement area. The removal of these three townships (hatched area, Figure 3) practically divided the Moose Range in half.

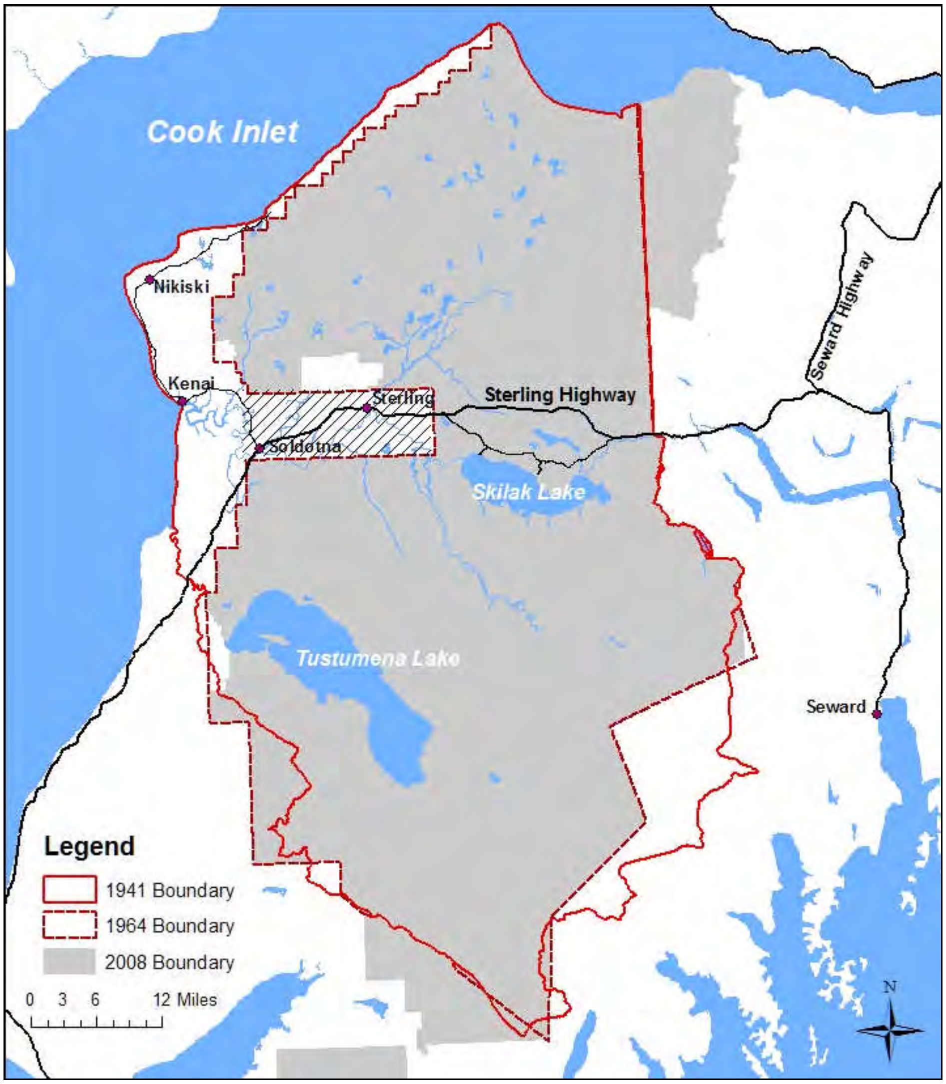


Figure 3. Boundary changes from establishment of the Kenai National Moose Range in 1941 (solid red line), the removal of three townships (hatched area) for settlement in 1964 (red dashed line) to present day Kenai National Wildlife Refuge (grey shaded area).

[2] Memorandum from J. Clark Salyer II, Chief, Branch of Wildlife Refuges, Washington, D.C. to Regional Director, Juneau, Alaska, on May 20, 1949.

The Bureau of Sport Fish and Wildlife planned three or more "moose runways" running north and south, several miles wide, to be preserved across the three townships removed from the Moose Range. This is the first historical reference to the importance of maintaining habitat connectivity between the north and south regions of the Kenai National Wildlife Refuge. Unfortunately, these three townships were extensively developed without any "moose runways". The Sterling Highway bisects the Kenai National Wildlife Refuge, further fragmenting the refuge since its creation as the Kenai National Moose Range in December 1941 (U.S. Fish & Wildlife Service 1985).

In 1963 the Alaska congressional delegation proposed removing 75,000 acres in the Skilak Lake area from the Moose Range. This action would have severed the refuge into a north and a south unit. A report prepared by the Alaska Field Committee[3] to respond to this proposal was made in 1964. The report recognized the importance of the Skilak Lake area for moose when it stated:

> *"Perhaps the most essential feature of this tract to moose is that of a migration corridor between the north and south sections of the Range…it is essential to retain the three-mile corridor to permit the unimpeded travel movement to and from their winter and summer ranges and through the winter area as required by forage and snow conditions. Elimination of this corridor would jeopardize the value of the Range for moose."*

It is clear that this area bisected by the Sterling Highway MP 58 -79 is critical for not only moose, but a host of wildlife species including caribou and brown bear (a population of special concern by ADF&G). As the Kenai Peninsula continues to grow and human development spreads, wild refuge lands become more critical to maintaining wildlife populations. Fragmenting refuge lands into smaller roadless blocks of habitat will greatly impact the congressionally mandated purpose for which the refuge is to be managed.

The FWS manages America's National Wildlife Refuge System and is tasked with conserving fish and wildlife populations and habitat for the benefit of the American people.

> "…national wildlife refuges are critical places for wildlife being squeezed by a world that runs on high octane… But when the bicentennial of the Refuge System comes around in 2103, generations not yet born will marvel at the land legacy we are creating today. I thank you for working so hard to continue and expand what the first century of refuge pioneers left to us – a guarantee that at least a part of this great continent will forever be home to wildlife, great and small." (Geoff Haskett, Chief National Wildlife Refuge System, email to employees dated 13 March 2008)

It is true that moose numbers are higher during winter in the developed corridor as moose are drawn to early seral habitat as forests are cleared for roads, utility lines, homes, businesses, and other human development. During severe winters with deep snow, cleared roads,

[3] Made up of representatives from the Bureau of Land Management, Bureau of Sport Fisheries and Wildlife, Solicitor's Office and the Office of the Secretary

driveways, parking lots and highways attract moose as well. Moose densities in the Kenai-Soldotna-Sterling area reached 14.5/km^2 (5.6/mi^2) during the severe winter of 1989-90 and a record 366 road-killed moose were recorded on the Kenai Peninsula that year (U.S. Fish and Wildlife Service 1996). However, moose are also susceptible to poaching, artificial feeding, loose dogs, and possible disease from domestic animals, and starvation. The human settled areas can become population sinks for moose and other wildlife species.

ADOT&PF sent a request to FWS (December 17, 2001) soliciting comments and information on a proposal to improve the Sterling Highway between MP 58 and 79. The Kenai Refuge in cooperation with the ADF&G submitted a study proposal to the ADOT&PF and the FHWA to examine ways of mitigating impacts to wildlife and improve safety for motorists. The study proposal was submitted in December 2003 and called for the formation of an interagency working group to oversee the study. This group was to include members from ADOT&PF, ADF&G, ADPS, the Alaska Moose Federation (non-profit), FHWA, and FWS. The study proposal was originally designed to collect and analyze WVC data and collar up to 35 cow moose for two successive winters to identify crossing areas. Later a third data source was added: getting motorists to call in wildlife sightings as they drive through the study area.

Phase 1 (pre-construction) of the study proposed to collect two winters of moose movement data, review previous WVC data and create a sense of ownership from the motoring public through the use of the wildlife hotline. These data will help determine the need for and placement of wildlife crossing structures and possible other moose mitigation strategies that may benefit and enhance the existing corridor. Phase 2 of the study will be a post-construction investigation into the success or failure of the mitigation. A final report will be submitted to ADOT&PF and FHWA from the interagency working group.

STUDY AREA

This study was conducted along the Sterling Highway between MP 58 in the east and 79 in the west, a 21-mile stretch of State Route 1 on the Kenai Peninsula. (Appendix A,Map 1; 60° 25’ - 60° 36’N, 150° 04’ - 150° 41’W). The Sterling Highway bisects the center of the Kenai National Wildlife Refuge. The project area begins at MP 58, the junction of the east entrance to Skilak Lake Road (the original Sterling Highway) in the upper Kenai River valley. The highway exits the Kenai Mountains around MP 63 and descends onto the Kenai lowlands - a broad expanse of wetlands, bogs, lakes and boreal forest. Black (*Picea mariana*) and white spruce (*Picea glauca*), mixed with aspen (*Populus tremuloides*), white birch (*Betula neoalaskana*) and willow (*Salix* spp.) line the highway except where bogs and muskeg are intersected. The highway crosses the East Fork of the Moose River, an anadromous stream, at MP 71.3. The west entrance to Skilak Lake Road is at MP 75.2. The west boundary of the Kenai Refuge is at MP 76 and the project ends at MP 79 near Sterling where the existing four-lane divided highway begins.

The present highway is a two-lane asphalt road with minimal shoulders for much of its length. The 300 foot right-of-way includes approximately 810 acres of refuge land. There are presently no crossing structures designed for wildlife along the highway. Numerous small culverts are located along the 21 miles primarily for water transport. Highway elevation ranges from 89 meters (<300 feet) at MP 79 up to 183 meters (600 feet) at MP 64.5. Habitat types within the 300 foot right-of-way along this section of the Sterling Highway are listed in Table 1 and shown on Map 1 (Appendix A).

Table 1. Land Cover Types within Sterling Highway MP58-79 right of way

Habitat	Acres	Hectares	% of Total
Needleleaf Forest - Black Spruce	188.1	76.1	23.2%
Needleleaf Forest - White Spruce	3.1	1.3	0.4%
Herbaceous	17.2	7.0	2.1%
Mixed (Aspen/Birch/Spruce) Forest	367.8	148.8	45.4%
Wetland	79.0	32.0	9.8%
Aspen	104.0	42.1	12.8%
Water	3.1	1.3	0.4%
Unvegetated (gravel pits,parking areas)	47.7	19.3	5.9%
TOTALS	**810.0**	**327.8**	**100.0%**

Average annual daily traffic volumes on this section of highway have slowly increased from 2,438 vehicles per day in 1996 to a peak of 3,458 vehicles per day (+42%) in 2007. Over the past 12 years there is an overall increasing trend (Figure 4). The Sterling Highway has highly varied seasonal traffic volume. ADOT&PF has no traffic counters within the study area.

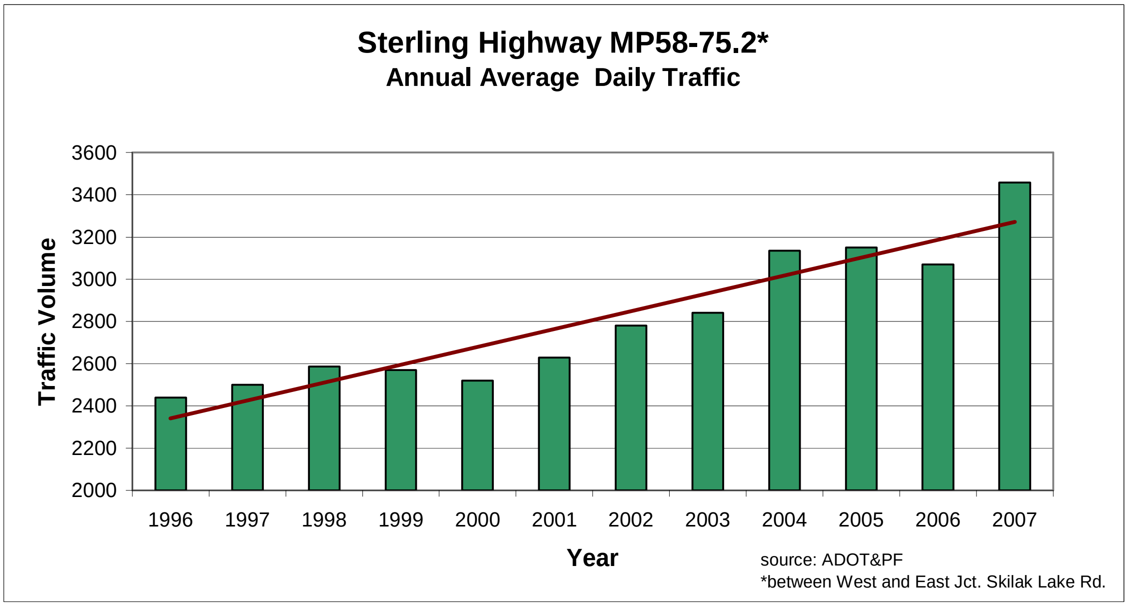


Figure 4. Annual Average Daily Traffic numbers with trendline.

However they maintain two traffic counters one at the west side (MP79.1) and another several miles east of the study area. In 2005 a traffic counter located at the intersection with Kenai Keys Road (MP79.1) documented 8,572 daily traffic volume in July. The highest traffic hours for 2005 were between 1pm and 6pm, which coincides with the lowest GPS crossings. Moose are likely bedded down during these hours in July and may be avoiding the highway corridor as high traffic volume creates a barrier for moose movement. A traffic counter to the east of the study area (Cooper Landing) has similar statistics for 2005. Peak daily traffic volume occurred in July at 7,613 with the highest traffic hours between 1pm and 7pm. These data are assumed to be similar for the study area.

The study area has a sub-arctic climate characterized by long, cold winters and short growing seasons in summer. Temperatures occasionally exceed 27°C (80°F) and rarely drop below minus 34°C (-30°F). Weather statistics for the western Kenai Peninsula come from the National Weather Service and include: average annual high temperature of 5.5°C (41.9°F) and low temperature of minus 3.6°C (25.5°F). Average annual total snowfall is 155.7 cm (61.3 inches). Snowfall amounts can be highly variable due to the snow and rain shadow effect of the Kenai Mountains. The eastern 5 miles of the study area traverse the Kenai Mountains while the western 16 miles cross the Kenai Lowlands.

METHODS

The three study objectives for the pre-construction phase were:

1. identify moose migration routes and high density crossing areas
2. summarize WVC data
3. collect information on wildlife sightings by the motoring public

The primary study objective was to identify moose migration routes and high density crossing areas. To accomplish this, we collected three sources of data for analysis: (1) monitoring GPS collared moose and caribou to determine successful highway crossing paths, (2) summarize WVC data from ADPS, ADF&G and ADOT&PF records to document unsuccessful crossing attempts and (3) call-in wildlife sightings to a wildlife hotline from motorists to assess potential crossing sites. Evaluating the success of mitigation measures that are employed or constructed during the reconstruction of the highway will be addressed in phase two (post-construction) of this study.

GPS Collaring

We utilized the model TGW-3700 GPS collar system manufactured by Telonics, Inc. of Mesa, Arizona. Every collar included a CR-2a programmable release mechanism. Data summarized by ADF&G on moose-vehicle collisions demonstrated a higher occurrence during winter months. Therefore we decided to program GPS collars to record locations every 30 minutes from October through March, then every two hours until collar release on July 1. The goal was to concentrate on obtaining detailed information on where and when moose crossed the highway during the winter months, while enabling the transmitters to function well past the release date to allow time for retrieval. Data were stored on the collar and could not be obtained until the collar was retrieved. Refuge aircraft were used to track each animal to ensure the animal was still alive and its location recorded.

Capture operations began in mid October 2005 using a Hughes 500D (Prism Helicopters, Wasilla, AK) piloted by Bruce Andrews. Unfortunately we had no snow on the ground which made for difficult sightability and captures. After two moose cows were captured we called off the effort until we got snow. Within a week we received a few inches of snow and contracted with Larry Larrivee for use of an R-44 helicopter (Pollux Aviation, Wasilla, AK) as a darting platform. The Refuge Super Cub was used to spot and monitor darted moose and caribou. Animals were immobilized using 4.0-5.0mg of Carfentanil mixed with 65-70mg of Xylazine. Blood samples and rump fat indices were collected from most animals. Animals were collared and ear tagged. Tolazoline (400mg) was administered to reverse the effects of xylazine, and Naltrexone was dosed at 100mg/mg of carfentanil. Reversals were given either ½ intramuscular and ½ intravenous or all intramuscular.

Thirty-one adult cow moose were captured and collared in late October and early November of 2005. One moose died shortly after capture. By July, 27 collars released and were retrieved that same month. Information was subsequently downloaded and the collars were refurbished. One moose collar was not recovered. The CR-2a mechanisms failed to release on two collars. Both were retrieved during the second capture operation in late October and early November of 2006. We captured and deployed collars on 32 cow moose (5 were recaptures from the prior year) and 5 cow caribou. One moose and one caribou died from the capture operation. The remaining collars were retrieved in July and August 2007; as in the previous year one moose collar was not recovered. We captured 7 caribou on November 7, 2007 and deployed GPS collars that were programmed as the moose and caribou collars in prior years. Cost of this third capture was borne by FWS and ADF&G. One caribou died shortly after capture. Another died from unknown causes within two months. The other 5 collars were retrieved in October 2008 and the data obtained was added to the data set from the previous two years.

Captures were conducted in the western half of the project area, due primarily to the habitat and terrain. There is more open habitat, flat terrain and better food sources in the western half. Both moose and caribou were more visible to searchers and easier to capture via helicopter in the more open habitat. The best winter range for moose is in two prescribed burn areas located on each side of the highway (Map 2, Appendix A). We searched for moose to capture in the eastern half, but were unsuccessful. In November of 2006, we captured three moose in the Mystery Creek prescribed burn units hoping to get some data for the eastern half of the study area. Collars were distributed evenly north and south of the highway.

New milepost markers were installed at 0.5 mile (0.8 km) intervals to assist the motoring public with reporting animal sightings more accurately, but also to aid in determining "hot spots" where the highest WVC, hotline reports and GPS crossings occurred. We used ArcGIS Version 9.2 software (Environmental Systems Research Institute, Inc., Redlands, CA) to analyze GPS data. We used Tracking Analyst extension for ArcGIS to delineate movement data, calculate crossing vectors, and time of day of crossings. We compiled crossings for moose and caribou by individual animal and by highway half mile segments. GPS collars recorded time in Coordinated Universal Time which we converted to Alaska Standard Time or Alaska Daylight Time depending on the date of each location.

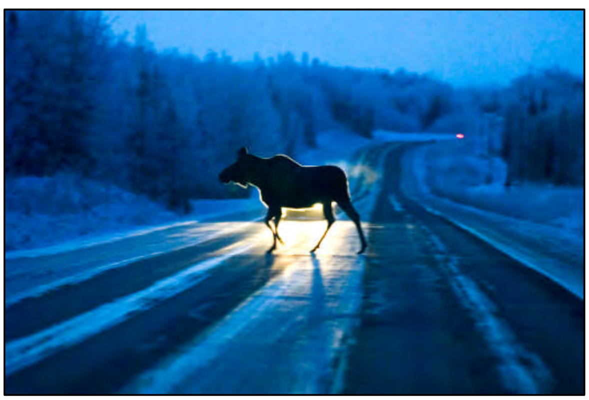
Wildlife-Vehicle Collisions

Data were combined on wildlife-vehicle collisions from two sources: ADOT&PF and the Alaska State Trooper radio logs (compiled by ADF&G). Most records were duplicated by each source, however unique incidents were also found in one source. On rare occasions Kenai National Wildlife Refuge officers responded to WVC that were not in data sources from either state agency.

These data included road-kills, accidents where animals were hit but not recovered, and animals found dead but not reported by motorists. These data were recorded according to some feature of the highway, usually milepost marker, stream crossing, pullout, or junction with another road. Data are now required to be collected with GPS units in latitude and longitude. Half-mile markers helped to improve the accuracy of WVC locations, prior to use of GPS units.

Wildlife Hotline

The third data set consists of motorist observations of wildlife on or near the highway. To aid motorists (especially those unfamiliar with the area) in establishing their location, we installed half MP markers along the 18 miles of the study area within the Kenai Refuge. A large reflective sign that warned motorists they were entering a high wildlife crossing area was posted at both the east and west end of the study area. The signs included the "wildlife hotline" phone number 262-2300.



We informed the public of our efforts and encouraged calls to the hotline from motorists through numerous local newspaper stories; posters displayed in stores, post offices, visitor centers; printed brochures; and public seminars. We also installed a radio transmitter at MP 62.3 to broadcast (1170 AM) a request for motorists to report wildlife sightings as they drive the Sterling Highway. The following information was sought.

- what species was observed
- how many (cow with calves, sow with cubs)
- between what milepost markers they were seen
- date
- time

RESULTS

Both resident and migratory moose inhabit the study area. It was suspected that moose from the Kenai Mountains move into the project area during deep snow periods. GPS tracking of 59 collared moose showed only one cow left the lowlands for the Kenai Mountains but then returned within a few days; this occurred in June 2006 (Appendix A, Map 5). Only 16 GPS collared moose resided in the study area. Most collared moose left the study area during spring to calve in areas to the west and north (Appendix A, Maps 5 and 6).

All nine collared caribou belonged to the Kenai Lowland herd, which calves north of the Kenai Municipal Airport and in the Kenai gas field, located between the mouths of the Kasilof and Kenai Rivers. This herd spends the winter months in the bogs and spruce forests between the Moose River flats and Skilak Lake as well as south of the Kenai River along the Funny River and Brown's Lake area. This herd is of concern due to the low productivity and senescence of adult cows in the herd. The Kenai Lowland herd is not hunted and an important mortality factor is WVC. This herd is highly visible via local roads and both visitors and locals enjoy seeing them.

GPS Crossings

We collected over 558,239 fixes from 59 GPS collared moose and 9 caribou. Two moose collars were not retrieved. Nine collared moose and two caribou never crossed the highway. Of the 50 moose and 7 caribou that did cross the highway, there were 1107 crossings (Appendix A, Map 4 and Appendix B, Table 2) and 3519 locations within the 300 ft highway right-of-way (Appendix B, Table 3). The highest total number of crossings (163) for any half mile segment was between MP 73.5 and 74 (Figure 5). Twenty-five moose and two caribou crossed the highway at this segment. This segment lies directly between two recent prescribed burns (see Map 2) that are currently the best winter moose habitat. The next highest number of crossings (140) occurred between MP 70 and 70.5. Fifteen of 50 collared moose and 2 of 3 collared caribou that crossed the highway did so at this particular half mile segment. The areas of highest moose and caribou crossings clearly lie between MP 69 and 75. This 6 mile section included 83% (914) of all GPS crossings.

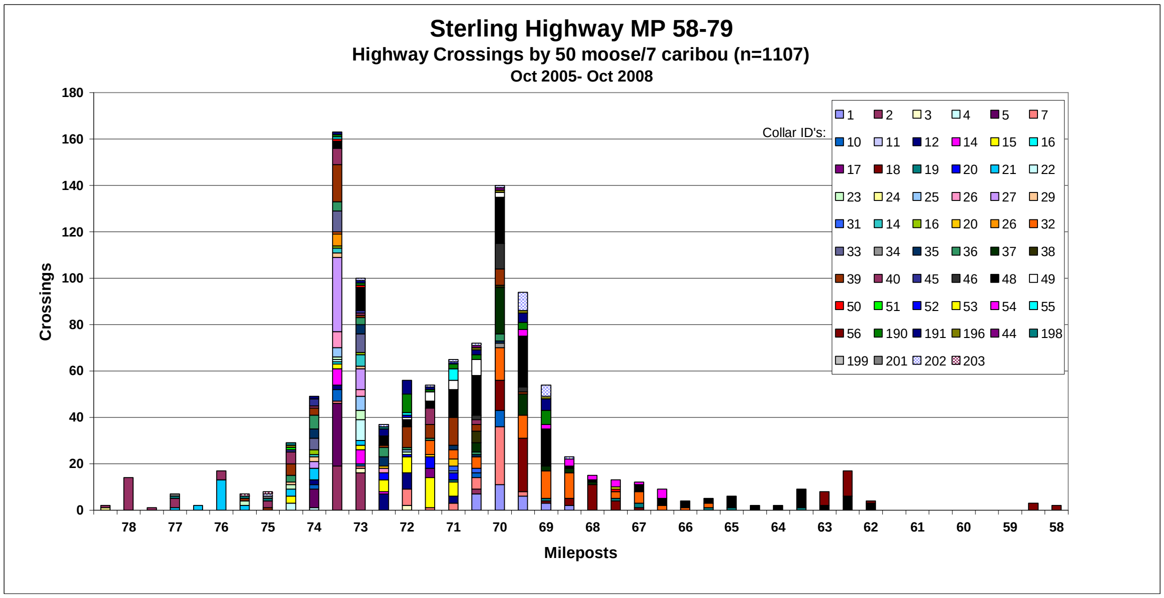


Figure 5. Sterling Highway crossings by GPS collared moose (n=1023) and caribou (n=84).

Most of the GPS moose and caribou crossings (65.4%) occurred between November and February, typically the darkest months of the year, with bad weather and poor road conditions. Winter is a time when salt/sand is used on the road that may attract animals. The peak of crossing activity occurred in January (Figure 6). Crossing activity decreased during March and April, but then another increase occurred in June, likely due to post parturition movements. Collars were programmed to drop 1 July which explains the lack of crossings between July and September. Two collars from year one did not release and were retrieved during captures in October 2006. The low number of crossings in October was due to deployment of collars only in the end of that month.

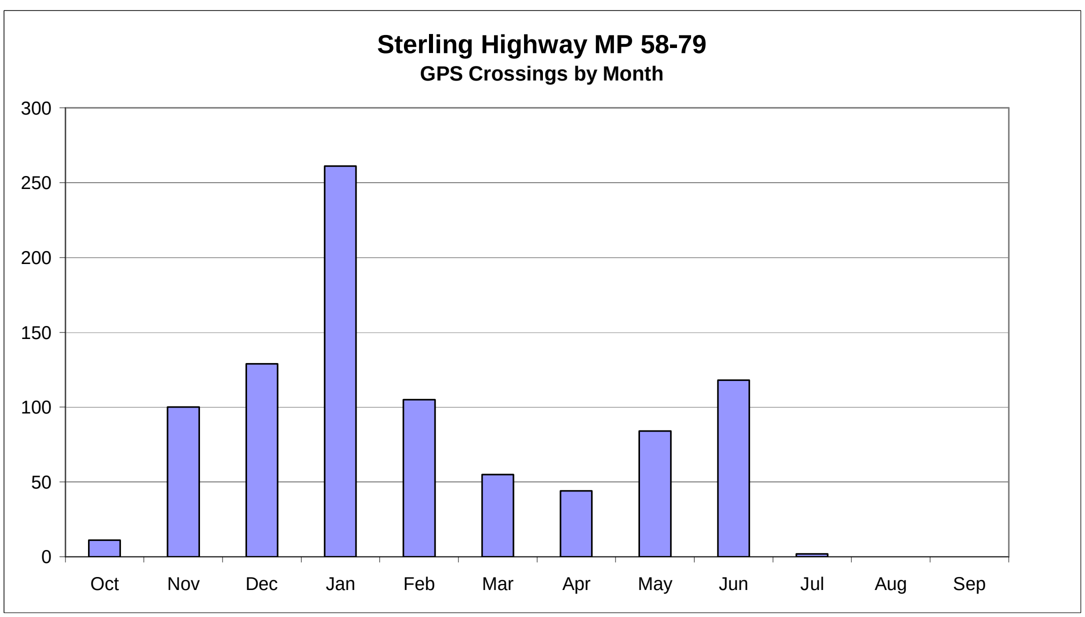


Figure 6. GPS Moose and caribou crossings of the Sterling Highway, October 2005 through August 2007 (n=918).

Moose and caribou crossings typically occurred diurnally. Crossings were least during the afternoon (Figure 7) coinciding with higher traffic volumes, but also normal resting periods.

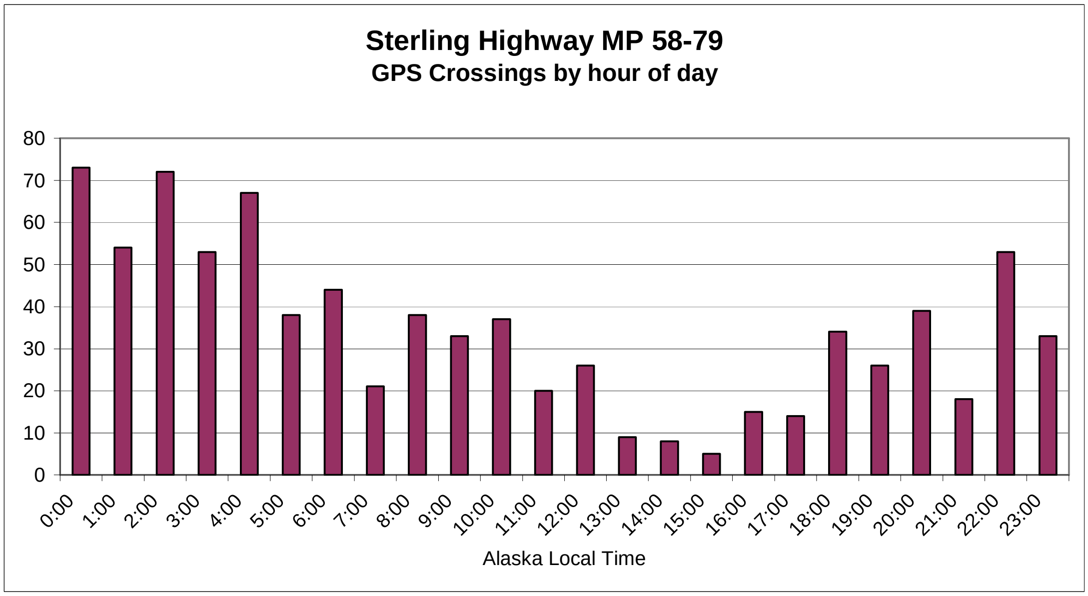


Figure 7. GPS Moose and caribou crossings of the Sterling Highway by time of day, Alaska Local Time (n=918).

Wildlife Vehicle Collisions

The WVC data were compiled between 2000 and mid-2007 from a combination of ADOT&PF records as well as from Alaska State Trooper (Soldotna Post) radio logs. There were 174 WVCs, an average of 26.8 per year for this section of highway. The actual collision rate is probably higher due to unreported accidents. Three collared moose from this study were killed by vehicles, one in May 2006, another in June 2006, and a third in December 2007. Out of 50 tagged moose that crossed the highway during this study 3 were killed by vehicles (6.0%). None of the nine collared caribou were killed by vehicles.

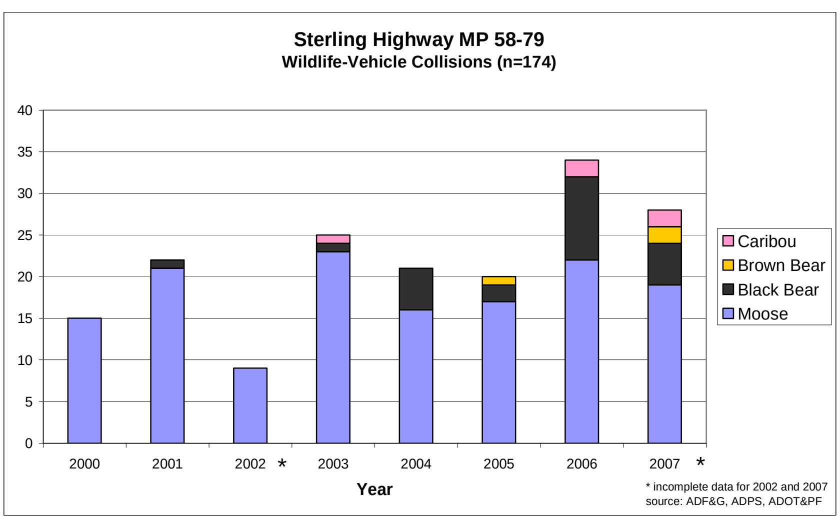


Figure 8. Wildlife Vehicle Collisions by species, 2000-2007.

Between 2000 and 2005, moose accounted for the vast majority of WVCs; however, in 2006 and 2007 bears and caribou made up 34% and 41% respectively, a significant increase from previous years (Figure 8). All moose-vehicle collisions in 2002 were from ADPS records only. There was no moose-vehicle records in the ADOT&PF file for that same year. Data for 2007 are only for January through June. Over the past seven and one half years moose made up 81% of the WVCs (Figure 9).

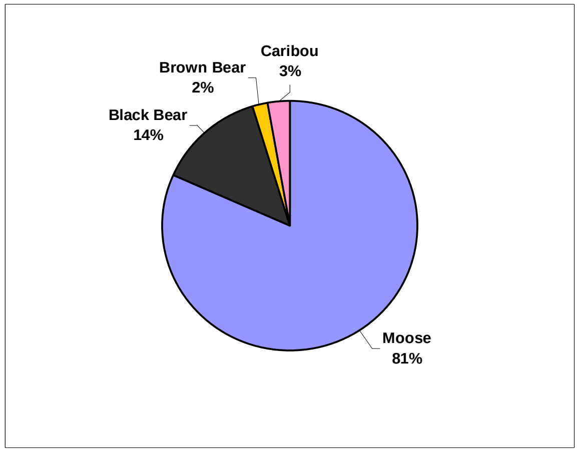


Figure 9. Composition of WVC by species, 2000-2007.

WVC between 2000 and 2007 include 142 moose, 24 black bears, 3 brown bears and 5 caribou. Figure 10 shows higher total WVC incidents along the west side of the project area with a peak of 16 moose collisions at MP 75. However, a higher percentage of bear collisions occurred in the eastern side of the study area between MP 58 and 62.

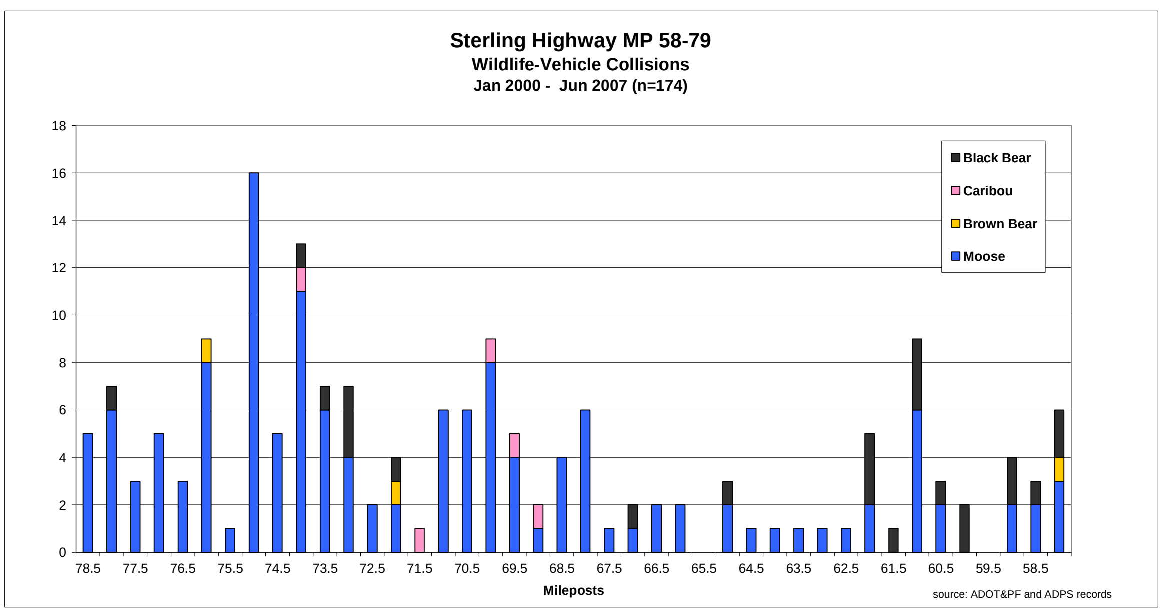


Figure 10. WVC by species by half mile segment, 2000-2007.

The average WVC per year is 26.8 for the Sterling Highway between MP 58 and 79. The number is likely higher considering incomplete records for 2002 and 2007. The three year average shows an increasing trend in collisions (Figure 11), despite declining moose road-kill numbers during the past 3 state regulatory years on the Kenai Peninsula. Again it is important to note that the data for 2007 does not include July through December as the information was not yet available.

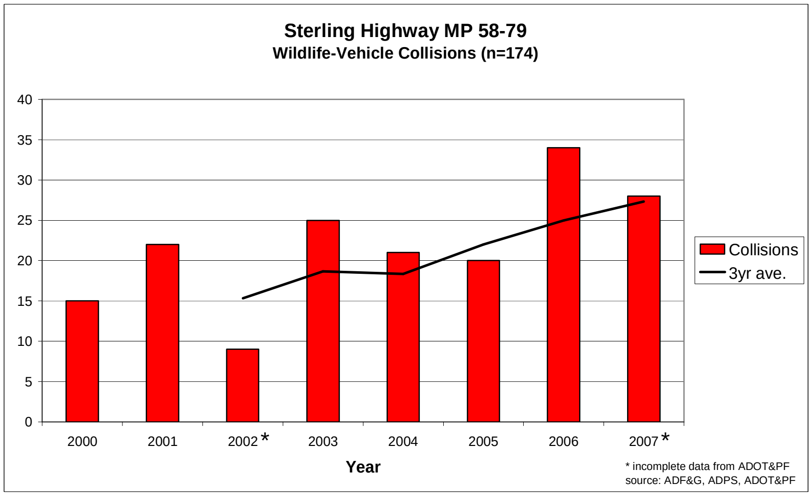


Figure 11. WVC by year 2000-2007.

Wildlife Hotline Sightings

These data were obtained from motorists along the highway beginning in November 2005 after new half MP markers were installed and the hotline phone number became operational. Figure 12 shows a clear concentration of animal sightings similar to the GPS crossings. Sightings were weighted by the number of animals seen per observation. Caribou were usually sighted in groups (one up to 20 animals) and had a higher weight than a sighting of an individual moose. These data are preliminary and will continue to be collected and updated as phone calls continue to come in. We recorded 232 phone calls from the public totaling 389 animals observed.

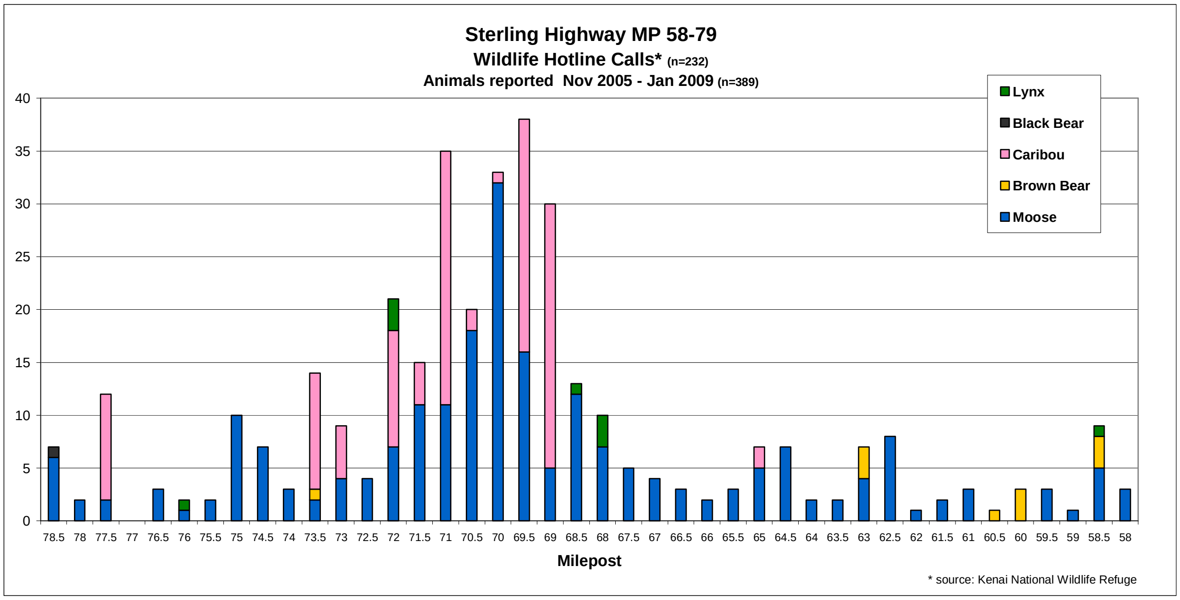


Figure 12. Wildlife hotline reports by species.

Hot Spots

Combining GPS moose and caribou crossings, WVC, and wildlife hotline sightings help to identify some "hot spots" along the 21 miles of the Sterling Highway we studied. Map 3 (Appendix A) displays the combination of WVC data from 2000 to 2007 (n=174), Wildlife Hotline sightings (n=389), and GPS moose and caribou crossings (n=1107). This map highlights MP 69 to 75, the area where our concern for mitigation and human safety should be focused.

DISCUSSION

Roads have far reaching impacts on the local environment and wildlife – direct habitat loss, degradation of habitat quality, habitat fragmentation, road avoidance, increased human exploitation, road mortality, road density relationships, anthropic habituation, changed biodiversity, changed hydrology, erosion, contaminants, storm water quality, salts, invasive species and noise impacts. Roads affect wildlife not only as individuals but as populations. Research shows that roads can isolate populations. Genetic work has illustrated that the Selkirk Mountain grizzly bear population in British Columbia is isolated from other populations by a road and associated human activity (Urquhart 2004). Moose and bear (brown and black) populations decrease with increased road density (Forman and Alexander 1998). Results from Grave et al. (2006) indicate Kenai Peninsula brown bear highway crossings may have already decreased due to present traffic level, and decreased connectivity and increased traffic volume could exacerbate population-level effects. Waller and Servheen (2005) hypothesized a threshold volume of 100 vehicles/hour beyond which highways in general become significant barriers to grizzly bear movement.

Many species show a tendency to avoid roads with high vehicle use. For example, female grizzly bears in Alberta, Canada showed a negative relationship to areas with more vehicles and traffic noise (Gibeau et al. 2002). Graves et al. (2006) found traffic volume on the Sterling Highway an important influence on bear crossings; bears moved more swiftly when crossing the highway than when traveling in other landscapes and cross where proximity of cover is close to the highway. Waller and Servheen (2005) found grizzly bears in Montana crossed U.S. Highway 2 closer to cover in open habitats. Thus clearing vegetation along the highway right-of-way as a means of reducing WVC can enhance the barrier effect of the highway for Kenai Peninsula brown bears. A decrease in WVCs from clearing a right-of-way may be the result of fewer animals crossing the highway, not that wildlife are more visible to drivers who can then avoid hitting them. This is the crux of the problem: reducing WVC, but not at the expense of creating an impermeable barrier for wildlife.

Increased traffic can also cause an increase in habitat loss as an animal's road avoidance zone increases with increasing traffic volume (National Research Council 2005). The ecological effect of road avoidance caused by traffic disturbance is probably much greater than that of road-kills seen along the road (Forman and Alexander 1998). Projected increases in traffic volume and speeds through the Kenai National Wildlife Refuge will likely result in wildlife's increasing road avoidance zone in relation to the Sterling Highway. In the Categorical Exclusion Environmental Documentation ADOT&PF projects AADT at 8592 by 2027 and a peak volume in July 2027 at 18,296! And ADOT&PF plans on increasing the posted speed limit from 55mph to 65mph.

As development of subdivisions, businesses, side roads, recreational facilities, utility corridors, and other human impacts expand from the Sterling Highway; it increases the barrier effect and reduces the "permeability" of the highway for wildlife. As the transportation corridor becomes wider from subsequent human development this barrier effect limits some wildlife species to smaller more fragmented areas, reducing population size and genetic variability, and free movement of individual animals across the once natural landscape. Suppression of natural-caused fires to protect human development (homes, businesses, cabins, utility lines, etc.) can perpetuate climax forests of spruce and limit the benefits to moose and other wildlife that results from fire.

Rommin and Bissonette (1996) recommend a 16-50% increase when estimating animal-vehicle collisions. Child et al. (1991) stated that the reported number of moose-vehicle collisions from the Ministry of Transportation and Highways in British Columbia may underestimate the actual number of moose kills by two to six times. Bangs et al. (1989) suggested the unreported rate was between 75-100% of those reported on the Kenai Peninsula. Tagged moose were killed by vehicles at twice the rate confirmed by troopers. During winters of heavy snowfall, the number of collisions reported in Alaska may be triple the number in an average snowfall season (Franzmann and Schwartz 1997). Garrett and Conway (1999) found substantial under-reporting of moose-vehicle collisions in the Anchorage area from 1991-1995. They stated that ADF&G reported some 648 moose killed by vehicles during the study period while the municipality only recorded 519 (80%).

During a collision with a motor vehicle, a moose usually is struck in the legs, causing its body to roll onto the hood of the vehicle, often collapsing the windshield and roof. As a result, motor-vehicle collisions involving moose are capable of causing substantial injury to vehicle occupants. Moose-vehicle collisions cause a characteristic pattern of head and neck injuries; eye injuries also commonly result (Sit et al 2005). Thomas (1995) estimated cost per collision at $15,150. The Alaska Moose Federation in their spring 2008 Newsletter state that the average cost in damages and property per moose-vehicle collision exceeds $15,000. However this figure does not include medical costs or lost wages. Each moose killed has a residual worth of $5,000. Huijser (2006) calculated the average total cost of moose-vehicle collision is $28,100.

Each cow moose or female calf that is killed on the highway can greatly impact the production potential of a local population. One cow and her offspring can potentially produce 724 calves over 18 years! The potential worth of a cow moose is detailed in the following link: http://www.growmoremoose.org/moosemodel.asp.

President Bush signed Executive Order 13443: Facilitation of Hunting Heritage and Wildlife Conservation on August 16, 2007. This order calls on the Department of Interior to "Establish short and long term goals, in cooperation with State and tribal governments, and consistent with agency missions, to foster healthy and productive populations of game species and appropriate opportunities for the public to hunt those species." The direct loss of moose, especially cows, through vehicle collisions may impact the local moose population and subsequent opportunity for hunting.

Improving the quality of WVC data collected is more difficult due to integrating information from three departments in state government. After working with all three departments in summarizing data for this project it is clear that there is duplication in some records while others are missing from one or more department's databases. The Alaska State Troopers are the crash reporting agency by law; however, they are not able to respond to every WVC, especially if no human injuries are involved. In cases where a charity is called to the scene if a moose is killed it is the responsibility of the charity to complete a form that is sent to ADOT&PF. Data used for agency decision making should be as accurate as possible. Recording WVC using GPS coordinates would greatly increase accuracy over locating WVC by MP markers.

The integration of overpasses and underpasses with fencing was cost effective in mitigating the "twinning" (from 2 lane to divided 4 lane) of the Trans Canada Highway in Banff National Park. Road mortality rates were lowered and conditions were improved for safe wildlife road-crossing after construction (Clevenger et al. 2002). One feature that may discourage some use by wildlife of overpasses in Banff is the arch design. Wildlife cannot see to the other side. It is recommended that future overpasses have an unobstructed cross-highway view to habitat on the other side. Overpasses in Banff are providing landscape connectivity and providing genetic interchange for the wildlife species for which they are intended. Banff has experienced a 96% reduction in road-kill of ungulates and an 80% reduction in all species through the mitigation of a variety of wildlife crossings and fencing (Clevenger et al. 2001).

Crossing structures are more likely to be used when placed in areas already known as travel corridors by wildlife (Foster and Humphrey, 1995; Bruinderink and Hazebroek, 1996; Land and Lotz, 1996; Ruediger, 2001). Several previous studies have reported that ungulates and most large mammals favor large open structures with high structural openness ratings (Reed et al.,1975; Foster and Humphrey, 1995; Land and Lotz, 1996; Ruediger, 2001). Openness ratios are determined by the (height x width)/length of a structure.

"Wildlife-vehicle collisions can be mitigated by a variety of measures," said Dr. Marcel P. Huijser, Ph.D., research ecologist, Western Transportation Institute at Montana State University, Bozeman. "These include fencing, combined with underpasses and vegetated overpasses for wildlife. These are the most proven methods for reducing animal-vehicle crashes, while allowing animals to move from one side of the road to the other." (Better Roads magazine, Randall-Reilly Publishing Co. LLC, November 2006)

The Western Governor's Association[4] in February 2007, unanimously approved policy resolution 07-01, ***Protecting Wildlife Migration Corridors and Crucial Wildlife Habitat in the West.*** Stakeholder working groups created by the Western Governor's Association have developed draft reports and recommendations on impacts to wildlife migration corridors and habitat from land use, transportation, energy and climate change. The governors of 19 western states (including Alaska) acknowledge the seriousness of the WVC problem and are looking at implementing wildlife mitigation on existing and new highways.

An added benefit of building crossing structures on refuge land is the lack of human development and a more natural habitat to facilitate wildlife use. Several studies (Clevenger

[4] Serving the Governors of 19 western states, including Alaska.

and Waltho 2004) have found that human use or development close to wildlife crossing structures will inhibit or negate their use by wildlife. The Kenai National Wildlife Refuge is trying to preserve a “wildlife travel corridor” along the north shore of Skilak Lake (see Skilak Wildlife Recreation Area Revised Final Management Plan p.51, also Appendix A, Map 8). This corridor may be extended to the refuge boundary upon completion of the Refuge’s updated Comprehensive Conservation Plan. This effort is to protect from human development a 3 mile wide corridor along the north/south refuge boundary line that crosses the Sterling Highway at MP76. This will allow for wildlife movements between the northern and southern sections of the refuge.

The Kenai Refuge investigated highway sound attenuation as a function of distance and habitat in July 2005 during high summer traffic volume (John Morton, umpubl.). Ten 500 m transects were run perpendicular to the Sterling Highway through 3 habitat types: open muskeg or wetland, coniferous forest, and forest with a deciduous component. Noise averaged 72 dBa immediately adjacent to the highway. Values as high as 120 dBa were recorded for short periods, loud enough to cause permanent hearing damage to humans. Most vehicle generated noise was reduced to background levels within 200 m of the highway. However, in open wetland habitats, vehicle noise was heard more than 0.5 km from the highway.

Lighting was not investigated or addressed due to earlier comments from ADOT&PF of the expense and maintenance required by lighting. Lights also have impacts on wildlife, especially birds, and may need added mitigation.

In the past, little brushing has been done along the Sterling Highway. If this is to be a serious option ADOT&PF will need to commit to brushing during the summer/fall and on a much more frequent basis than has been done in the past. Hydroaxing along the highway right-of-way or under adjacent powerlines sets vegetation to an early seral stage, producing good moose browse and another attraction towards the highway. This attraction can be reduced if mowing could be done more frequently and preferably in the fall. However, Rea (2003) recommends cutting brush early in the growing season.

As per habitat modifications, it is a congressionally mandated purpose of the refuge to “*conserve the fish and wildlife populations and habitats in their natural diversity*”. Even though the refuge has historically altered small acreages through crushing and burning, human caused wildfires and lightning strikes have far surpassed refuge management. While refuge management is focused on altering habitats in specific areas, wildfires and lightning can and do occur anywhere.

Static “Moose Xing” signs were in place along the Sterling Highway when the numbers of moose killed by vehicles was one of the highest in the state. Wildlife crossing signs (deer, moose, elk, and caribou) have “little or no impact on mortality rates, habitat connectivity, or human safety. Signs alone are not recommended as a mitigation measure for habitat fragmentation or wildlife mortality” (Ruediger and DiGiorgio 2007). Motorists habituate to static signs quickly, and become less alert over time.

ADOT&PF utilizes sand with a 6-8% salt content for sanding highways in winter (personal communications, Carl High). The use of salt may be an attraction for moose and caribou to the highway. Fraser and Thomas (1982) found the small amount of salt used to prevent the clumping of sand was sufficient to attract ungulates. Brown et al. (2000) found lithium chloride can deter caribou or other ungulates from licking road salt, thereby reducing animal-vehicle collisions.

Raised highway structures such as concrete median barriers or steel guardrails have the potential to block or limit movement of animals across roads. The steep gravel slopes topped by steel guardrails between MP 58 and 59 has the potential to block or limit animal movement and funnel animals to cross in nearby areas that are more level without guardrails. As road networks extend across the landscape and their densities increase, habitats fragment and become impoverished biologically (Forman et al. 2003).

CONCLUSIONS

Growing research across North America clearly demonstrates the importance of wildlife crossings for maintaining or enhancing the permeability of roads and decreasing the impact of roads to wildlife (Bissonette and Adair 2008, Clevenger and Waltho 2005, Forman and Alexander 1998). However, wildlife crossing structures should not be used to justify building new roads in unroaded habitat. Some alternatives in the Sterling Highway MP 45-60 project propose this. Relatively large, interconnected wildlife populations are more viable than small fragmented or isolated populations.

While it is simpler, and some may say prudent, to break down highway projects into smaller manageable "phases", this process cannot foresee the dangers from an ecological or broader landscape perspective. While the environmental impact of one "phase" of the Sterling Highway may be looked at as non-significant to the letter of the law (National Environmental Policy Act), the intent of the law may be circumvented. It is clear that the Sterling Highway from the junction with the Seward Highway at Tern Lake (MP 37) westward to Soldotna (MP 93) bisects the Kenai Peninsula. As human development expands along the Sterling Highway and outward from it habitat fragmentation and cumulative impacts become more severe and ecologically damaging.

This particular study has only addressed the section of the Sterling Highway between MP 58 and 79. It is important to consider the impacts to wildlife over the entire length of the Sterling Highway as a "human development" corridor. Human-induced fragmentation can happen quickly across large areas and can permanently affect biodiversity (Hilty et al. 2006). Wildlife has always had to deal with discontinuous habitats, what is new is the accelerating rate of habitat fragmentation that has been occurring in response to human population growth. In addition, fire suppression, which artificially decreases the quantity and quality of adjacent habitat, adds to the habitat fragmentation. The Kenai Peninsula is one of the fastest growing areas in the state. Only by integrating project-level decisions with system-wide studies along with active moose mitigation implementation can transportation agencies address the larger connectivity needs of wildlife species.

Alaska's Statewide Transportation Policy Plan (adopted November 29, 2002) lays out policy to:

> b. Minimize the impact of transportation projects on significant visual resources, **wildlife**, recreation and subsistence areas.
> c. Ensure **strict environmental assessment** and comprehensive review
> d. Provide funding to allow the appropriate state and federal agencies to participate in natural habitat and wetland **mitigation efforts**
> e. Favor transportation projects that … **reduce accidents**…minimize air and noise pollution.

The Kenai Peninsula Borough had the highest number of moose-vehicle collisions in 2005 of all Alaska boroughs (Alaska Strategic Highway Safety Plan, p.1-27). Collisions with moose account for 18.3% of all reported vehicle crashes in the Kenai Peninsula Borough. One of the strategies for reducing moose-vehicle collisions in the Alaska Strategic Highway Safety Plan is to provide safer wildlife crossings through highway improvements as well as managing adjacent habitat. This plan recommends the "Sterling Highway Skilak Lake Wildlife Refuge Area" as one of six highway segments in the top moose-vehicle collision corridors that more easily lends itself to highway crossing controls and restrictions because this is public land and therefore, have few access points.

The general function of a wildlife crossing structure is to get animals safely across a roadway, thereby providing for natural movements and reduced road-kills. When this is achieved, individual animals and their populations as a whole will benefit (Froman 2003). McDonald (1991) stated that during initial planning of the Glenn Highway project, fencing the entire project length and an overpass crossing were suggested, but because of the additional expense and lack of documented use these designs were not incorporated. However, work in Banff National Park in Canada found grizzly bears, wolves and all ungulates (deer, elk and moose) tend to prefer wildlife overpasses. Successful overpasses provide habitat connectivity not just to adjacent habitats but also for a much broader landscape scale.

ADOT&PF Research and Development office has approved a Glenn Highway application of the Electro-Mat to test the ability to limit moose from entering the existing fenced corridor between Muldoon and the Fort Richardson gate. Results of this testing may prove useful in the construction of the Sterling Highway corridor.

Bears and moose are specifically listed in the Kenai Refuge congressionally mandated purposes. The population of Kenai Peninsula brown bears is also mentioned in the State of Alaska Comprehensive Wildlife Conservation Strategy (2005). In November 1998, the ADF&G identified the Kenai Peninsula population of brown bears as a "Species of Special Concern." The department took this action because the population "is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance." Over the last 6 years ADF&G sealing records documented 22 brown bears struck and killed on Alaskan highways; 17 (77%) of these bears were from the Kenai Peninsula; 3 within our project area.

> "Historically, management of the brown bear population has focused primarily on annual harvest levels with little attention given to management of **habitat**. Wildlife managers are now concerned that the **cumulative effects** of increasing land-use activities may ultimately result in an irreversible decline in brown bear numbers on the Kenai Peninsula. Accordingly, brown bear conservation should be considered in comprehensive land-use planning as well as in development-specific planning. The stakeholders developed specific recommendations with respect to **habitat linkages**, residential development, recreation and tourism, resource extraction, roads and access, off-road vehicle

use, utilities, landfills, land management plans, and land acquisitions and exchanges." (Alaska's State Wildlife Action Plan)

The Kenai Peninsula Brown Bear Conservation Strategy (June 2000) recommends protecting important brown bear habitat and the significant habitat linkage area on public lands (Kenai National Wildlife Refuge) west of Skilak Lake. The long-term health of brown bears on the Kenai Peninsula depends upon maintaining quality bear habitat. The Kenai Peninsula is one of the fastest growing regions in the state. The infrastructure (gaslines, pipelines, powerlines and roads) to service the Kenai Peninsula will continue to fragment and further threaten the viability of brown bears.

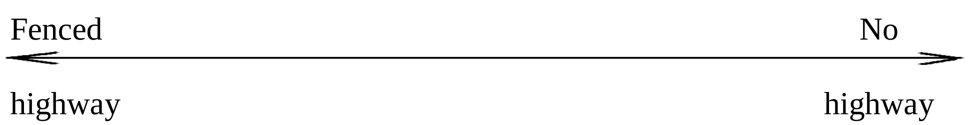
The cooperating agencies in this project –ADOT&PF, ADF&G, ADPS, Alaska Moose Federation, FHWA and the FWS – all seek to reduce WVC but the FWS is also mandated by congress to conserve fish and wildlife populations and habitats. Almost 60 years ago, FWS recognized the impact of habitat fragmentation and suggested "moose runways" to maintain habitat connectivity through former refuge land being developed for human settlement. The suggestion went unheeded. We can avoid expensive litigation from a future accident (Arizona Court of Appeals 2004); or expensive and regulated mitigation if for example, Kenai Peninsula brown bears, presently a "species of special concern", become threatened or endangered, by effectively and cooperatively addressing the WVC problem.

The average cost of a moose-vehicle collision at $28,100 (Huijser 2006) multiplied by the average number of collisions along the Sterling Highway between MP 58 and 79 (26.8 per year) equates to $753,080. In 10 years this equates to over $7.5 million. This figure increases if unreported accidents are considered. Over the life of the new reconstructed highway proper wildlife crossings can save the lives (both human and wildlife), and also save money. The Sterling Highway within the Kenai National Wildlife Refuge would provide an important test site for future Alaska highway projects for assessing the effectiveness of a wildlife overpass and a wildlife underpass, and wildlife mitigation strategies as a whole.

RECOMMENDATIONS

There are two views of the problem with WVC along the Sterling Highway. One is from the motorist who sees moose and other wildlife on the highway as a danger to property (vehicle) and human life; the other is from the animal's perspective: they need to cross the highway to get to habitat, food, a mate, or escape cover, and take the chance of getting hit by a vehicle before making it across the highway. The animal can and sometimes does make the choice not to cross the highway. Extreme solutions to the problem range from fencing the entire highway to keep animals off the highway (making the highway a physical and impenetrable barrier for wildlife, to removing the highway (replacing the existing highway with habitat, creating a much larger block of habitat and removing the barrier totally). On a scale of permeability, the highest would be to remove the existing highway; the lowest would be to completely fence the existing highway. Another possibility to achieve high permeability while keeping a highway would be an elevated highway.

Impermeable **Highly Permeable**



The Refuge's Skilak Wildlife Recreation Area Revised Final Management Plan (U.S. Fish and Wildlife Service 2007) calls for treatment (prescribed burning) of 50-100 acres/year to enhance wildlife viewing. These treatments will adjoin the 1980's enhanced habitat areas (south of the Sterling Highway). The refuge began in 2007 and hopes to complete in 2009 burning the Lily Lake crushed area (500 acres) to the north of the Sterling Highway (Map 2). Having early seral habitats both north and south of the highway between MP 73 to 75 will likely continue high moose crossings in this area. Creation of over 20,000 acres of early seral vegetation within recent burns (both wildfires and prescribed burns) should help increase moose numbers within the study area in the coming years. Both black and brown bears and wolf numbers would benefit from an increase in prey species.

To reduce WVC, species-specific information about crossing and mortality rates and species data on preferred and successful crossing structures is needed. We have collected this data for moose and to a lesser extent for caribou. We also have limited data from earlier telemetry work on brown bears. Construction of wildlife crossing structures on refuge lands has a great advantage over other land ownership. Vulnerability or the likelihood of future land development is minimized. Refuge lands are set aside for wildlife conservation and human development of these lands is restricted much more so than outside the refuge boundary. Therefore wildlife crossing structures will likely be effective over the long-term, adding to their cost-benefit. Research shows that many species of wildlife are sensitive to the presence of humans and may not use an area heavily used by humans (Taylor and Knight 2003).

Therefore managers should also plan development of campgrounds, picnic sites, trails, parking areas, restroom facilities, or other human activities away from wildlife crossings.

Care must be taken to ensure that crossing opportunities are placed closely enough to each other so that fencing does not simply make the highway a more effective barrier to movement and population connectivity (Servheen and Shoemaker 2004). Graves et al. (2006) recommend a conservative approach would be to place crossing structures at 1-km intervals for Kenai Peninsula brown bears. Florida built 36 wildlife underpasses along a 40-mile section of I-75 (Alligator Alley) for Florida panthers (Foster and Humphrey 1995); Banff National Park has constructing a total of 24 wildlife crossings structures along 28 miles of the Trans Canada Highway (Clevenger 2006); Arizona constructed 17 wildlife crossings along 17 miles of SR 260 (Dodd et al. 2007). Montana will have 40 wildlife crossings within a 56-mile section of U.S. 93. The state of Washington is planning 29 wildlife crossings on a 15.2 mile stretch of I-90 called Snoqualmie Pass East Project. These states, among others, are leading the way for responsible environmental design and stewardship. Maximizing wildlife crossings provides greater connectivity, greater gene flow, and greater robustness to catastrophes such as wildfires.

Complete permeability will not be achieved, and may not be reasonable given limited funds. However, even limited movement across a highway may not prevent population isolation and decline (Bissonette and Adair 2008). This is why subsequent post-construction monitoring is essential to document the effectiveness of wildlife crossing structures. If the mitigation proves to be ineffective, additional crossings may be desirable, not only for the Sterling Highway MP 58-79 but for the MP 45-60 project as well.

It is virtually impossible to exclude all wildlife from fenced highways; therefore, it is imperative that any fenced areas include means of egress for wildlife that inadvertently enter the highway corridor. Recent research has shown one-way gates to be less effective and more costly due to maintenance than earthen escape ramps (Hammer, M. L. M.S. thesis, Utah State University, 2002). Lack of maintenance on one-way gates can lead to wildlife mortality. The FWS, in cooperation with ADF&G, will be experimenting with moose at the Moose Research Center to determine an optimum height for earthen escape ramp for moose.

Initially information on any mitigation will need to be conveyed to the public, especially the motoring public. It is suggested that news media be invited to publicize the mitigation and what motorists can do to help in WVC avoidance. Another option for public awareness is to build rest stop signs and kiosks to provide information to the motoring public on the local area wildlife, movement patterns, wildlife crossings and driving tips.

Wildlife overpasses are being used by wildlife in Florida, Hawaii, New Jersey and Utah. Montana (U.S. 93), Colorado (I-70), and Connecticut (SR 6) are currently planning wildlife overpasses. Where there is suitable habitat at and leading to the overpass, it was found that overpasses were effective for a wide variety of animals. Structures at least 60 meters (197 ft) wide were more effective than overpasses narrower than 50 meters (164 ft) wide, especially for larger mammals (NCRHP Synthesis 305). Overpasses in Banff are preferred by both grizzly bears and moose.

Crossing structures may ultimately benefit wildlife by restoring some fraction of habitat connectivity that was lost when the highway was built, but they are still part of our transportation infrastructure. WVC are a serious safety hazard on many highways because they are built through wildlife habitat. As such, any measure to reduce the risk of accidents is a legitimate transportation expense (White 2007). Cost effectiveness always has to be considered by transportation agencies.

Issues not addressed in this report, but that deserve attention include: air quality, noise levels, pollutants in runoff, hydrologic flow, contaminated sediments along and under the highway, wetland fill, scenic view protection, invasive plants, and fire suppression to protect human developments along the Sterling Highway. Some of these issues are discussed in the Sterling Highway MP 58-79 environmental document. Construction related impacts require coordination with the Kenai Refuge for gravel, protection of salmon streams, etc. Close coordination with FWS needs to occur as this reconstruction project progresses.

Clevenger and Waltho (2004) recommended that long-term monitoring schemes designed to evaluate crossing structure efficacy cover a period of at least 4 years and longer if possible. The adaptation period in a protected area, Banff National Park, was approximately 4 to 6 years. We expect a similar result for the Kenai Refuge. The original study proposal (December 2003) called for a two year post-construction effort. However, after reviewing the current literature, that 2-year time frame will not provide an accurate estimate of the success of any mitigation. This is a critical feature of the entire study – to document the use of and success of crossings for wildlife. We need to know which species prefer one structure over another as well as what design features are preferred. Knowledge gained from this project would be instrumental in future transportation projects across the state, in particular the next phase of the Sterling Highway project between MP45 and 58.

Specific Recommendations (Map 8, Appendix A):

1. Fence the highway between MP 69.2 and 75.2. This section of highway includes 45% of WVC, 68% of the Wildlife Hotline sightings, and 81% of the GPS moose and caribou crossings. Allow for human crossings through the fence via stairs, gates, etc. Also include earthen escape ramps for wildlife that inadvertently enter the fenced corridor. Do not install one-way gates.
2. Within the fenced section (approximately 6 miles) include 4 wildlife crossings. This provides for greater permeability of the fenced section of highway, even though it is less than one crossing structure per mile. The proposed passing lanes should be built within the fenced section of highway. This will allow higher traffic speeds with increased safety from WVC.
   - A wildlife overpass near MP 73. The overpass will provide benefit for a wide array of wildlife. Most recent literature suggests wildlife overpasses accommodate a greater number of species than a wildlife underpass. A comparison between the use of the wildlife overpass and the underpass will then be possible in the second phase of the study.

- A single or better yet, a multi-span bridge over the East Fork of the Moose River at MP 71.4. The multi-span, preferred over a single span, will alleviate wetland impacts of a single span while creating a much greater openness ratio for a greater number of species. It may even create a net increase in wetlands. Include soundproof barriers on sides of roadway on the bridge.
- Provide for wildlife "crosswalks" near the east and west ends of the fencing. This may be standard wildlife fence with cattle-guards across the highway or the use of Electro-braid^{TM} fencing and electric mats across the road. Properly managed, electric fences are an effective method to reduce moose-vehicle collisions (Leblond et al. 2007). Electric fencing has the advantages of being less expensive and less obvious in terms of visual impact than conventional metal wired fences. This is important for the area is a "State Scenic Byway".

3. There are several areas where large amounts of gravel fill have been deposited in wetlands when the highway was first built. Steel guardrails are also present. Put large culverts (suitable for moose/bears) in at MP 58.2, 58.5, 61.9, and 64.6. This provides crossings for wildlife while restoring hydrologic flow. These are also in areas likely to be used by black and brown bears which comprise the bulk of the road-kill in this area. This may also provide a net increase in wetlands.

MP 58.5 failed culvert where hydrologic flow is an issue.

4. Extend the post-construction phase of this study for a minimum of 4 years, not the original study plan for only 2 years. It is clear from recent research that it takes wildlife time to adjust and learn to use the structures. And this post-construction phase of the study will provide critically important findings for future transportation projects in Alaska and elsewhere.
5. Any culvert or underside of bridge should include texturing (popcorn) to reduce sound and echoing. Rhino-lining culverts and use of natural stone or brick (uneven surfaces) for retaining walls will help reduce noise levels to enhance wildlife use. Noise abatement through the use of "quiet pavement" may help and should be considered for use within a half mile zone of crossing structures to further encourage their use by wildlife. This type of pavement may need to be evaluated as "experimental" and funded as such.
6. Contour shoulders for easier clearing of brush and less erosion.

7. Provide information to the public, via kiosks along the highway, websites, public meetings, newspaper/TV/Radio stories etc., to explain the purpose of the project and the ongoing study. Hopefully this project will show the public a much improved transportation project.
8. Limit human use in the vicinity (1 mile) of crossing structures. No parking areas, pullouts, trailheads, rest stops, picnic sites, campgrounds, bike paths.

SAFETEA-LU, the national highway legislation, through Transportation Enhancement provides funding for environmental mitigation to reduce vehicle-caused wildlife mortality while maintaining habitat connectivity (wildlife crossings). But it is up to the state to use the funding mechanisms in the bill. Federal Lands Highway Program is a possible funding source since the Sterling Highway crosses federal public land (refuge). Monies from this source qualify as the 20% “non-federal” match for mitigation. Alaska’s congressional delegation could fund Sterling Highway mitigation via line item when the highway bill is reauthorized by Congress in 2009. It is likely that the WVC will rise given an increased moose population, increased traffic volume and speeds if nothing is done to protect both motorists and wildlife along the Sterling Highway. Del Frate and Spraker (1991) state that moose road-kills nearly doubled when motorists increased speed following ADOT&PF’s “dry road” policy in 1983. The time to mitigate highways is during any upgrades. Reference the Glenn Highway corridor - a $1,000,000 investment in 1986 dollars for fencing and an expanded bridge at Ship Creek to allow moose to migrate beneath it has resulted in a $13,000,000 vehicle collision savings alone. Over 800 moose saved and an unknown number of human lives.

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Training/Conferences attended by Rick Ernst:

1. International Conference on Ecology and Transportation (ICOET) 2003, Lake Placid, NY Aug 2003
2. Rockies Wildlife Crossing Field Course, Southern Rockies Ecosystem Project, Payson, AZ, April 11-13, 2005
3. ICOET 2005, San Diego, CA, Oct 2005
4. Innovative Approaches to Wildlife/Highway Interactions, National Conservation Training Center, Shepherdstown, WV, May31 – June 2, 2006
5. Mitigating Wildlife Impacts on wildlife and fisheries, Western Transportation Institute, Banff, Canada, October 12-13, 2006
6. I-70 Wildlife Crossing Workshop, Utah Dept. of Transportation, Richfield, UT, May 2-3, 2007
7. ICOET 2007, Little Rock, AR, May 2007 – presented paper and poster

APPENDICES

A. Maps

1. **Landcover types along the Sterling Highway project area.**
2. **Habitat enhanced through prescribed burns and wildfires.**
3. **Hot spots (sum of WVCs, Wildlife Hotline, and GPS Crossings)**
4. **GPS crossing vectors for moose and caribou (October 2005-October 2008).**
5. **GPS moose movements between October 2005 and July 2006.**
6. **GPS moose movements between October 2006 and July 2007.**
7. **GPS caribou movements between October 2006 and October 2008.**
8. **Recommended Wildlife Mitigation**

B. Tables

2. **Highway Crossings**
3. **Locations within the highway right-of-way**

C. Wildlife Hotline Brochure

D. Budget

STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group
Kenai Peninsula, Alaska

HABITATS
Source: Kenai Refuge 1996-2002

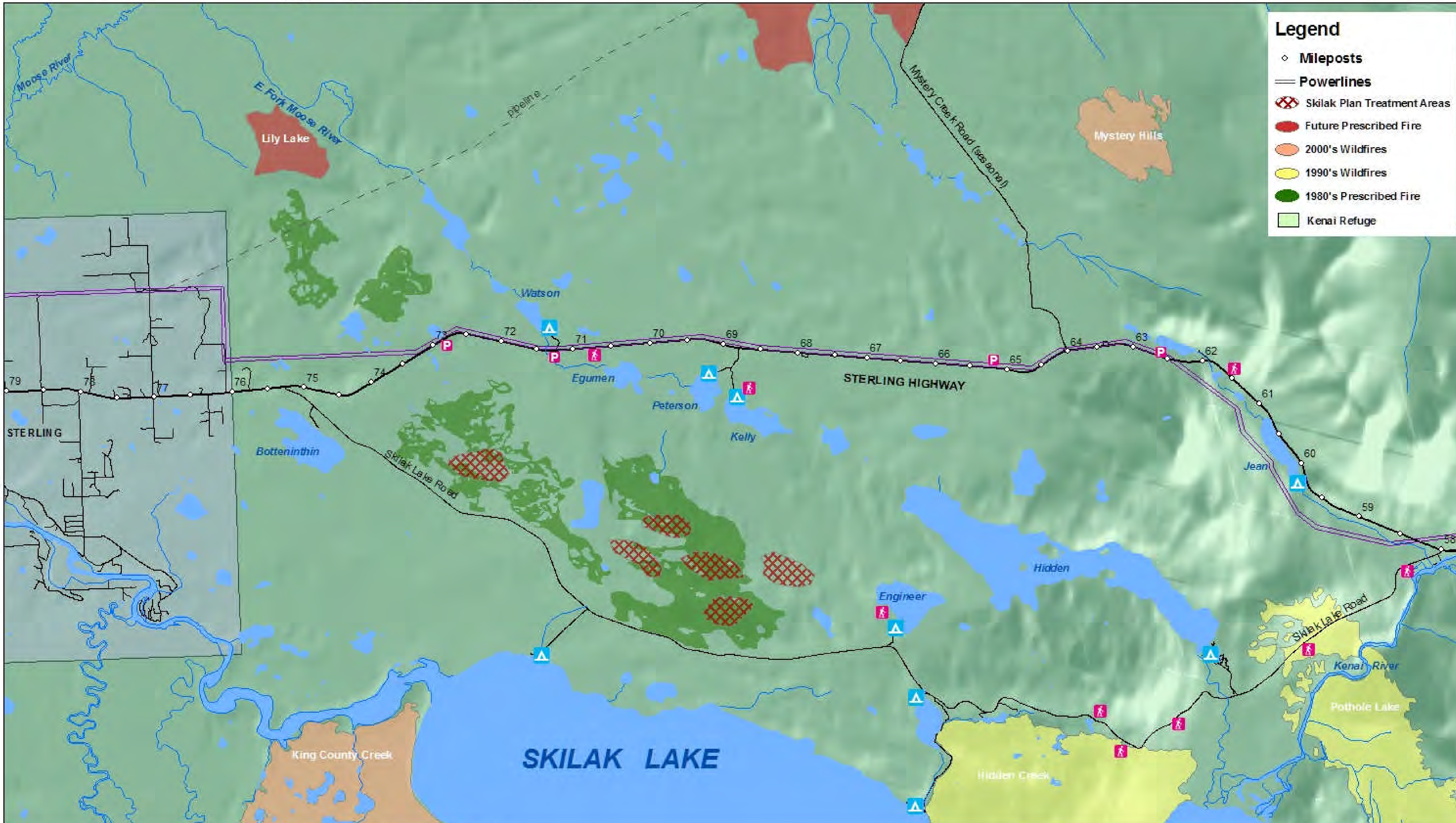
Map 1. Landcover types along the Sterling Highway project area.

STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group

Kenai Peninsula, Alaska

WILDFIRE AND PRESCRIBED BURN
Source: Kenai Refuge 1980-2008



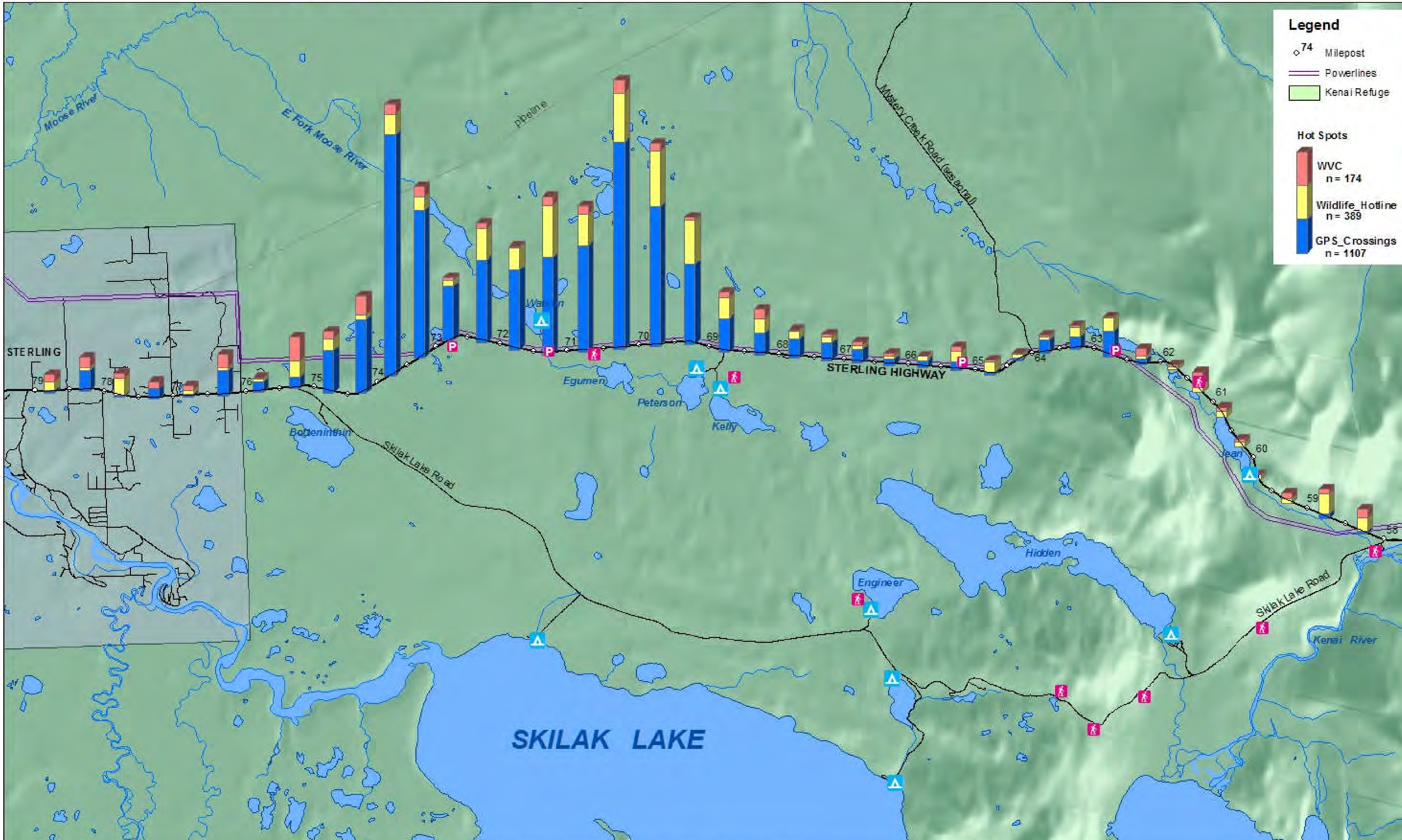
Map 2. Habitat enhanced through prescribed burns and wildfires.

Interagency Working Group

Kenai Peninsula, Alaska

SEGMENTS OF HIGHEST CONCERN

Total Wildlife Vehicle Collisions, Hotline Sightings, and GPS Crossings



MAP 3

Map 3. Hot spots (sum of WV Collisions, Wildlife Hotline, and GPS Crossings) along the Sterling Highway.

0 0.5 1 2 Miles

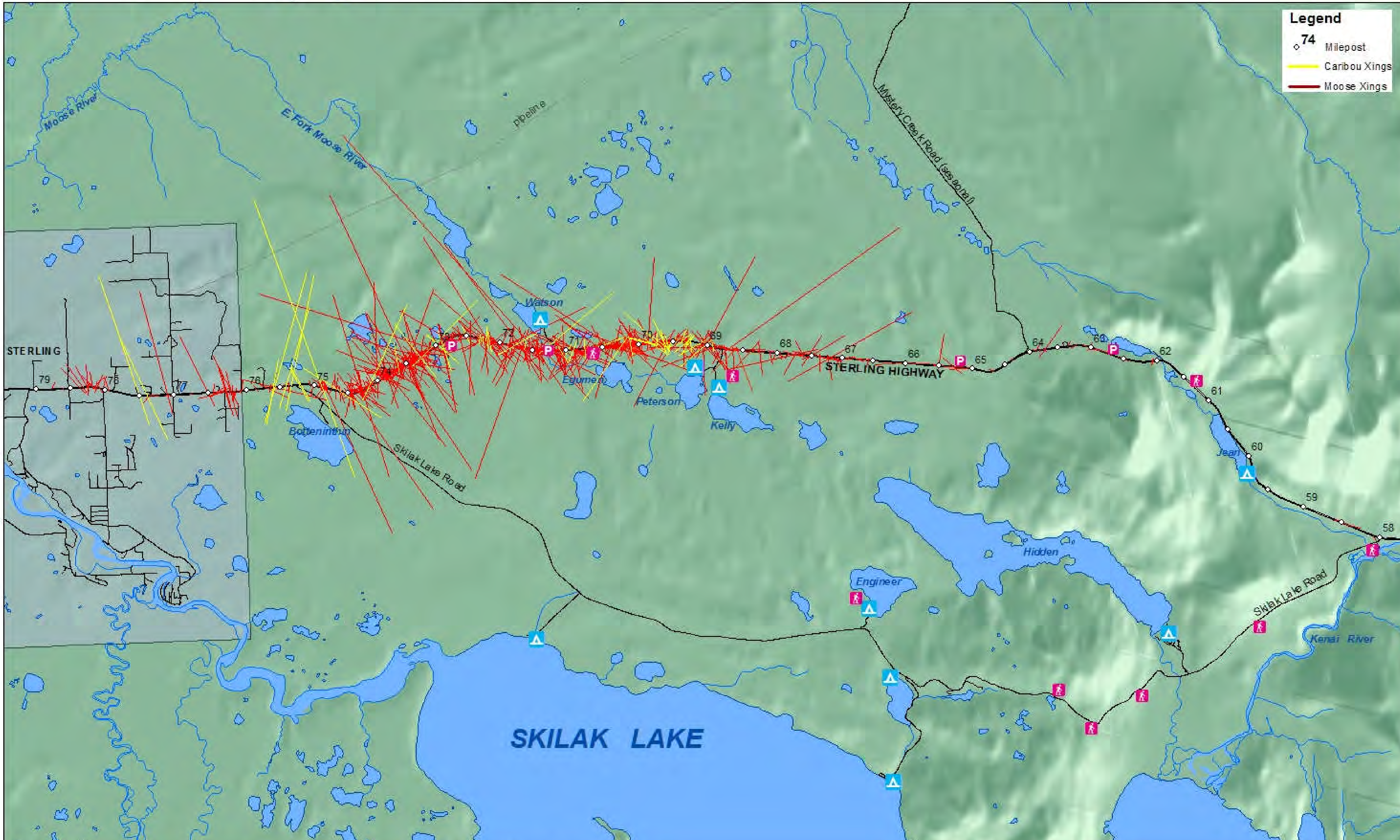
STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group

Kenai Peninsula, Alaska

GPS CROSSINGS

Vectors for 50 moose (n=1023) and 7 caribou (n=84)

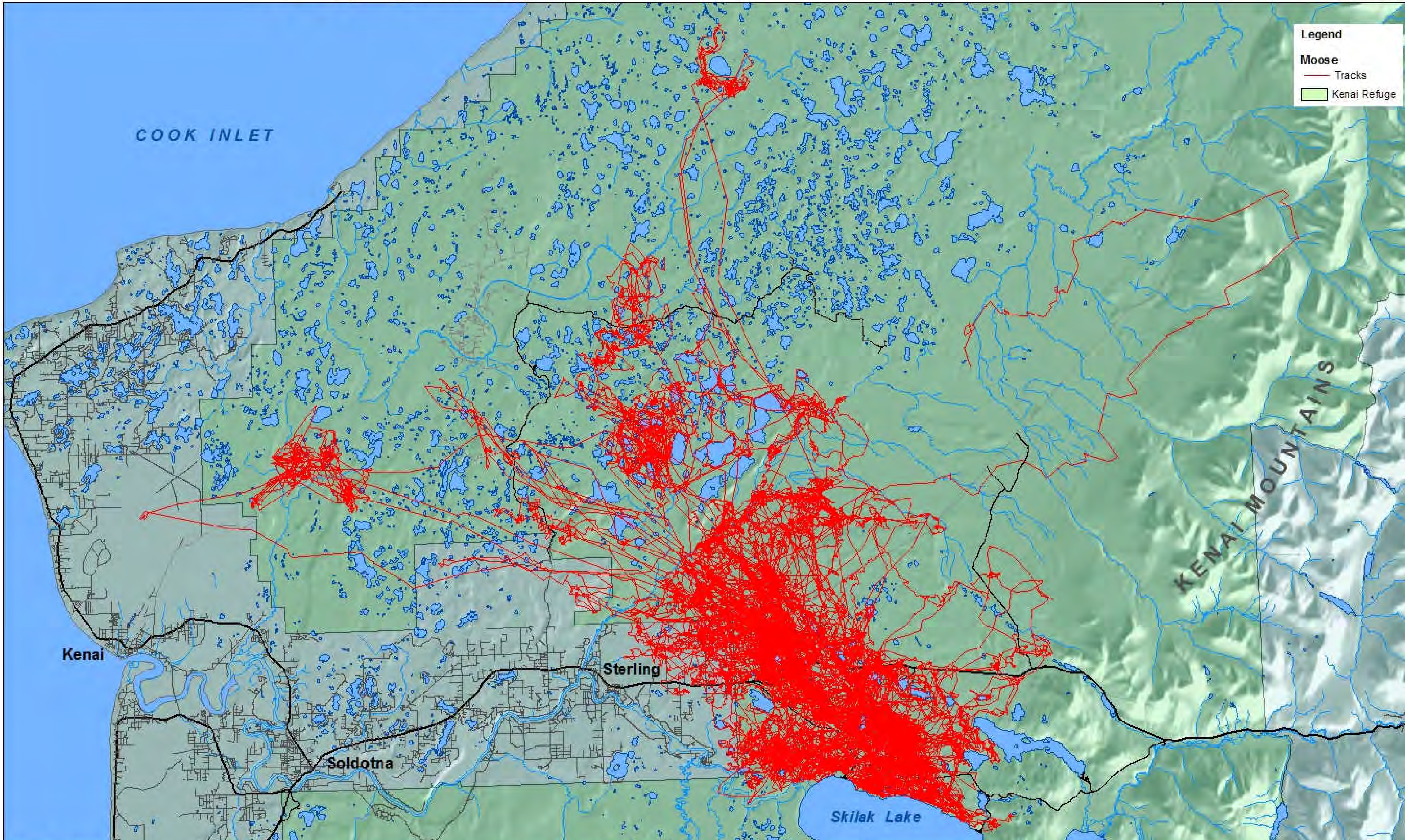


Map 4. GPS Crossing vectors for moose and caribou (October 2005-October 2008).

STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group
Kenai Peninsula, Alaska

GPS COLLAR MOVEMENTS YEAR 1
29 Moose (n=247,438 locations)

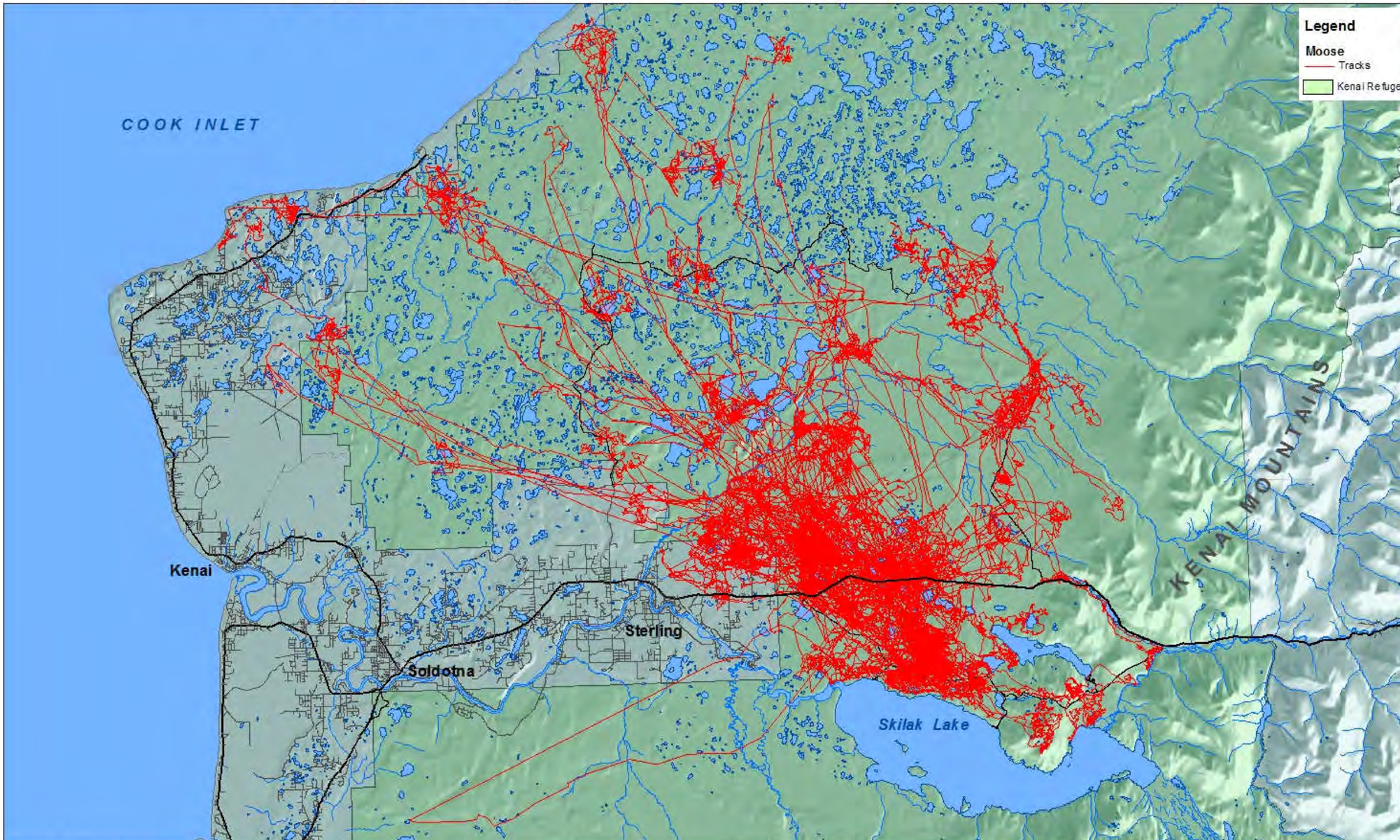


Map 5. GPS moose movements between October 2005 and July 2006.

STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group
Kenai Peninsula, Alaska

GPS COLLAR MOOSE MOVEMENTS YEAR 2
30 Moose (n=248,346 locations)



MAP 6

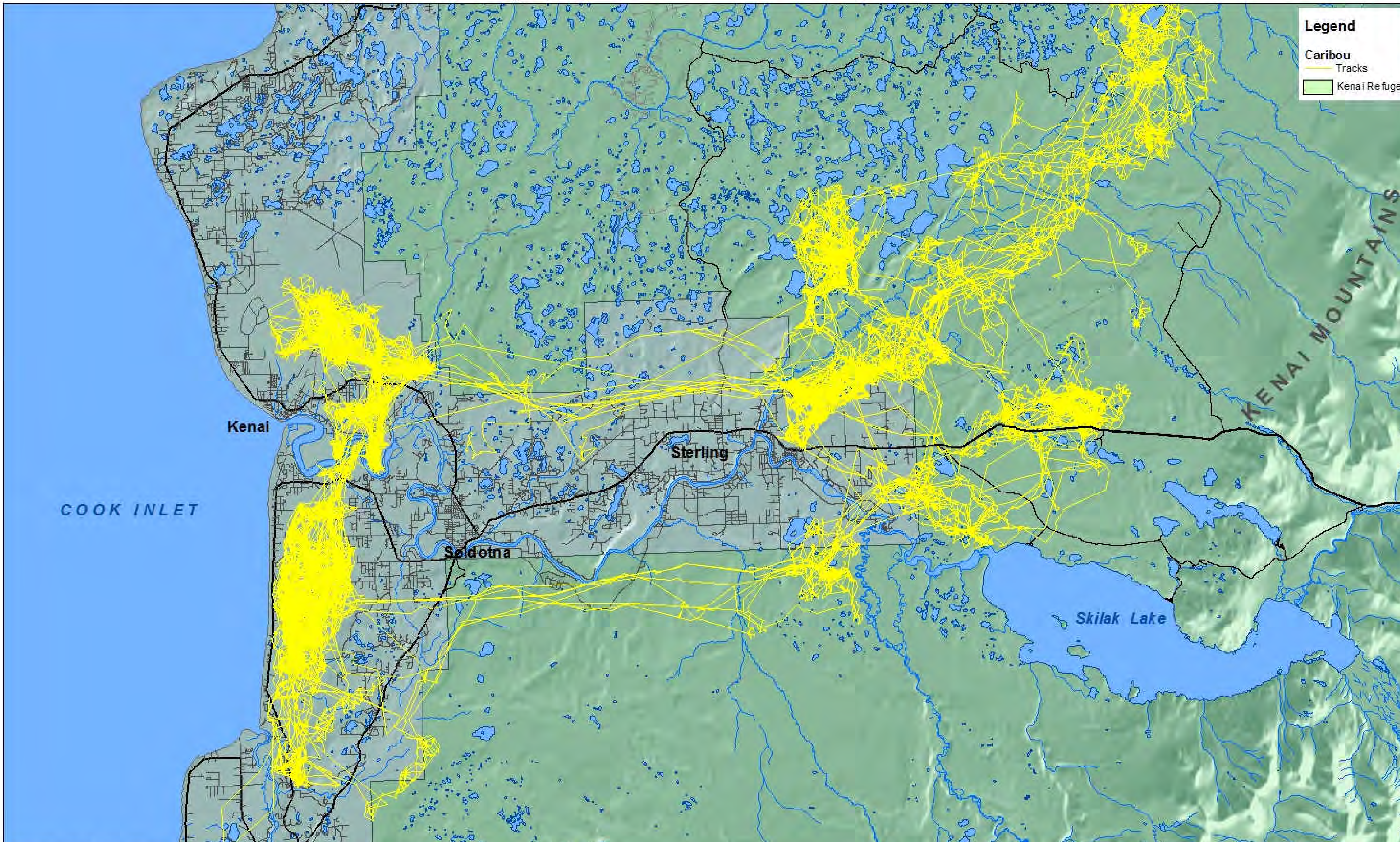
Map 6. GPS moose movements between October 2006 and July 2007.

0 1.5 3 6 Miles

STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group
Kenai Peninsula, Alaska

GPS COLLAR CARIBOU MOVEMENTS YEAR 2 & 3
9 Caribou (n= 62,455 locations)



Map 7. GPS Caribou movements between October 2006 and October 2008.

STERLING HIGHWAY MP58-79 PROJECT

Interagency Working Group

Kenai Peninsula, Alaska

RECOMMENDATIONS

Proposed locations for wildlife mitigation

Map 8. Recommended Wildlife Mitigation

Appendix B - Table 2. Highway Crossings by GPS collared moose and caribou.

Sterling Highway MP58-79 Project

Highway Crossings

Segments	Total Xings	1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	29	30	31
Resident->		✓						✓	✓	✓								✓	✓			✓			✓				✓	✓
		Moose Year 1 [2005/06]																												
78.5 - 79.0	2																							1						
78.0 - 78.5	14																													
77.5 - 78.0	1																													
77.0 - 77.5	7																				1									
76.5 - 77.0	2																				2									
76.0 - 76.5	17																				13									
75.5 - 76.0	7																				2		2							
75.0 - 75.5	8																													
74.5 - 75.0	29				3										3						3		2					1		
74.0 - 74.5	50				1	8				2	1	2									5						3	2		
73.5 - 74.0	163		19			27	1			5		2		7	2	1						1	1		4	7	32	2		
73.0 - 73.5	100		16	2			1			1				6	2						2	9	4		6	3	9	1		
72.5 - 73.0	37											7		1	5					3						2				
72.0 - 72.5	56			2			7					7			7					1			1		1					
71.5 - 72.0	54						1								13		4			5										
71.0 - 71.5	66						3				1	3			6				1	3					1					2
70.5 - 71.0	72	7	2				5			2																				2
70.0 - 70.5	140	11					25			7								13												
69.5 - 70.0	94	6					2											23												
69.0 - 69.5	54	3																1	1											
68.5 - 69.0	23	2																3												
68.0 - 68.5	15																	11												
67.5 - 68.0	13																	4	1											
67.0 - 67.5	12																	1	2											
66.5 - 67.0	9																													
66.0 - 66.5	4																													
65.5 - 66.0	5																		1											
65.0 - 65.5	6																		1											
64.5 - 65.0	2																													
64.0 - 64.5	2																													
63.5 - 64.0	9																		1											
63.0 - 63.5	8																													
62.5 - 63.0	17																													
62.0 - 62.5	4																													
61.5 - 62.0	0																													
61.0 - 61.5	0																													
60.5 - 61.0	0																													
60.0 - 60.5	0																													
59.5 - 60.0	0																													
59.0 - 59.5	0																													
58.5 - 59.0	3																													
58.0 - 58.5	2																													
TOTALS	1107	29	37	4	4	35	45	0	0	17	2	21	0	14	38	1	4	56	8	12	28	10	10	1	12	12	44	6	0	4

Segments	13	14	16	20	26	32	33	34	35	36	37	38	39	40	41	42	44	45	46	48	49	50	51	52	53	54	55	56	57	58
Resident->						✓	✓									✓	✓			✓	✓									
	Moose Year 2 [2006/07]																													
78.5 - 79.0														1																
78.0 - 78.5														14																
77.5 - 78.0														1																
77.0 - 77.5														4																
76.5 - 77.0																														
76.0 - 76.5														4																
75.5 - 76.0													1																	
75.0 - 75.5													1	3																
74.5 - 75.0										3			5	5				1					1							
74.0 - 74.5		1	2				5		4	6			3	1				3												
73.5 - 74.0		2	1		5	1	9			4			16	7						3		1					1			
73.0 - 73.5		5	1				8		4	3			1	1				1		10		1								
72.5 - 73.0				1					4	4			1							4										
72.0 - 72.5										1			9							3	1			1			1			
71.5 - 72.0				1		6				1			6	7						3	4									
71.0 - 71.5				3		4			2				12							12	4						5			
70.5 - 71.0						5			1	1	4	5	3	2			1		2	17	7									
70.0 - 70.5						14		2	1	3	20	1	7				1		11	20	2									
69.5 - 70.0						10					9		1						2	22						3				
69.0 - 69.5						12					2									16						2				
68.5 - 69.0						11					2									1						3				
68.0 - 68.5											1									1						2				
67.5 - 68.0						3																1			1	3				
67.0 - 67.5						5														3						1				
66.5 - 67.0						2														3						4				
66.0 - 66.5						1														3										
65.5 - 66.0						2														2										
65.0 - 65.5																				5										
64.5 - 65.0																				2										
64.0 - 64.5																				2										
63.5 - 64.0																				8										
63.0 - 63.5																				2								6		
62.5 - 63.0																				6								11		
62.0 - 62.5																				3								1		
61.5 - 62.0																														
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60.5 - 61.0																														
60.0 - 60.5																														
59.5 - 60.0																														
59.0 - 59.5																														
58.5 - 59.0																												3		
58.0 - 58.5																												2		
TOTALS	0	8	4	5	5	76	22	2	16	26	38	6	66	50	0	0	2	5	15	151	18	3	1	1	1	18	7	23	0	0

Segments	190	191	194	196	198	199	201	202	203	MP
	2006 Caribou 2007									
78.5 - 79.0										
78.0 - 78.5										78
77.5 - 78.0										
77.0 - 77.5					1		1			77
76.5 - 77.0										
76.0 - 76.5										76
75.5 - 76.0					1				1	
75.0 - 75.5					1		1	1	1	75
74.5 - 75.0				1	1					
74.0 - 74.5		1								74
73.5 - 74.0	1	1								
73.0 - 73.5	1	1						1		73
72.5 - 73.0		3			1			1		
72.0 - 72.5	8	6								72
71.5 - 72.0	1	1						1		
71.0 - 71.5	2	1						1		71
70.5 - 71.0	2	2		1				1		
70.0 - 70.5				1				1		70
69.5 - 70.0	3	4		1				8		
69.0 - 69.5	6	5		1				5		69
68.5 - 69.0								1		
68.0 - 68.5										68
67.5 - 68.0										
67.0 - 67.5										67
66.5 - 67.0										
66.0 - 66.5										66
65.5 - 66.0										
65.0 - 65.5										65
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60.5 - 61.0										
60.0 - 60.5										60
59.5 - 60.0										
59.0 - 59.5										59
58.5 - 59.0										
58.0 - 58.5										58
TOTALS	24	25	0	5	5	0	2	21	2	

Sterling Highway MP58-79 Project

Locations within the 300' ROW

		Moose Year 1 [2005/06]																													Moose Year 2 [2006/07]																														[2006/07]				Caribou [2007/08]				
Segments	Totals	1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	29	30	31	13	14	16	20	26	32	33	34	35	36	37	38	39	40	41	42	44	45	46	48	49	50	51	52	53	54	55	56	57	58	190	191	194	196	198	199	201	202	203
78.5-79.0	6																																											6																										
78.0-78.5	25																																											25																										
77.5-78.0	11																				10																							1																										
77.0-77.5	16																				1																							15																										
76.5-77.0	11																				11																																																	
76.0-76.5	29																				22																							7																										
75.5-76.0	9																				9																																																	
75.0-75.5	5																				1																						2	1									1																	
74.5-75.0	21				1										1						4							1												6			6	2																										
74.0-74.5	77					41						4			1						1						7	4							2		2			2			11	2																										
73.5-74.0	405		27			96	2			12		4		7	5					12		3			1	33	70	14							9	1	22			3			47	30						7																			
73.0-73.5	195		22				3			4				9	5							11	1		5	22	17	2				17			2		6		4	2			13	8						42																			
72.5-73.0	109		2									31			10					2					1	7								2					1	2			3							43		1					4												
72.0-72.5	178		6				34					11			55										1									24									2	3						26	1						7				6	2							
71.5-72.0	145		5				1					2			51		2			11														5		7							9	25						20	1	2					3				1								
71.0-71.5	121						4					10			12					2														4		6			1				14	15						40	4						6				2	1							
70.5-71.0	222	7	1				15			1																										4					9	24	7	13					8	129	3	1																	
70.0-70.5	600	20					141			13								17																		35		2			68	31	29						64	180																			
69.5-70.0	457	5					20											99																		70		1			83	6	9						20	120						24												3	
69.0-69.5	138	3																20																		13		1			3									82						13					2	1							
68.5-69.0	45	1																21																		17														2						4													
68.0-68.5	66																	40																		10														11		2				3													
67.5-68.0	29																	17																		5																6				1													
67.0-67.5	46																		1																	23														6						16													
66.5-67.0	19																																			4														11						4													
66.0-66.5	25																																			5														20																			
65.5-66.0	33																																			11														22																			
65.0-65.5	12																																																	12																			
64.5-65.0	6																		1																															5																			
64.0-64.5	37																																																	37																			
63.5-64.0	60																																																	60																			
63.0-63.5	111																																																	36								75											
62.5-63.0	194																																																	73								121											
62.0-62.5	23																																																	5								18											
61.5-62.0	3																																																	3																			
61.0-61.5	0																																																																				
60.5-61.0	3																																																									3											
60.0-60.5	0																																																																					
59.5-60.0	0																																																																					
59.0-59.5	0																																																																					
58.5-59.0	22																																																									22											
58.0-58.5	5																																																									5											
TOTALS:	3519	36	63	0	1	137	220	0	0	30	0	62	0	16	140	0	2	214	2	27	59	14	1	0	8	62	94	21	0	0	0	17	0	35	13	211	30	4	6	15	163	61	152	153	0	0	0	0	92	992	9	12	1	0	0	65	20	244	0	0	11	4	0	0	0	0	0	3	0

Overview

Wildlife-vehicle collisions along the Sterling Highway within the Kenai National Wildlife Refuge are among the highest in rural Alaska. The Alaska Departments of Transportation, Fish & Game, and Public Safety; the Federal Highway Administration; Alaska Moose Federation; and the U.S. Fish & Wildlife Service are trying to solve this problem.

There are new milepost markers along the north side of the highway. Markers are in half-mile increments (white numbers on green background) to make it easier to report wildlife locations.

You Can Help

We are seeking your help in reporting wildlife along the Sterling Highway from milepost 58 (east entrance to Skilak Lake Road) to milepost 79 (where the 2-lane turns into a divided 4-lane near Sterling).

This information will help in the design and reconstruction of the highway to include methods to reduce wildlife-vehicle collisions. Our goal is to make the highway safer for motorists and wildlife. As you drive through the Kenai National Wildlife Refuge, please obey the speed limit (55 mph) and stay alert for wildlife.

If you do hit an animal, call the Alaska State Troopers at 907-262-4453.

Report Wildlife Sightings

Call (907) 262-2300

Please call the Hotline to report wildlife sightings on or near the road.

Please include the following information:

What animal:
moose, black bear, wolf
How many:
cow & calf, sow & 2 cubs
Location:
between MP 68.5 and 69
Date & Time:
June 5 at 7:30 am

Thank you for your help!

Alaska Dept of Fish & Game
Alaska Dept of Public Safety
Alaska Dept of Transportation
Alaska Moose Federation
Federal Highway Administration
U.S. Fish & Wildlife Service

Sterling Highway
Wildlife-Vehicle Collision Study

Photo © 2005 M. Scott Moon/Peninsula Clarion

With your help, we can make highways safer for people and wildlife

Sterling Highway MP 58-79
Wildlife-Vehicle Collision Study
Legend
Milepost Markers
Roads
Sterling Highway
Secondary Road
Campground
0
1.5
3
6 Miles
N
W
E
S
Kenai
National
Wildlife
Refuge
Sterling Highway
Mystery Creek Road
Skilak Lake Road
Watson Lake
Egumen Lake
Peterson
Kelly
Kelly Lake
Bottenintnin Lake
Engineer Lake
Hidden Lake
Jean Lake
Jean Lake
Visitor Contact Station
Lower Skilak
Upper Skilak
Hidden Lake
SKILAK LAKE
76
75
74
72.5
71.5
70
68
67
65.5
64.5
63
61.5
60
58.5

Appendix D. Budget

Wildlife Mitigation and Human Safety for Sterling Highway MP58-79 Project			
Pre-Construction Phase I Budget - 2005-2007			
Telemetry Equipment	Price per Unit	Units	**Costs**
GPS/SOB collars - with remote release	$2,600	35	$91,000.00
Antennas	$150	1	$154.00
Data Download: processing software, cables and adapter			$345.60
Telonics CR2 collar release programming software, cables			$144.05
Subtotal			**$91,643.65**
Capture Operations			
Darts and supplies			$1,087.00
Immobilizing drugs and reversals	$200	70	$13,620.00
Ear tags	$100	1	$0.00
Subtotal			**$14,707.00**
Sampling Equipment			
Red Top Vacutainers	$235	1	$120.00
Subtotal			**$120.00**
Air Support			
Supercub (captures, telemetry, retrieval of dropped collars)	150/hr	100	$14,628.00
Helicopter (captures, retrieve dropped collars and redeploy)	750/hr	40	$21,348.00
Subtotal			**$35,976.00**
Computer/Camera Equipment			
laptop computer			$1,485.00
ARC/GIS and Statistics software (provided by FWS)			$0.00
Aerial Photos, Maps (provided by FWS			0.00
Subtotal			**$1,485.00**
Miscellaneous			
Travel for meetings, aviation fuel and oil, repairs for telemetry equipment, batteries, etc.			$1,500.00
FWS administrative overhead (FWS contracting office)	18%		$32,800.00
Attend Wildlife/Highway Interaction Workshop-Banff,AB			$2,078.00
Attend Transportation Impacts on Wildlife Class - NCTC			$1,131.73

books on Wildlife Corridors/proceedings of ICOET			$61.00
Subtotal			**$34,300.00**
Highway Milepost signs/equipment			
Signs from Warning Lights of Alaska			$4,966.76
phone software/modem			$125.29
Infomax AM radio transmitter			$1,048.00
printing up 5,000 brochures for wildlife hotline			$1,380.00
Vehicle use (fuel)			$78.00
Tune radio to 1170AM signs			$749.00
Subtotal			**$5,092.05**
Refurbishment			
Refurbish collars (new batteries,new straps, reprogram)	$1,560	32	$49,920.00
Shipping	$150		$150.00
FWS administrative overhead	18%		$14,683.00
Subtotal			**$64,753.00**
Pre-Construction Total (2 years)			**$248,076.70**