8. WILDLIFE RESOURCES

8.1. Introduction

The Project area, including the Upper and Middle Susitna River subbasins, contains a diversity of wildlife and wildlife habitats that support game and non-game populations managed by the State of Alaska, primarily within Game Management Units (GMUs) 13A, 13B, 13E, 14A, 14B, 16A, and 16B. The purpose of the wildlife studies developed for the Susitna-Watana Hydroelectric Project are:

- To provide current wildlife baseline data for the Project area; and
- To provide current wildlife habitat availability and use data for habitat evaluation.

Information developed from the proposed studies will provide the basis for assessments of potential Project-related impacts; development of avoidance and protection measures; development of protection, mitigation, and enhancement measures; and development of resource management and monitoring plans.

Proposed studies are focused on wildlife and their habitats within the Project area that are important for human use, that are protected by federal and state laws, and that are potentially sensitive to Project-related activities and habitat changes.

8.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

Project construction, existence, and operation would result in five general classes of impacts on terrestrial wildlife:

- Permanent habitat loss;
- Temporary habitat loss and alteration;
- Barriers and hazards to animal movements;
- Disturbance; and
- Changes in recreational and hunting patterns (AEA 2011).

The potential Project-related impacts for wildlife are further described in the PAD (AEA 2011).

Mechanisms for Project-related impacts may include:

- Direct and indirect loss and alteration of wildlife habitats from Project construction and operation;
- Potential physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities and related indirect effects, including habitat connectivity and genetic isolation;
- Potential direct mortality due to Project-related fluctuating water and ice conditions in the reservoir and downstream river reaches;

- Potential direct, indirect, and cumulative impacts on predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development;
- Potential direct behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development;
- Potential direct mortality due to vehicle strikes, exposure to contaminants, attraction to garbage and human activity, and protection of life and property; and
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development.

8.3. Resource Management Goals and Objectives

ADF&G is responsible for the game animal management, protection, maintenance, and improvement of Alaska's fish and game resources in the interest of the economy and general well-being of the state (AS 16.05.020). The mission of ADF&G is "to protect, maintain, and improve the fish, game, and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the sustained yield principle." The guiding principles of ADF&G include providing "the greatest long-term opportunities for people to use and enjoy Alaska's fish, wildlife, and habitat resources," and maintaining "the highest standards of scientific integrity and providing the most accurate and current information possible" (ADF&G website: www.ADF&G.alaska.gov). Federal projects with potential impacts to wildlife are also subject to review under the Fish and Wildlife Coordination Act (16 U.S.C. § 661a *et seq*.) and where applicable to the Endangered Species Act (16 U.S.C. §1531).

ADF&G monitors populations and manages subsistence and sport hunting and trapping for game mammals (5 AAC 85.045 – moose; 5 AAC 85.025 – caribou; 5 AAC 85.055 – Dall's sheep; 5 AAC 85.015 and 85.020 – bears; 5 AAC 85.025 – wolf and wolverine; 5 AAC 85.065 – small game; 5 AAC 85.060 – fur animals;)) through regulations set by the Board of Game (AS 16.05.255). The Federal Subsistence Board, which comprises representatives from the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, and U.S. Forest Service, oversees the Federal Subsistence Management Program (57 FR 22940; 36 CFR Parts 242.1–28; 50 CFR Parts 100.1–28) with responsibility for managing subsistence resources on Federal public lands for rural residents of Alaska.

Most of Game Management Unit (GMU) 13 (except Subunit 13D, south of the Glenn Highway), including the upper Susitna River basin, currently is managed by ADF&G under a predator control program instituted in response to the state's intensive management law, passed in 1994. Bears in GMU 13 are of interest both as predators of caribou (*Rangifer tarandus*) and moose (*Alces americanus*) and as important game species. GMU 13 is an intensive management area where predator control measures are implemented to increase caribou and moose populations. In GMU 13, predator control measures have included land-and-shoot harvest of wolves (*Canis lupus*) and liberalized regulations for the harvest of wolves and bears.

Eagles, raptors, and all migratory birds are protected by Federal laws and agreements, including the Bald and Golden Eagle Protection Act (BGEPA: 16 U.S.C. § 668) and the Migratory Bird Treaty Act (MBTA: 16 U.S.C. § 703), and a recent memorandum of understanding (MOU) concerning the implementation of Executive Order 13186 with regard to protection of migratory birds (FERC and USFWS 2011). That agreement was created to establish a voluntary framework to ensure that both agencies cooperate to conserve birds and their habitats by identifying and mitigating potential adverse effects resulting from the development of energy infrastructure. The MOU defines bird "species of concern" as those species—including several raptors—that are listed as sensitive or of conservation concern by various management agencies, agency working groups, and non-governmental conservation organizations (FERC and USFWS 2011; also see ABR, Inc. 2011 and AEA 2011).

The MBTA is enforced by the U.S. Fish and Wildlife Service (USFWS) and, in practice in Alaska, is used primarily to monitor and regulate waterfowl harvest; ensure that land-clearing activities occur outside of the bird nesting season to prevent destruction of bird nests; and to encourage development of appropriate avoidance and mitigation measures for federally regulated development projects and activities.

8.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Agencies, Alaskan Native entities, and other licensing participants were involved in developing wildlife study plans. During four terrestrial resources workgroup meetings, agencies and other entities gave input on needed wildlife studies and study methods. A meeting with U.S. Fish and Wildlife Service (USFWS) helped design the eagle and raptor survey. Comments regarding wildlife studies were received in letters from Alaska Department of Natural Resources (ADNR) Office of Project Management and Permitting (OPMP), Alaska Department of Fish and Game (ADF&G), Alaska Department of Environmental Conservation (ADEC), and the USFWS. A white paper from ADF&G and follow up emails detailed wildlife study needs. Table 8.4-1 summarizes wildlife study communications, and the meeting materials, letters, and other communications that are listed in Table 8.4-1 are presented in Attachment 8-1.

Table 8.4-1. Summary of consultation on Wildlife Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
White Paper	11/22/2011		ADF&G, Wildlife Conservation	Comments on Terrestrial Wildlife Research and Monitoring Needs
Email	12/20/2011	M. Burch	ADF&G	Comments on Terrestrial Wildlife Research and Monitoring Needs
Letter	01/12/2012	P. Bergman	USDOI	Comments regarding Bald and Golden eagles, migratory birds and consideration of BLM-Alaska Sensitive Animal and Plant Lists (Filed with FERC)
Terrestrial and Aquatic Resources Workgroup Meeting Notes	01/26/2012	Various	ADF&G, ADNR, BLM, FERC, NHI, NMFS, NPS, USFWS	Wildlife study plans (See Attachment 1-1.)
E-mail	02/02/2012	J. Klein	ADF&G	Recommend incorporating all fish and wildlife information into a user-friendly, GIS-related format
Letter	02/10/2012	A. Rappoport	USFWS	Comments on Eagle and Raptor Nest Study.
Cultural and Terrestrial Resources Workgroup Meeting Notes	02/28/2012	Various	ADF&G, ADHSS-HIA, ADNR, ADNR_OHA, BLM, EPA, FERC, NPS, USFWS	Wildlife study plans (See Attachment 1-1.)
Terrestrial Resources Workgroup Meeting Notes	04/02/2012	Various	ADF&G, BLM, NHI, NPS, USFWS	Wildlife study plans (See Attachment 1-1.)
Eagle/Raptor Technical Group Agency Meeting	04/11/2012	M. deZeeuw, J. Muir	USFWS	Eagle take permits under the Bald and Golden Eagle Protection Act (BGEPA) and 2012 study plan for surveys of eagles and other raptors
Study Requests, Letter	05/30/2012	T. Crafford, ADNR OPMP	ADNR, ADEC, ADF&G	Comments on wildlife study plans (Filed with FERC.)
Study Requests, Letter	05/31/2012	A. Rappoport	USFWS	Comments on wildlife study plans (Filed with FERC.)
Terrestrial Resources Workgroup Meeting Notes	06/06/2012	Various	ADF&G, Ahtna Native Corporation, BLM, ADNR OPMP, EPA, NHI, NPS, USFWS, Kenai Watershed Forum	Wildlife study plans (See Attachment 1-1.)
E-mail	06/12/2012	L. Verbrugge, PhD	USFWS	Study plan for wood frogs and chytrid fungus

8.5. Study of Distribution, Abundance, Productivity, and Survival of Moose

8.5.1. General Description of the Proposed Study

The moose study will be conducted by the ADF&G. The moose study was initiated in 2012 and will continue through 2013 and 2014. ADF&G will continue to survey and monitor radio-collared moose throughout the lifespan of the radiocollars that are deployed for the study (approximately 2016).

This study plan outlines the objectives and methods for characterizing moose movements, population, distribution, productivity, and habitat use in the study area through geospatial analysis. Aerial radiotelemetry surveys, via fixed-wing aircraft, will be used to monitor distribution, productivity, harvest potential, and habitat use of moose in the study area. In addition to radio collars, GPS/Argos satellite collars will be deployed to evaluate fine-scale spatial distribution and movements of cows and bulls. Winter surveys will be flown to assess potential loss of winter range in the inundation area. GeoSpatial Population Estimation (GSPE) techniques (Ver Hoef 2002, Kellie and DeLong 2006) and traditional count methods in portions of the study area will be used to generate population estimates. Browse surveys will be used to monitor habitat utilization of the inundation zone, transportation corridors, and areas downstream of the Project area.

8.5.1.1. Study Goals and Objectives

The goal of the study is to obtain sufficient population information to evaluate the potential effects of the Project on moose.

Specific study objectives include:

- Document the moose population and composition in the study area;
- Assess the relative importance of the habitat in the inundation zone, proposed transportation corridors, and the riparian area below the Project;
- Document the productivity and calf survival of moose using the study area;
- Document the level of late winter use of adults and calves in the proposed inundation area;
- Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project;
- Assess the relative importance of the habitat in the inundation zone and proposed transportation corridors to moose;
- Document the amount of potentially available habitat for improvement through crushing, prescribed burning, or other habitat enhancement; and
- Analyze and synthesize data from historical and current studies of moose as a continuation of the 2012 moose study (AEA 2012).

8.5.2. Existing Information and Need for Additional Information

Moose studies during the early 1980s for the original APA Susitna Hydroelectric Project proposal were comprehensive and annual monitoring of moose populations in the general area

has been conducted by ADF&G, but more recent data specific to this Project are needed to accurately characterize the current moose population size, distribution, and habitat use. New information is also needed to assess current issues pertaining to human use of the population in the Project region.

For management purposes, moose in Game Management Unit (GMU) 13 are monitored annually using aerial trend count surveys. Within GMU 13A, B, and E, a total of four continuous count areas (CAs) are surveyed annually (CA3, 5, 6, 13, and 14; Figure 8.5-1); additional areas are surveyed periodically. These surveys provide managers with population composition and general trend data, and have been used in this area successfully since the 1950s.

Additional areas, such as CA7 which includes Watana Creek in GMU 13E, are not surveyed regularly. CA7 was surveyed annually between 1980 and 1986, (776-1284 moose observed; 0.9-1.5 moose per square mile). The most recent aerial trend count survey in this area was conducted in 2001 (776 moose observed; 0.9 moose per square mile). An intensive population survey was also conducted in spring 2012, a year of heavy snowfall. A total of 441 moose (60 calves and 381 adults) were observed on 277.65 square miles for a density estimate of 1.59 moose per square mile. The estimated density will likely increase after the estimate is adjusted for sightability (R. Schwanke, 2012, pers. comm. 6/22/12). An additional intensive population survey will be conducted of the area downstream from the proposed dam location.

Changes in hunter access due to the proposed Project will be evaluated. Hunter demand for moose in GMU 13 is very strong and continues to grow. Due to this trend and with implementation of moose population composition objectives in the early 1990s, the GMU 13 moose population composition has been closely monitored to maintain a sustainable harvest and high hunter satisfaction rates. Existing annual monitoring efforts for moose in GMU 13A and 13E address abundance, distribution, and recruitment for the purposes of assessing annual moose population trends and related harvest regulatory strategies. These data, however, are insufficient to accurately address potential Project-related impacts, or to identify potential mitigation measures for moose. Data collected through standard Very High Frequency (VHF) radio-telemetry, satellite-linked GPS telemetry, and aerial surveys of population composition, density, and calf production will document currently used areas, as well as provide data on the timing and duration of seasonal range use and the proportion of the regional moose population that uses the Project area. Previous habitat evaluations were based on vegetation cover types that were mapped within 16 kilometers (10 mile) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). However, that vegetation mapping was conducted over 30 years ago.

Both the vegetation mapping and the habitat evaluation will be updated during Project studies (see Sections 8.19 and 9.5, respectively). The wildlife habitat evaluations completed in the early 1980s were based largely on vegetation types. This study will go beyond vegetation mapping to document the habitat utilized by moose, and the actual biomass removed by browsing. Moose locations derived from this study can be used to develop a stratified sampling design (Paragi et al. 2008) and to identify habitats that may be suitable for treatment to enhance habitat for moose and other early successional species.

The information developed will be used to inform development of appropriate protection, mitigation, and enhancement measures for the Project in support of ADF&G management objectives for moose in GMU 13.

8.5.3. Study Area

The moose study will reflect the relative use of the Project area by moose (Figure 8.5-1). The study area will include the majority of GMU 13E east of the Parks Highway and the Alaska Railroad from the Denali Highway south to upper Chunilna Creek. The study area will also include a small portion of northwest GMU 13A from Kosina Creek east to the Oshetna River drainage. This area encompasses the impoundment, access and transmission corridors, and associated Project infrastructure. To assess the relative use of these primary focus areas, the study area must be somewhat larger to fully evaluate the seasonal habitat preferences of moose likely to use the focus areas.

8.5.4. Study Methods

8.5.4.1. Moose Movements, Productivity and Survival

To assess moose movements in the Project area, as well as productivity and survival, a sample of cow and bull moose will be radio collared. Additionally, GPS/Argos satellite collars will be deployed on bulls and cows to detect fine-scale movements for both sexes.

Moose will be captured and collared in late March and November-December depending on various factors including the physical condition of moose and hunting seasons. Radio collars are expected to function for 5 to 7 years, whereas GPS collars have a 2-year lifespan. If greater than expected collar malfunctions or hunting losses occur, additional captures/collar replacement outside the outlined schedule may be required to maintain a sufficiently large sample size.

In October 2012, approximately 30 radio collars will be deployed, 20 on cows and 10 on bulls. At the same time, approximately 20 GPS collars will be deployed; 13 on cows and 7 on bulls.

Another 30 radio collars will be deployed in March 2013, 20 on cows and 10 on bulls, as well as an additional 20 GPS collars, 13 on cows and 7 on bulls. The two separate capture periods will help address the spatial variability of a migratory moose population, as well as potential loss of collared animals during the hunting season. GPS collars will be removed in November 2014 and/or March 2015.

The sample size of 60 radio-collared moose with a 2 cow to 1 bull ratio is expected to adequately record movements and productivity of moose in the study area and to evaluate the relative importance of the Project area in terms of available habitat throughout the year.

Monthly aerial radiotelemetry surveys via fixed-wing aircraft will be conducted within the study area to document the distribution of radio-collared moose. During the critical spring calving (May 10–June 15) and fall hunting seasons (September 1-20), aerial surveys will be conducted weekly to more precisely document the distribution of moose within the study area. Additionally, to accurately document productivity and associated calf loss, surveys will be conducted daily during peak calving (May 15–31). Fixed-wing PA-18 aircraft will be used for these radiotracking flights.

Fine-scale movements will be monitored with the 40 GPS collars deployed on 26 cows and 14 bulls. Due to the relatively consistent annual moose habitat use and movement patterns, the relatively short 2-year lifespan of GPS collars should be sufficient for documenting fine scale movements of moose in this area. Considering that the Project area is used year round by moose, gathering daily locations with the use of GPS collars is the only way to ensure that habitat use

and travel patterns, particularly during calving, hunting season, and the rut for both sexes are accurately identified.

GPS locations of collared moose will be used to evaluate spatial distribution and movements of cows and bulls. Location, date, reproduction, and survival status will be documented for each moose located during scheduled radiotelemetry flights. Data analysis and visual representation of data will be accomplished using ArcGIS software.

8.5.4.2. Population Monitoring

Moose populations will be evaluated using three survey techniques. Conventional survey methods pertaining to optimal snow conditions, daylight, flight patterns, etc., (Ballard and Whitman 1988) will be used for all surveys to maximize survey precision, maintain consistency between surveys, and facilitate comparisons to existing datasets. To assess winter use of the inundation area, an ADF&G pilot-observer team flew the area of inundation in late winter (March 20–22) of 2012 and will do so again in 2013. Due to antler drop, it will not be possible to distinguish cows from bulls during late winter surveys, but numbers of calves and adults will be reported.

Intensive population estimates utilize GeoSpatial Population Estimation (GSPE) techniques (Ver Hoef 2002, Kellie and DeLong 2006) or the Gasaway Population Estimator. The timing of population estimates will depend on survey conditions, logistical concerns, and potential scheduling conflicts with other concurrent moose surveys. The preferred approach is to estimate moose populations above and below the proposed dam within the study area during one GSPE sampling event. A total of 200 or more randomly selected 6-square mile sample units will be surveyed. If this approach proves not feasible, then two separate GSPE surveys will be conducted sampling about 150 sampling units in each area above and below the dam (300 total units). If the latter approach becomes necessary, surveys conducted above and below the dam will likely occur in different years. Sample units will be flown at a high search intensity (>6.5 minutes per square mile). Counts may be corrected for sightability using established methods.

Previously established trend count Areas CA7 and CA14 will be surveyed in November of 2012, 2013, and 2014.

8.5.4.3. Moose Browse Survey and Habitat Assessment

To estimate the proportion of browse biomass removed by moose, we will employ methods developed by Seaton (2002) and described by Seaton et al. (2011) and Paragi et al. (2008). Current annual growth (CAG) of important browse species such as willow (*Salix* spp.), aspen and balsam poplar (*Populus* spp.), and Alaskan birch (*Betula neoalaskana*) will be estimated. Only plants with CAG between 0.5 meters and 3 meters will be sampled. Three plants per species at each sample plot will be selected and 10 twigs on each plant will be measured. The diameter at the base of CAG (or the point where twig is browsed, if older than last annulus) and the diameter at the point of browsing will be noted. Duration of sampling will be 8 to 10 days each year to occur in March 2013 and 2014. Sampling must occur after most of the winter browse activity has occurred but before spring green up. Small helicopters will be used to access study plots. The browse study will be conducted for two years to account for annual variation in snow depth and other conditions.

The seasonal use and importance of the inundation zone and transportation corridors will be quantified primarily by analysis of radio and satellite tracking data to determine moose movements and habitat preferences. Browse utilization surveys will further refine the relative importance of habitat within the study area by documenting the impact of moose on vegetation. Browse utilization surveys will cover available habitat above and below the dam within the extent of the GSPE survey grid. Vegetation and other studies conducted in association with the Project licensing process will be used to identify areas where potential habitat improvement may occur to mitigate for the loss of habitat in the Project area.

8.5.4.4. Impact Assessment

The primary impacts of Project construction and operation, as described in the Pre-application Document (PAD, AEA 2011), are moose habitat loss and alteration, blockage of movements, and increased mortality due to subsistence and recreational harvest facilitated by improved hunter access along transmission and access corridors. Data on the population, distribution, productivity, and habitat use of moose in the study area will be used to assess Project impacts. Location data, population data, and browse intensity data can be plotted on the wildlife habitat map that will be developed under the botanical resources study plans (see Sections 9.5, 9.6 and 9.7) to identify important moose habitats or to provide quantitative or semi-quantitative estimates of habitat value. Direct habitat loss can be calculated through geospatial analysis by overlaying the impoundment, access and transmission corridors, and related Project infrastructure onto the habitat map and evaluating the loss of important moose habitats. Indirect habitat loss and alteration and avoidance impacts can be estimated by applying various buffer distances, as determined from available information on the anticipated effects of similar projects or activities on moose. By incorporating population data from the various surveys into the analysis, the number of animals affected can be estimated. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on moose populations. The concurrent investigation of riparian habitats downstream of the dam site will provide additional data with which to assess impacts on moose, establishing baseline conditions and modeling riparian succession in areas in which habitat or browse availability may be affected by altered flow regimes. Harvest data collected by the ADF&G will be used to establish baseline harvest levels and to monitor increased harvest that may result from improved access. Data on the movements of radiocollared moose can be used to assess potential blockage of movements in the inundation area. Any necessary PM&E measures will be developed by examining the seasonal distribution and abundance of moose among habitats in relation to the geographic extent and seasonal timing of various Project activities.

8.5.5. Consistency with Generally Accepted Scientific Practice

Moose movement patterns and productivity and survival in the Project area will be studied by marking animals with radio and GPS satellite collars. The combination of these two collar types will provide both broad-scale and local-scale information on movement patterns in the Project area. These data will be necessary to evaluate broad (seasonal) movements and more local-scale movements within those areas expected to be affected by Project development. The use of these two collar types represents a robust approach to collecting data on moose movement patterns, productivity, and survival that are in widespread in Alaska and elsewhere. The outlined sample

sizes should be more than sufficient for an accurate and precise representation of moose distribution, movements, and productivity within the study area.

The capture methods employed in this study will be standard capture, handling and monitoring techniques for moose (Schmitt and Dalton 1987). Helicopters and chemical immobilization techniques will be utilized for moose captures. All methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee certification. Standard permits required by the State of Alaska for animal capture and monitoring are in-hand.

Moose population monitoring will be conducted by intensively surveying randomly located plots and extrapolating those data to the study area, a technique that is widely used in Alaska and is the appropriate sampling design for determining population levels of ungulates that are widely dispersed across the landscape (Ver Hoef 2002, Kellie and DeLong 2006).

Moose browse will be studied using methods developed by ADF&G for studies in Interior Alaska to estimate the proportion of browse biomass removed (Paragi et al. 2008, Seaton et al. 2011). These are currently thought to be the most appropriate methods for quantifying moose browse in Alaska.

8.5.6. Schedule

This is a multi-year study that was initiated in 2012. ADF&G will continue to survey and monitor radio-collared moose throughout the collar lifespan (approximately 2016) and will produce a final technical summary report. However, the three years of study information culminated in the Revised Study Report is expected to be sufficient to provide enough information to assess potential impacts of the Project on Moose.

2012:	
October	Deploy initial radio and satellite collars and monitor at least monthly.
2013:	
March	Deploy remaining radio and satellite collars and monitor at least monthly. Conduct adult/calf population survey of inundation zone and adjacent habitat. Conduct winter browse utilization assessment
May 10 to June 15	Monitor radio collars weekly (daily monitoring May 15 – 31)
September 1 - 20	Monitor radio collars weekly
November	Conduct post-rut aggregation composition surveys in CA7 and CA14 and follow up with GSPE for area below dam
December	Initial Study Report
2014:	
March	Conduct winter browse utilization assessment
May 10 to June 15	Monitor radio collars weekly (daily monitoring May 15 – 31)
September 1 - 20	Monitor radio collars weekly

November	Conduct post-rut aggregation composition surveys in CA7 and CA14 Remove satellite collars
December	Updated Study Report
2015:	
March	Remove remaining satellite collars

8.5.7. Level of Effort and Cost

This multi-year study is estimated to cost $750,000.

8.5.8. Literature Cited

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8.5.9. Figures

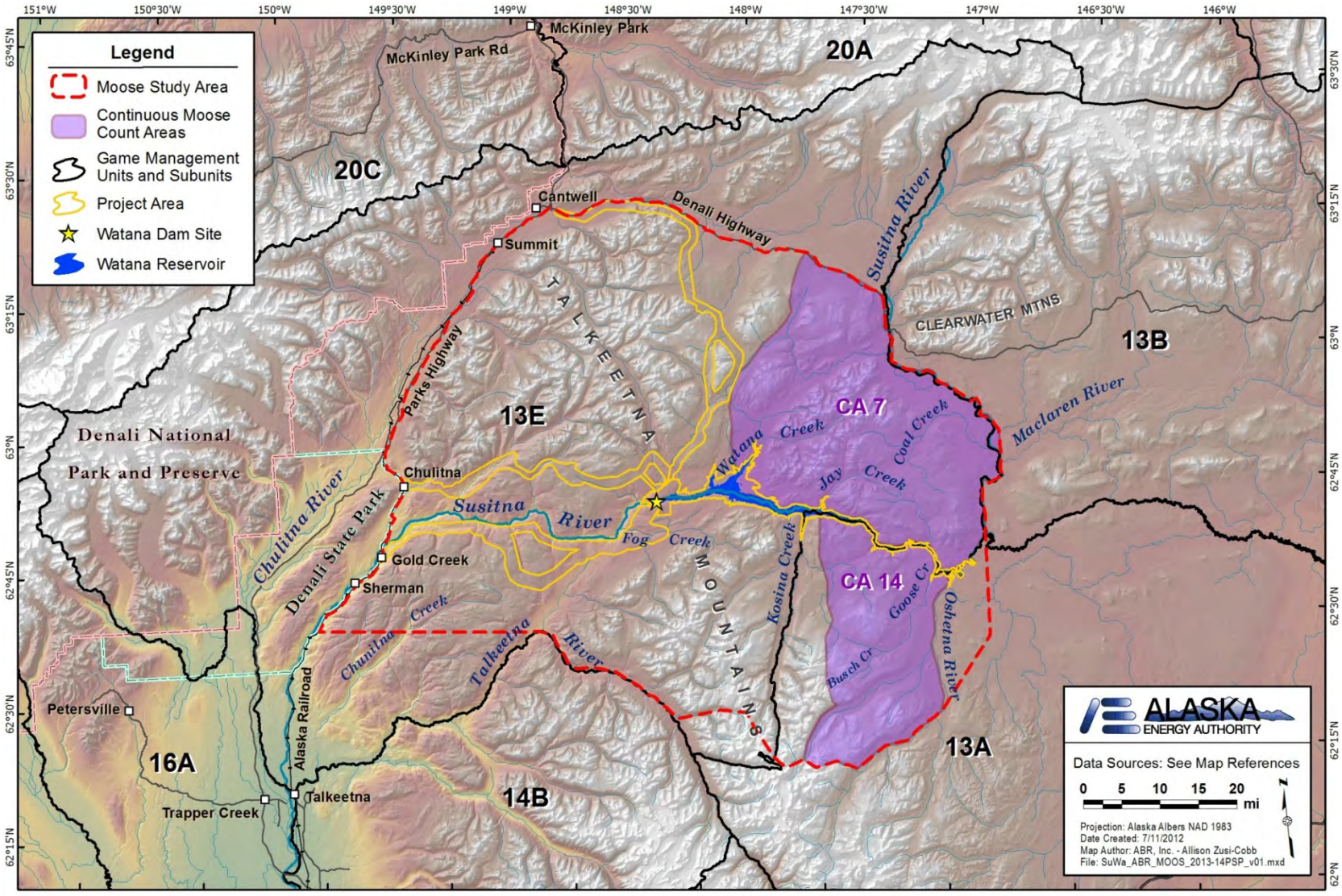

Figure 8.5-1. Moose study area.

8.6. Study of Distribution, Abundance, Movements, and Productivity of Caribou

8.6.1. General Description of the Proposed Study

This study plan outlines the objectives and methods for characterizing caribou movements, population, distribution, productivity, calf survival, group size, and density in the Project area through geospatial analysis. Aerial radiotelemetry surveys via fixed-wing aircraft will be utilized to monitor seasonal use and distribution in the study area, including characterization of calving areas, rutting areas, wintering areas, and migration/movement corridors within the study area. In addition to radio collars, GPS/Argos satellite collars will be deployed to evaluate fine-scale spatial distribution and movements of cows and bulls.

This is a multi-year study that is being completed by ADF&G. ADF&G initiated a caribou movement study in 2012. This study supplements ADF&G's ongoing caribou research in the region by increasing the sample size of radio-collared cows and radiocollaring bulls in both the Nelchina and Delta caribou herds to more fully delineate the seasonal movements and range use of each herd. Radio collars will be deployed in October 2012 and will be monitored for the remainder of this study. Satellite collars deployed in October 2012 will be removed in October 2014.

8.6.1.1. Study Goals and Objectives

The goal of this study is to obtain sufficient population information on caribou to evaluate Project-related effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors.

Four specific objectives have been identified:

- Document seasonal use of, and movement through, the Project area, as defined in Section 8.6.3) by both females and males of the Nelchina caribou herd (NCH) and the Delta caribou herd (DCH);
- Assess the relative importance of the Project area to both the NCH and DCH;
- Document productivity and calf survival of caribou using the Project area; and
- Analyze data from historical caribou studies and synthesize with recent data for the NCH and DCH as a continuation of the caribou task of 2012 study W-S1 (AEA 2012).

8.6.2. Existing Information and Need for Additional Information

The current population objective for the NCH was established to ensure consistently high sustainable harvest levels for Alaskan hunters (Tobey and Schwanke 2009). ADF&G's management objectives for the NCH in GMU 13 and GMU subunit 14B are to maintain a fall population of 35,000 to 40,000 caribou, with minimum ratios of 40 bulls to100 cows and 40 calves to100 cows; and to provide for an annual harvest of 3,000 to 6,000 caribou (Tobey and Schwanke 2009). ADF&G's management objectives for the DCH in GMU 20A are to maintain a bull:cow ratio of greater than or equal to 30 bulls to100 cows and a large bull:cow ratio of greater than or equal to 6 large bulls to 100 cows; reverse the decline of the herd and increase the midsummer population to 5,000–7,000 caribou; and sustain an annual harvest of 300 to 700 caribou (Seaton 2009).

The caribou study for the original APA Susitna Hydroelectric Project began in 1980 and continued through 1985. The objectives of the study were to determine the population status of the NCH, delineate subherds; and identify range use, movement patterns, migration routes, and migration timing (ABR 2011). Three resident subherds were identified and the proposed reservoir was found to intersect migration routes used by pregnant cows moving to calving grounds during late April and May and cows and calves moving to summer range during late June and July (Pitcher 1982). Current caribou use of the Project area is complicated by range expansion and mixing of DCH with the NCH (Seaton 2009).

Caribou range use and movement studies during the early 1980s for the APA Susitna Hydroelectric Project are insufficient to accurately characterize current caribou use of the Project area. The NCH is a moderately large herd with 40,233 caribou in 2011 (ADF&G, unpublished data); whereas the DCH is much smaller with 2,985 caribou in 2007 (Seaton 2009). Since 1985, the number of NCH caribou has increased significantly. Both the NCH and the DCH use portions of the Project area extensively. A related change has been increased use of summer and winter range in the northwestern portion of the NCH range in subunit 13E, northwest of the Project location. Because the NCH continues to calve in the eastern Talkeetna Mountains in GMU 13A, south of the Project location, changes in summer and winter range could mean more caribou will cross through the greater Project area during seasonal migrations to and from the calving grounds.

Current annual monitoring efforts for the NCH and DCH by ADF&G identify general herd distribution, productivity, and annual survival for the purpose of assessing annual herd trends and related harvest strategies. These data are insufficient, however, to assess the potential Project-related impacts or to identify potential mitigation measures for caribou in the Project area. Mixing of the two caribou herds since the mid-1990s in the northern portion of the Project area between the Susitna River and Butte Lake has been a more recent development that adds a level of complexity to range use and importance for the two herds (Seaton 2009). In addition, established vegetation exclosures in the NCH range can be used to monitor abundance of lichens in an ungrazed area for assessment of range conditions.

Documentation of currently used areas, along with information on timing, duration, and proportion of the regional population that uses those areas, can be used to develop any necessary avoidance, minimization, and mitigation measures, including seasonal and access restrictions. This information will also be useful in preventing inadvertent disturbance from unrelated field studies for the Project.

8.6.3. Study Area

The caribou study area will reflect use of the Project area by the NCH and the DCH. The study area will include the majority of GMU 13E east of and including Broad Pass (Figure 8.6-1). The area will also include drainages into the Upper Susitna River in GMU 13B, as well as a small portion of northwest GMU 13A from Kosina Creek east to the Oshetna River. This area encompasses the reservoir impoundment zone, associated infrastructure, and potential access and transmission-line routes from the west and the north. Downstream areas in the middle Susitna River basin that could be affected by changes in stream flows, temperatures, and ice conditions that could alter conditions for river crossings traditionally used by caribou will also be included. To assess the relative use of these primary focus areas, the study area must be somewhat larger

based on the history of caribou movements in this area to fully evaluate habitat preferences and migration routes of caribou.

8.6.4. Study Methods

ADF&G initiated a caribou movement study in 2012. This study supplements ADF&G's ongoing caribou research in the region by increasing the sample size of radio-collared cows and radiocollaring bulls in both herds to more fully delineate the seasonal movements and range use of each herd. In addition, Argos satellite-linked GPS collars will be deployed on bulls and cows to detect fine-scale movements for both herds. Some captures will occur in the month of April to target caribou overwintering in the Project area, with additional captures occurring in October to target migratory caribou.

Due to limited battery life, the GPS collars will need to be removed after 2 years, refurbished, and redeployed to gather enough data to adequately describe movements and range utilization and incorporate annual differences. GPS collars will be removed at the end of the study to ensure that all data stored onboard the collars is retrieved. Radio collars will be deployed with the expectation that they will remain on the animals.

Radio collars will be deployed in October 2012 and will be monitored for the remainder of this study. Satellite collars deployed in October 2012 will be removed in October 2014. Collar failures are not anticipated, although a small percentage may malfunction, requiring capture and replacement outside of the schedule outlined.

All existing NCH and DCH radio-collared caribou will be monitored within the greater project area monthly via aerial radio-telemetry. During critical spring and fall crossing periods, as well as calving, additional weekly flights will occur.

No net loss is expected to occur for existing herd monitoring programs. For those caribou currently radio-collared, if radio collars are replaced with GPS collars for purposes of this project, new or refurbished radio collars will need to be re-deployed on each of these animals at the end of the project.

To adequately address seasonal movements and range use by bull caribou, 10 radio collars have been deployed on NCH bulls, and 5 on DCH bulls, supplementing approximately 80 existing radio collars on NCH cows, and 40 existing radio collars on DCH cows. An additional 10 radio collars will be deployed on NCH bulls and 5 on DCH bulls in October 2012 as part of this project. The female segment represents the reproductive portion of the herd, as well as the leading edge of seasonal movements, supporting the higher number of collars for cows.

Radio-collared caribou must be located via fixed-wing aircraft. Monthly aerial radiotelemetry flights will provide general documentation of herd distribution and the extent of herd mixing in the greater project area. Additional weekly flights during spring and fall migrations will result in more precise documentation of use of the greater project area by both herds. The large sample of radio-collared caribou is necessary to fully evaluate the relative importance of the greater Project area in terms of available herd ranges and potential movement corridors. The outlined sample sizes should be sufficient for an accurate representation of herd-wide movement patterns and range use.

To address fine-scale movements—both temporally and geographically—a total of 60 GPS collars will be deployed (40-45 on NCH animals and 15-20 on DCH animals). Up to 70 percent

of the GPS collars will be deployed on cows. Considering that the proposed impoundment area is primarily used during herd migration, gathering daily locations with the use of GPS collars is the only way to ensure that travel corridors and travel patterns are identified. Small piston-powered (Robinson R-44) helicopters and chemical immobilization techniques will be used for caribou captures and fixed-wing aircraft (Piper PA-18) will be used for radio-tracking flights.

Locations collected from satellite and GPS collars will be used to evaluate spatial distribution and movements of cows and bulls from each herd. Additional locations, reproduction, survival status, and group size will be documented for each caribou located during scheduled radio-tracking flights.

Data analysis and visual representation of data will be accomplished using a geographic information system running ArcGIS software. Population estimates based on existing data will be calculated consistent with the method used to collect the data. Density estimates will be calculated at a spatial resolution suitable to evaluate potential habitat loss and alteration from the Project. Telemetry data will be used to delineate seasonal ranges and movement corridors using techniques such as kernel density estimates (Seaman and Powell 1996) and Brownian bridge (or similar) movement model techniques (Horne et al. 2007, Sawyer et al. 2009), depending on the volume and suitability of the data for use with these techniques.

8.6.4.1. Impact Assessment

The primary impacts of the Project on caribou are likely to be from direct and indirect habitat loss and alteration, and blockage of movement corridors for portions of the range of both the NCH and the DCH. Other potential impacts include changes in mortality rates that may result from increased subsistence or recreational harvest facilitated by improved access or from changes in predator populations, and mortality from collisions with vehicles or unstable ice conditions in the impoundment. Data on the distribution, abundance, productivity, and habitat use of caribou in the study area will be used to assess Project impacts. Location data will be used to identify movement corridors. Location and abundance data can be plotted on the wildlife habitat map that will be developed under the botanical resources study plan (see Sections 9.5, 9.6, and 9.7) to identify important caribou habitats. Direct habitat loss can be calculated through geospatial analysis by overlaying the impoundment, access and transmission facility "footprints", and related proposed Project infrastructure onto the habitat map and evaluating the loss of important caribou habitats. Indirect habitat loss and avoidance impacts can be estimated by applying various buffer distances, as determined from available information on the anticipated effects of similar projects or activities on caribou. Similarly, movement corridors can be compared to Project features to assess the extent to which movements and distribution may be affected. ADF&G harvest data will be used to establish baseline harvest levels and to monitor changes in harvest that may result from improved access. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on caribou populations.

8.6.5. Consistency with Generally Accepted Scientific Practices

ADF&G is the primary agency responsible for monitoring caribou populations in Alaska. The techniques used to capture, collar, and track caribou in this study have been developed by ADF&G through decades of experience working with big game species in Alaska. The methods employed in this study will consist of standard capture, handling, and monitoring techniques for

cow caribou (Adams et al. 1987). In recent years, these techniques also have been used for bull caribou. All methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee certification. Standard permits required by the state of Alaska for animal capture and monitoring are in-hand.

Caribou data will be analyzed according to commonly accepted statistical techniques. Spatial statistics will be conducted with commonly accepted techniques such as fixed-kernel density estimation with least-squares cross validation or plug-in bandwidth selection (Seaman and Powell 1996, Gitzen et al. 2006).

8.6.6. Schedule

This is a multi-year study that was initiated in 2012. The following schedule is for 2013-2014 activities.

2013:

January	Monitor collars deployed in 2012 at least monthly throughout study.
May/June and August/September	Monitor radio collars weekly
December	Initial Study Report

2014:

April	Remove satellite collars deployed in Apr 2012
May/June and August/September	Monitor radio collars weekly
October	Redeploy satellite collars removed in Apr 2014, remove satellite collars deployed in Oct 2012
December	Updated Study Report

8.6.7. Level of Effort and Cost

This is a multi-year study that is being completed by ADF&G. The approximate cost of the study through 2014 is $610,000.

8.6.8. Literature Cited

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8.6.9. Figures

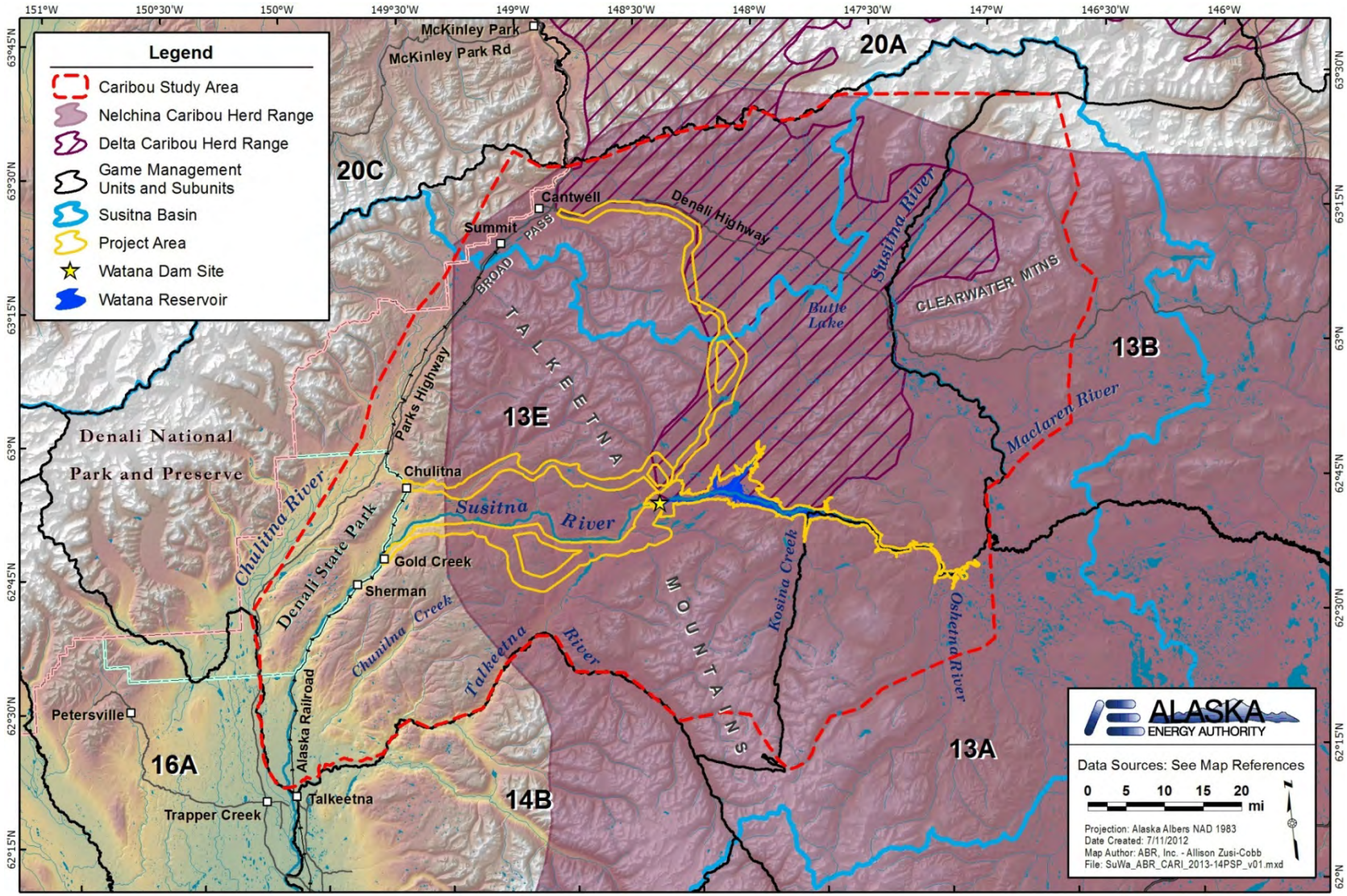

Figure 8.6-1. Study area for caribou.

8.7. Study of Distribution, Abundance, and Habitat Use of Dall's Sheep

8.7.1. General Description of the Proposed Study

The Dall's sheep study will be conducted for two years in 2013 and 2014. The study is designed to evaluate how many sheep use the Project area, where they are distributed, what habitats they occupy, and whether mineral licks in the Project area receive high levels of seasonal use by sheep.

8.7.1.1. Study Goals and Objectives

The goal of the study is to obtain sufficient information on the population, distribution, and use of mineral licks by Dall's sheep (*Ovis dalli*), an important species of big game in the Project area, to use in evaluating potential Project-related effects and identifying measures to avoid, minimize, or otherwise mitigate those effects.

Four primary objectives have been identified for this study:

- Estimate the current population size of Dall's sheep in the Project area;
- Delineate the summer range of Dall's sheep in the Project area;
- Evaluate the current condition and use of mineral licks in the Project area; and
- Analyze and synthesize data from historical and current studies of Dall's sheep in the greater Project area as a continuation of the 2012 study (AEA 2012).

Data collected through aerial surveys and ground-based monitoring of sheep habitat will document currently used areas for use in developing any necessary protection, mitigation, and enhancement measures.

8.7.2. Existing Information and Need for Additional Information

Dall's sheep were studied in the region during the early 1980s. Aerial surveys of the Watana Creek Hills counted 130–220 animals (Tankersley 1984). Later surveys of the Watana Hills counted 97 and 50 sheep (Peltier 2008). The sheep population in the larger management area has declined overall following a steep decline after the winter of 1999–2000 and additional declines during 2004–2007 (Peltier 2008). No sheep use of areas on Mount Watana (directly south of the proposed Watana impoundment) or near the Denali Highway access corridor was documented in the 1980s (Tankersley 1984).

During the 1980s research, mineral licks were identified on lower Jay Creek and upper Watana Creek (Tankersley 1984). Sheep used those licks mainly between mid-May and mid-June and at least 31 percent of the sheep population observed in the Watana Creek Hills in 1983 traveled 8 kilometers or more to the Jay Creek lick. The Watana reservoir proposed in the 1980s would not have inundated the Jay Creek lick at a normal maximum operating level of 2185 feet but may have resulted in the loss of lower areas of the Jay Creek lick and associated resting areas due to accelerated erosion, and may have inhibited sheep travel along and across Jay Creek (Tankersley 1984).

The management objectives for the Talkeetna Mountains and Chulitna–Watana Hills in Game Management Unit (GMU) Subunits 13A, 13E, 14A, and 14B are to maintain sheep populations that will sustain an annual harvest of 75 rams (Peltier 2008). This study only addresses sheep populations within portions of GMU 13A and 13E.

The Project will result in wildlife habitat loss and alteration, blockage of movements of mammals, wildlife disturbance, and changes in human activity due to construction and operation.

New information is needed for a current enumeration of sheep abundance in the greater Project area, primarily in the Watana Creek Hills, and to evaluate the current extent of seasonal use of the Jay Creek and Watana Creek mineral licks by sheep. The primary concerns for Dall's sheep are alteration of movement patterns, changes in the use of nearby mineral licks, disturbance, and changes in harvest patterns due to increased human access. Current data on distribution, population size, and use of the Jay Creek and Watana Creek mineral licks will be important for assessing potential impacts on the local sheep population and developing any protection, mitigation and enhancement measures if necessary.

8.7.3. Study Area

The study area lies within GMU Subunits 13E and 13A, which encompasses the Project facilities, potential access and transmission-line corridors, and the inundation zone for the reservoir(Figure 8.7-1). Surveys also will be conducted in the Watana Creek Hills and other Dall's sheep habitat adjacent to the inundation zone.

8.7.4. Study Methods

The proposed Dall's sheep study would consist of three components:

- Aerial survey for summer distribution and minimum population estimation;
- Ground monitoring and photographic monitoring of mineral lick use; and
- Analysis of historical (1980s) data and synthesis with current ADF&G monitoring results.

Aerial distribution and population estimate surveys can be conducted for sheep habitat in the greater Project area following ADF&G protocols in summer after lambing (late June-early July). Ground-based surveys of the Jay Creek and Watana Creek mineral licks will be conducted by observers using spotting scopes in the mid-May to mid-June period when lick use is generally at its peak. Time-lapse cameras will also be placed at strategic locations to record the number of sheep using both licks. Results will be compared with those from ground-based surveys of mineral licks conducted in the 1980s (Tankersley 1984). The use of wildlife monitoring cameras will substantially enhance the volume of data that can be collected at a relatively low cost.

Analysis of time-lapse camera images will include enumeration of the number of sheep (including lambs) visible by date and time of day; if image quality allows, other data on sex and age composition will be recorded. Conducting surveys in both 2013 and 2014 will provide information on annual variability, and the 2013 effort will be used to modify the 2014 field effort, if necessary.

8.7.4.1. Impact Analysis

The primary type of impact mechanisms resulting from of Project construction and operation on Dall's sheep likely include:

- Direct loss and alteration of Dall's sheep habitats, including key habitat features such as mineral licks, from Project construction and operation;
- Blockage or alteration of movements and changes in distribution due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities;
- Mortality of Dall's sheep due to Project-related fluctuating water and ice conditions in the reservoir and downstream river reaches;
- Changes in mortality that may result from altered abundance and distribution of sheep predators due to increased human activities and habitat changes resulting from Project development; and
- Mortality of Dall's sheep from increased subsistence and recreational harvest.

Data on the distribution and abundance of Dall's sheep and their use of mineral licks in the study area will be used to assess Project impacts through geospatial analysis, evaluation of the responses of the Dall's sheep to other similar projects, as documented in the scientific literature, and an examination of the current physical characteristics of the Jay Creek and Watana Creek mineral licks. Direct habitat loss caused by the Project can be evaluated by overlaying the impoundment, access and transmission corridors, and related infrastructure (including any predicted changes around the two mineral licks) and the summer sheep ranges delineated from aerial surveys onto the Project wildlife habitat map. Similarly, buffer zones can be delineated around the Project footprint, as determined from the available information on the expected effects, to estimate indirect impacts. Population data can be incorporated into the geospatial analysis to estimate the number of sheep that may be affected. The GIS analysis can be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on sheep. Harvest data from ADF&G and population data from aerial surveys will provide a baseline with which to assess changes in mortality rates that may result from increased harvest, lake ice conditions, increased predation, or altered access to important habitats. Information from other studies also will be pertinent to assessment of potential Project impacts on Dall's sheep, in particular the large predator studies (Section 8.8) and harvest analysis (Section 8.20).

8.7.5. Consistency with Generally Accepted Scientific Practice

Aerial surveys will provide the best indication of the minimum population of sheep in the Project area and therefore potentially impacted by the Project. These surveys will be conducted using the methods used by ADF&G for sheep in GMU 13. Monitoring the Jay Creek and Watana Creek mineral licks with a combination of ground-based observations and time-lapse photography will provide a cost-effective method of collecting data on the seasonal timing and number of sheep using the licks during the summer. Data will be analyzed in accordance with commonly accepted statistical techniques for wildlife studies.

8.7.6. Schedule

Aerial surveys of the Dall's sheep population in the study area will be conducted in June–July of 2013 and 2014. Time-lapse cameras will be deployed at mineral licks in early May and cameras will be removed in August in both 2013 and 2014. Periodic ground observations of the mineral licks will be conducted during the mid-May to mid-June period in both years. Data analysis, analysis of photographs, QA/QC, and reporting will be conducted after camera retrieval each year.

2013:

- Aerial Surveys: one week during June/July
- Mineral Lick Surveys:
  Ground observations and camera set-up and maintenance: early May, late May, early June, late June, July, August (2–3 days per visit)
- Initial Study Report: December

2014:

- Aerial Surveys: one week during June/July
- Mineral Lick Surveys:
  Ground observations and camera set-up and maintenance: early May, late May, early June, late June, July, August (2–3 days per visit, with potentially less effort depending on 2013 results)
- Updated Study Report: December

8.7.7. Level of Effort and Cost

Aerial surveys will require one observer and one pilot in a small tandem-seat fixed-wing airplane, flying daily for up to one week per summer to survey the sheep habitat in the greater Project area. The final size of the area to be surveyed will be determined in consultation with ADF&G and other resource managers.

Observations of mineral licks and set-up and maintenance of time-lapse cameras will be completed by two observers on four field visits during May and June and on two shorter trips by one observer later in the summer to check the cameras and change the memory cards. Viewing, summary, and analysis of the photographs will be conducted in the fall after camera retrieval.

Project costs in 2013 are anticipated to be less than $200,000. A similar level of effort will be required for 2014.

8.7.8. Literature Cited

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8.7.9. Figures

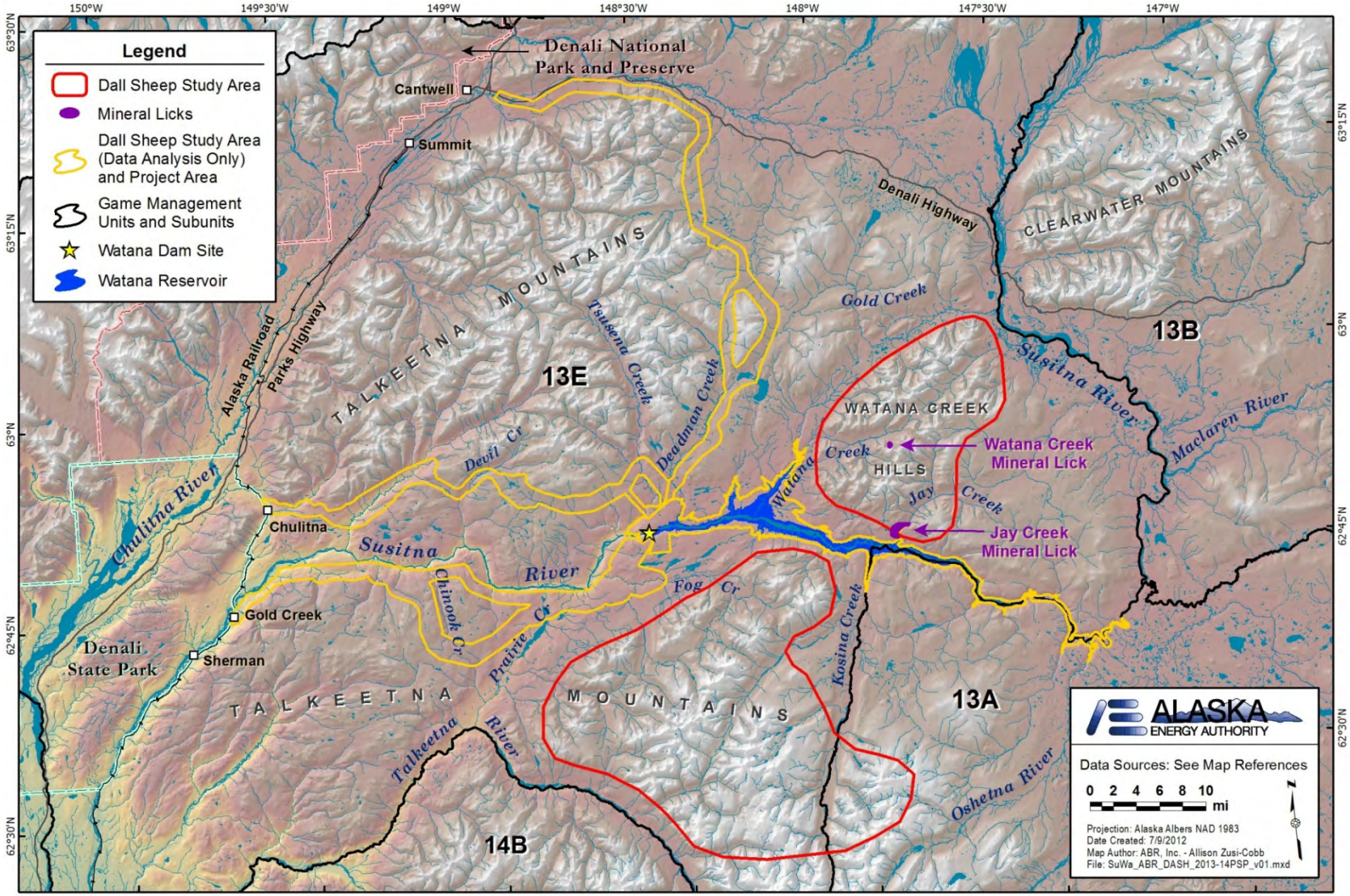

Figure 8.7-1. Dall's sheep study area.

8.8. Study of Distribution, Abundance, and Habitat Use by Large Carnivores

8.8.1. General Description of the Proposed Study

The large carnivore study is a multi-year (2012–2014) effort that relies primarily on analyses of ADF&G data from ongoing State of Alaska monitoring projects and on focused field work on bears downstream from the proposed Watana dam.

8.8.1.1. Study Goals and Objectives

The goal of the study is to obtain sufficient information on three dominant predators and game animals in the region—brown bear (*Ursus arctos*), black bear (*U. americanus*), and wolf—to use in evaluating Project-related effects and identifying any appropriate measures to avoid, minimize, or mitigate those effects.

Project development will inundate or modify habitats used seasonally by brown bears, black bears, and wolves. In addition, the associated development infrastructure and human activities in the area during construction and operation are likely to have indirect effects on bears and wolves through changes in prey populations, including moose, caribou, and salmon, and changes in disturbance and human hunting patterns. Data collected through this large-carnivore study will provide information on the value of lost, created, or altered habitats for bears and wolves in the area.

Four primary objectives have been identified for this study:

- Estimate the current populations of brown bears, black bears, and wolves in the greater Project area, using existing data from ADF&G;
- Evaluate bear use of streams supporting spawning by anadromous fishes in habitats downstream of the proposed dam that may potentially be altered by the Project;
- Describe the seasonal distribution and habitat use of wolves in the greater Project area using existing data from ADF&G; and
- Synthesize historical and current data on bear movements and seasonal habitat use in the greater Project area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies (AEA 2012a).

8.8.2. Existing Information and Need for Additional Information

Existing information for bears and wolves is further detailed below. This study would supply baseline data essential to assess potential Project-induced impacts and facilitate the development of any PM&E measures, if deemed necessary. The study results would provide the following information:

- Habitat-use data for developing habitat evaluation criteria;
- Distribution data during harvest periods for the ongoing wildlife harvest analysis study initiated in 2012 (AEA 2012b);
- Abundance, productivity, and potential impacts for subsistence users; and

- Survival and mortality for predator-prey relationships to enable assessment of Project-related mortality risk.

8.8.2.1. Bears

The original APA Susitna Hydroelectric Project included studies of the population size and density, demography, seasonal movements, dispersal, den locations, and predation rates on moose calves by both brown and black bears from 1980 to 1985 (ABR, Inc. 2011). No studies of bears were conducted downstream from Devils Canyon. The density of brown bears in the upstream area was estimated to be 29.7 bears/1,000 square kilometers for an area of 12,127 square kilometers defined as the area within 1 mean brown bear home range diameter from the Susitna River (Miller 1987). Approximately 12 percent of the relocations (n = 1,720) of radio-collared brown bears occurred in the area that would have been inundated by the APA Susitna Hydroelectric Project Low Watana reservoir; bears used that area twice as frequently as expected both in the spring and for all months combined. This pattern of use was evident for males and most females, but not for females accompanied by cubs of the year. Bears spent the highest proportion of time in the Watana impoundment zone during June, when they foraged on south-facing slopes for roots, new vegetation, and overwintered berries, and preyed on moose calves. Females with young cubs tended to stay at higher elevations, possibly to reduce the risk of predation on cubs by male brown bears (Miller et al. 1997).

Brown bears preyed on moose calves from late May to early June, with predation rates declining substantially by mid-July (Ballard et al. 1990). In addition to moose calves, the Susitna bear population had access to salmon, which is unusual for brown bears in interior Alaska. Bears, especially males, moved to the Prairie Creek drainage, a tributary to the Talkeetna River located southwest of Stephan Lake (between the Devils Canyon and Watana dam sites), during July and early August to feed on spawning Chinook salmon (LGL 1985). Despite the availability of protein-rich animal foods, berry production appeared to be a major factor limiting brown bear productivity in the Susitna study area (LGL 1985). Miller (1987) estimated berry abundance and canopy coverage within and above both impoundment zones proposed for the original APA Susitna Hydroelectric Project. Horsetails (*Equisetum* spp.), an important spring food, were more abundant outside the impoundment zones, but some sites with abundant horsetails would have been inundated by the proposed reservoirs (Helm and Mayer 1985). An ADF&G study of brown bear movements and demography in GMU 13A is nearing conclusion; that study area is located south of the proposed reservoir inundation zone for this Project.

The density of black bears in black bear habitat comprised of spruce forest and shrub-lands along the Susitna river was estimated to be 90 bears/1000 square kilometers in the 1980s (Miller 1987); that density estimate has not been updated since (Tobey 2008). Although black bears in the upper basin occasionally ate moose calves, berries appeared to be their most important food source (LGL 1985). Black bears spent most of their time in forested areas along creek bottoms, but moved out into adjacent shrublands during late summer as they foraged for berries, particularly in the area between Tsusena and Deadman creeks (Miller 1987). In May and June, 52 percent and 46 percent, respectively, of all locations of radio-collared bears occurred in areas that would be flooded by the proposed impoundment (Miller 1987).

The ADF&G management objective for brown bears in GMU 13 is to maintain a minimum population of 350 animals (Tobey and Schwanke 2009). The management objective for black

bears in GMU 13 is to maintain the existing population of black bears with a sex structure that will sustain a harvest of at least 60 percent males (Tobey 2008). Bears in GMU 13 are of interest both as predators of caribou and moose and as important game species.

The Project is likely to result in wildlife habitat loss and alteration, blockage of movements of mammals, disturbance, and changes in human activity and access due to construction and operation of the Project. Bears often pose management challenges for large development projects in Alaska because of their attraction to areas of human activity and associated waste-handling facilities; proper disposal of anthropogenic wastes is important for minimizing such problems.

8.8.2.2. Wolf

Most of GMU 13 (except Subunit 13D, south of the Glenn Highway), including the upper Susitna River basin, currently is managed by ADF&G under a predator control program instituted in response to the State's intensive management law, passed in 1994. Since 2006, the number of wolves in GMU 13 has been within the current management goal range of 135–165 wolves (3.3–4.1 wolves/1,000 square kilometers) after the end of the hunting and trapping seasons (Schwanke 2009). In neighboring GMU 14, the wolf population was estimated at 100–130 animals in fall 2004 and 145–180 in fall 2007, well above the management objective of a minimum population of 55 wolves (Peltier 2006, 2009). GMU 14 currently is not included in the State's predator control program.

The wolf study for the original APA Susitna Hydroelectric Project was conducted during 1981–1983 in the Nelchina and upper Susitna River basins, building on regional studies that began in the 1970s (see ABR 2011 for details). That study provided data on pack size, territory boundaries, den and rendezvous sites, and feeding habits, based on radio-tracking of collared animals. During the study period, 13 different packs and a lone individual used areas in or adjacent to the Devils Canyon and Watana impoundment zones proposed for the APA Susitna Hydroelectric Project. Wolf packs used almost the entire upper Susitna basin, except areas above 4,000 feet. elevation; elevational use varied seasonally, probably in response to availability of prey species. In each year, 5–6 wolf packs used the areas that would have been inundated by the APA Susitna Hydroelectric Project. Den and rendezvous sites usually were located on well-drained knolls and hillsides with sandy, frost-free soils and mixed, semi-open stands of spruce, aspen and willow. The most important potential impact on wolves from the APA Susitna Hydroelectric Project was predicted to be reduced winter availability of primary prey species (moose and caribou) in the impoundment zones. In addition, habitat loss due to inundation and facilities development would have caused wolves to adjust territory boundaries, potentially resulting in intraspecific strife.

Wolves have been studied extensively in GMU 13 since the mid-1970s and are the subject of ongoing surveys for ADF&G's intensive management program. The number of wolves and packs using the Project area currently is unknown, although it appears to be substantially lower than during the original APA Susitna Hydroelectric Project studies because of current predator control efforts in GMU 13 and 16. Research in recent years has focused on ADF&G's Nelchina study area in GMU Subunit 13A, located south of the proposed reservoir.

8.8.3. Study Area

GMU 13 is an intensive management area where predator control measures have been implemented by the State of Alaska to increase caribou and moose populations. In GMU 13, predator control measures have included land-and-shoot harvest of wolves and liberalized regulations for the harvest of wolves and bears.

Field studies of large carnivores will be limited to surveys of bear use of anadromous fish spawning streams in the middle reach of the Susitna River and its tributaries downstream from the proposed Watana dam site. The study area for bear surveys lies within GMU Subunits 13A and 13E and encompasses the proposed Project area, including the impoundment zone, the access and transmission corridors, and other Project features (Figure 8.8-1). Additional survey work would be conducted downstream from the proposed Watana Dam site, primarily in tributary drainages that contain spawning runs of anadromous fishes, as far downstream as the confluence of the Susitna River and the Chulitna River.

No field studies are proposed for wolves and the wolf study will comprise an analysis of existing ADF&G data from GMU subunits 13A, 13B, 13E, 14B, 16A and 20A.

8.8.4. Study Methods

8.8.4.1. Bears

ADF&G has concluded that adequate data generally are available for brown bears and black bears in the greater Project area to evaluate potential impacts of the Project, but "information on downstream use of habitat and the importance of salmon in bear diets in conjunction with impacts to salmon would aid in identifying potential impacts to bears downstream of the dam" (letter from M. Burch, ADF&G, to AEA dated November 22, 2011). ADF&G does not consider bear dens to be "sensitive" locations because they are seldom reused (letter from M. Burch, ADF&G, to AEA dated December 20, 2011).

A multi-faceted approach will be used to address the need for current information on bears in the Project area. Reanalysis of 1980s data and synthesis with current data from other previous or ongoing ADF&G telemetry studies and other regional management studies will provide data on bear populations, movements, and habitat use in the study area (AEA 2012a).

Surveys of bear use of anadromous fish spawning streams in the middle reach of the Susitna River and associated tributaries downstream from the proposed Watana dam site will be conducted to assess the use of those resources for bears in the Project area. The surveys would be conducted by monitoring streams using a combination of ground-based stream surveys incorporating time-lapse photography and DNA sampling from hair snares to quantify the bear population using the downstream area. Hair-snag stations would be deployed along game trails and scent stations in a grid pattern centered on the Susitna River (downstream from the dam site and upstream from Talkeetna). The size and design of the hair-snag grid will be based on the expected densities of bears, logistical considerations for access to the area, and comparison with similar studies in central Alaska.

DNA analysis of bear hair samples would provide information on the sex and species of bear, a minimum estimate of the number of different individuals in the area, and stable isotope signatures. The isotopic signature would be used to classify the proportion of the diet made up of

salmon, terrestrial meat, or vegetation (Fortin et al. 2007). If adequate samples can be obtained, mark-recapture analysis of the hair samples would provide a population estimate of the number of bears using the sampling area (Immel and Anthony 2008, Gardner et al. 2010).

Evaluation of berry resources in the reservoir inundation zone can be accomplished during the concurrent mapping efforts for vegetation, wetlands, and wildlife habitats to assess the distribution and abundance of berry plants as forage for bears.

8.8.4.2. Wolf

ADF&G's Division of Wildlife Conservation has expressed the opinion that ongoing monitoring work would be sufficient (ADF&G memorandum to AEA, 22 November 2011), so no additional field surveys are deemed necessary for the Project. Hence, desktop analyses of existing ADF&G data would be used to meet the study objectives for wolves.

Historical reports from the original APA Susitna Hydroelectric Project study will be reviewed and synthesized, where possible, with data from other recent and current monitoring by ADF&G of wolves in GMU subunits 13A, 13B, 13E, 14B, 16A and 20A, as a continuation of AEA's wildlife studies (AEA 2012), initiated in 2012 . Mapping of wolf pack territories and movements from existing ADF&G telemetry datasets would provide useful background information, although delineation of current pack territories will not be possible without tracking collared individuals, and the applicability of the available data to the greater Project area need to be evaluated. Although the findings of the wolf study conducted for the original APA Susitna Hydroelectric Project program remain relevant and could be used for the current Project analyses, the original telemetry data for wolves are no longer available and therefore cannot be reanalyzed using newer geospatial techniques.

8.8.4.3. Impact Assessment

The ;primary impacts on bears are expected to be direct loss of habitat, changes in prey density and distribution, changes in berry production, changes in human use and hunting effort, and increased potential of mortality due to defense of life or property (DLP), or availability of anthropogenic food sources. Impacts on bears will depend, in part, on the proposed plan to control anthropogenic food sources. The primary impacts on wolves are likely to be direct loss of habitat, changes in prey distribution and density, disturbance, and changes in hunting effort.

Telemetry data from the ADF&G will be used, in conjunction with bear survey data described above, to identify important habitats and high-use sites for bears and wolves in the Project area. Data on the distribution, abundance, movements, and habitat use by bears and wolves will be used to assess Project impacts. Direct habitat loss can be estimated through geospatial analysis by overlaying the impoundment, access and transmission corridors, and other project infrastructure on the Project habitat map (Sections 9.5, 9.6 and 9.7) to identify important habitats that would be lost. Additional indirect habitat loss and avoidance effects can be similarly estimated by applying various buffer distances, as determined from available information on anticipated effects. Data from the bear DNA study can be used to estimate the number of animals that might be affected at various high-use areas and to assess the dietary importance of those streams to the bear population downstream of the Watana dam. Harvest data from ADF&G will provide baseline data for evaluation of changes in harvest and other mortality that may result from improved access. Data on the seasonal distribution, abundance, and movements of bears

and wolves among habitats in relation to the geographic extent and seasonal timing of various Project activities can be used to identify necessary avoidance and minimization measures.

8.8.5. Consistency with Generally Accepted Scientific Practice

Mark-recapture analysis of genetic markers and stable isotopes analysis of hair samples have been widely used in recent years. Analysis of hair samples to determine bear diet and population size has been previously used (Fortin et al. 2007, Gardner et al. 2010).

8.8.6. Schedule

This is a multi-year study that was initiated in 2012. Reanalysis and synthesis of existing bear and wolf data through 2011 is currently being conducted (AEA 2012a). Incorporation of new data and additional analyses will be conducted incrementally as recent and current data are obtained from ADF&G databases. Field surveys of bear use of salmon streams downstream from the proposed dam site will be conducted during mid- to late summer in 2013 and 2014 to coincide with the timing of spawning runs of salmon. Evaluation of berry resources in the reservoir inundation zone would be accomplished during concurrent mapping efforts for vegetation, wetlands, and wildlife habitats. Data analysis, QA/QC, and reporting would be conducted in the fall and winter months after recent and current data are transferred from ADF&G and field work is completed in late summer. The Initial Study Report and Updated Study Report will be prepared in December 2013 and 2014, respectively.

8.8.7. Level of Effort and Cost

Sightability of bears from aerial surveys over forests is low and the large Project area makes direct observations from the ground problematic. Stable-isotope analysis of bear hair provides an indirect estimate of the major components of bear diets without requiring capture and handling of bears. Approximately 1 to 2 weeks of field time by a crew of two biologists would be required in mid-summer to establish the hair-snag grid between the proposed dam site and Talkeetna. The hair-snag stations then would be checked at weekly intervals during late summer, when use of the area is expected to be highest.

Collection of data on berry distribution and abundance in the reservoir impoundment zone would be conducted during the vegetation and wetland field surveys, eliminating the need for separate field surveys.

Project costs in 2013 are anticipated to be less than $250,000. A similar level of effort will be required for 2014.

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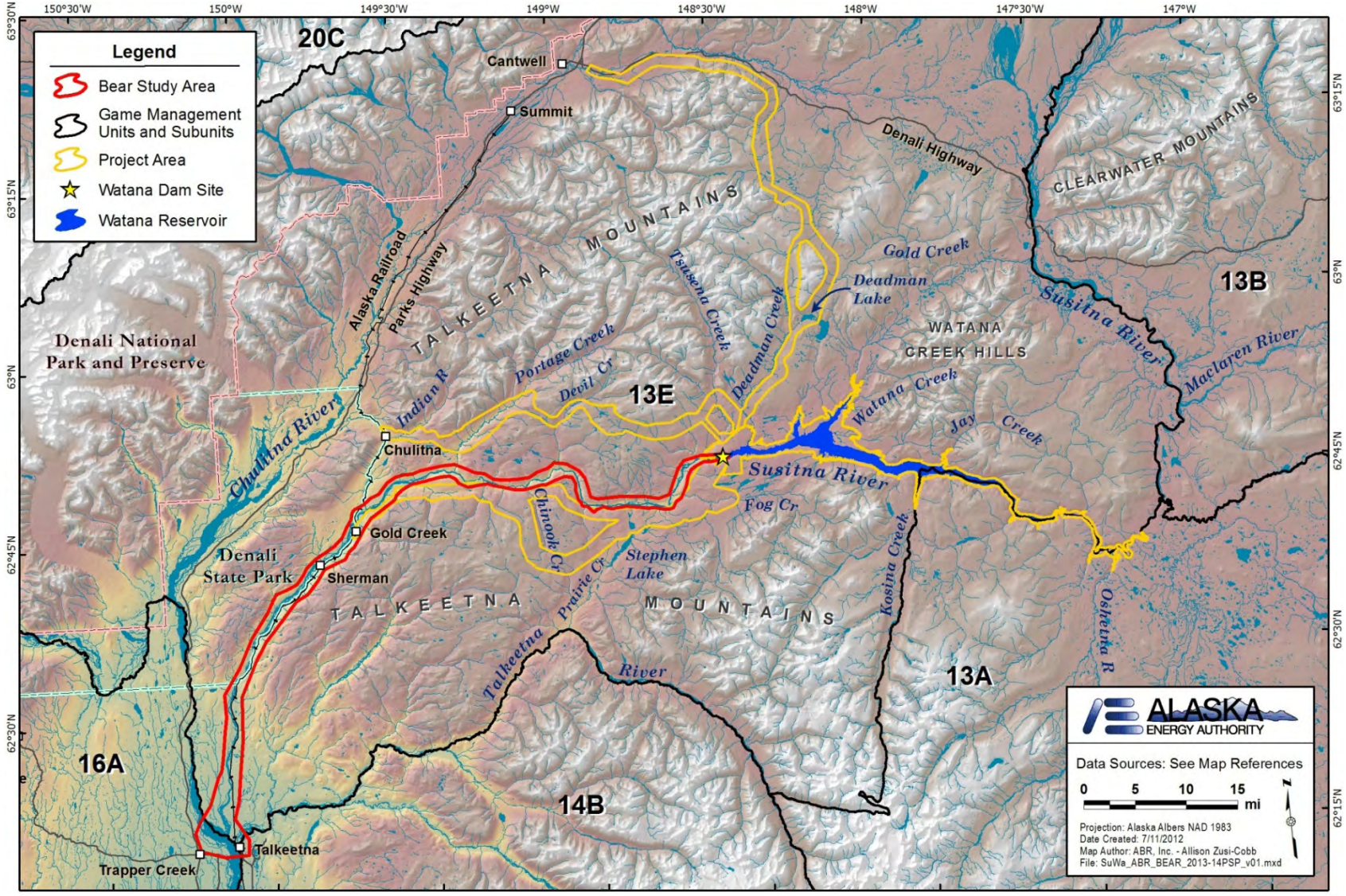

Figure 8.8-1. Study area for bears.

8.9. Study of Distribution and Abundance of Wolverines

8.9.1. General Description of the Proposed Study

The wolverine study is a multi-year study that was initiated in 2012 as a desktop exercise and will be completed in 2013. Data on wolverine monitoring efforts in the study area prior to 2012 will be obtained from ADF&G in 2012 and a single aerial survey will be conducted in late winter 2013.

8.9.1.1. Study Goals and Objectives

The overall goal of this study is to collect preconstruction baseline population data on wolverines (*Gulo gulo*) in the greater Project area (reservoir impoundment zone; facilities, laydown, and storage areas, access and transmission-line routes) to enable assessment of the potential impacts from development of the proposed Project. This information will be used to estimate the number of wolverines that may be affected by the Project and to evaluate impacts on habitats used seasonally by wolverines.

Three specific objectives have been identified for this study:

1) Describe the winter distribution of wolverines;
2) Describe winter habitat use by wolverines; and
3) Estimate the current population size of wolverines.

8.9.2. Existing Information and Need for Additional Information

The Project will result in wildlife habitat loss and alteration, blockage of movements of mammals, disturbance, and changes in human activity due to construction and operation of the Project. The Project may result in habitat loss, reduced access, or displacement from seasonally used sensitive habitats in the middle and upper Susitna River basin such as denning areas, or prey calving and wintering areas, caused by increased human activity.

The wolverine study would provide baseline data for the Project area, including winter habitat-use data for development of habitat evaluation criteria. The study would provide a basis for impact assessments; for developing any appropriate protection, mitigation, and enhancement measures, which may include resource management and monitoring plans.

ADF&G conducted a mark–recapture study of radio-collared wolverines in the upper Susitna River basin for the original APA Susitna Hydroelectric Project to investigate population density and distribution, habitat selection, home-range size, and seasonal movements from 1980 to 1983 (see details in ABR 2011). A sample of 22 wolverines was equipped with VHF radio-collars between April 1980 and April 1983. Sufficient data to estimate home-range size were obtained for only four males and three females, however. Harvest records, track data, and incidental sightings also were used to help estimate distribution, population size, and food habits of wolverines in the Susitna basin. In addition to collared animals, the carcasses of 136 wolverines that had been harvested in or near the study area were examined. Habitat use by wolverines varied among seasons, with respect to both elevation and vegetation types. Wolverines were located at higher elevations in summer and lower elevations during winter (Whitman et al. 1986). Collared wolverines avoided tundra habitats in winter and forested habitats in summer, probably

because of seasonal changes in prey availability, and used other habitats in proportion to their availability. The most notable potential impact of the original APA Susitna Hydroelectric Project on wolverine was considered to be permanent loss of winter habitat. A potential decrease in the regional moose population as a result of the project would have reduced the amount of carrion available to wolverines during winter. Whitman and Ballard (1983) estimated that 45 percent of the wolverines in the Susitna basin used the impoundment zone, and therefore, would have been affected to some degree by the reservoir. Improved access and a greater human presence in the region would have increased the potential for higher harvest rates of wolverines.

No recent estimate of the wolverine population is available for the Project area. Because the relative inaccessibility of much of the Project area may make it a refugium (population source area) for the wolverine population in Game Management Unit (GMU) 13, ADF&G requested the wolverine population to be estimated (ADF&G memorandum to AEA, 22 November 2011).

8.9.3. Study Area

The study area encompasses the proposed Project area, including the impoundment zone, dam site, access and transmission-line corridors, and other project infrastructure and adjacent areas as illustrated in Figure 8.9-1. Most of the area is within Game Management Unit (GMU) Subunits 13E and 13A. The exact boundaries will be defined after consultation with ADF&G who have offered to help plan the survey, drawing on the expertise of their furbearer biologists, who have developed the method that is proposed for use in this study (Golden et al. 2010).

8.9.4. Study Methods

An aerial survey using snow-tracking in winter and a sample-unit probability estimator (SUPE; Becker et al. 2004, Golden et al. 2007) would be used to estimate the number and density of wolverines in the Project area. With this method, the survey area is stratified based on predicted density and is divided into sample units (e.g., 25-square kilometers for wolverines; Golden et al. 2007). Sample units are selected at random from each stratum and are surveyed soon after a significant snowfall, until all tracks within selected sample units are located. Tracks are then followed in both directions to map the entire movement path since the last snowfall and the number of animals in the group is estimated. Data are analyzed using program SUPEPOP and formulas from Becker et al. (1998). Surveys sampling 65–70 percent of high-density sample units and 45–50 percent of medium- and low-density sample units should result in a density estimate with a coefficient of variation (CV) of <10 percent.

Historical reports from the original APA Susitna Hydroelectric Project study will be reviewed and synthesized, where possible, with data from other recent and current monitoring by ADF&G in GMU Subunits 13A, 13B, 13E, 14B, 16A and 20A, as a continuation of the wildlife harvest study (AEA 2012), which began in 2012 . Although the findings of the wolverine studies conducted for the original APA Susitna Hydroelectric Project remain relevant and can be used for current Project analyses, the original telemetry data for wolverines are no longer available (R. Strauch, ADF&G, 2012 pers. comm.), so cannot be reanalyzed using newer geospatial techniques.

8.9.4.1. Impact Assessment

Potential impact mechanisms of the proposed Project on wolverine include:

- Direct and indirect loss and alteration of wildlife habitats from Project construction and operation;
- Physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities and related indirect effects, including habitat connectivity and genetic isolation;
- Direct and indirect impacts on predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development;
- Behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development;
- Direct mortality due to vehicle strikes, exposure to contaminants, and protection of life and property; and
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development.

Wolverines typically occur at lower densities near human development (May et al. 2006, Gardner et al. 2010) and this may be the primary impact of the Project on wolverines. Data on the winter distribution, abundance, and habitat use by wolverines in the study area will be used to assess Project impacts of habitat loss and behavioral avoidance. Observed locations of wolverines and, where feasible, abundance data will be plotted on the wildlife habitat map of the Project area that will be developed under the botanical resources study plans and each habitat ranked by level of use. Direct loss of preferred or important habitats can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the Project habitat map. Indirect loss and avoidance estimates can be made by applying various buffer distances, as determined from the available information on the anticipated effects. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on wolverines. ADF&G harvest data will provide a baseline against which to assess impacts of changes in level of harvest. Any necessary PM&E measures will be developed by examining the seasonal distribution and abundance of wolverines among habitats in relation to the geographic extent and seasonal timing of various Project activities.

8.9.5. Consistency with Generally Accepted Scientific Practice

The sample-unit probability estimator (SUPE) is used by ADF&G for wolverine studies. Golden et al. (2007) used a SUPE to estimate wolverine density in two areas of Alaska. The ADF&G Division of Wildlife Conservation supports the use of a SUPE survey for estimating the wolverine population (letter from ADNR [representing State agencies, including ADF&G] to AEA dated May 30, 2012).

8.9.6. Schedule

This is a multi-year study that was initiated in 2012. Data on wolverine monitoring efforts in the study area prior to 2012 will be obtained from ADF&G in 2012 (AEA 2012). A single aerial SUPE survey will be conducted in late winter 2013 after a significant snowfall. Additional wolverine data for 2012–2013, if any, will be added if it becomes available from ADF&G, following completion of data entry, verification, and QA/QC checks. An Initial Study Report will be prepared in December 2013. An Updated Study Report will be issued in December 2014.

8.9.7. Level of Effort and Cost

It is anticipated that a single aerial survey in late winter (February/March 2013) will be adequate to provide a population estimate of wolverines in the Project area. Multiple pilot/observer teams would be used to cover as much of the Project area as possible within as short a time period as possible once suitable survey conditions are achieved following a fresh snowfall. It is estimated that 48–72 hours of flight time would be required, using small aircraft. ADF&G has offered to help plan the survey, drawing on the expertise of their furbearer biologists, who have developed the method that is proposed for use in this study (Golden et al. 2010).

Project costs in 2013 are anticipated to be less than $120,000. There is no field work planned for 2014.

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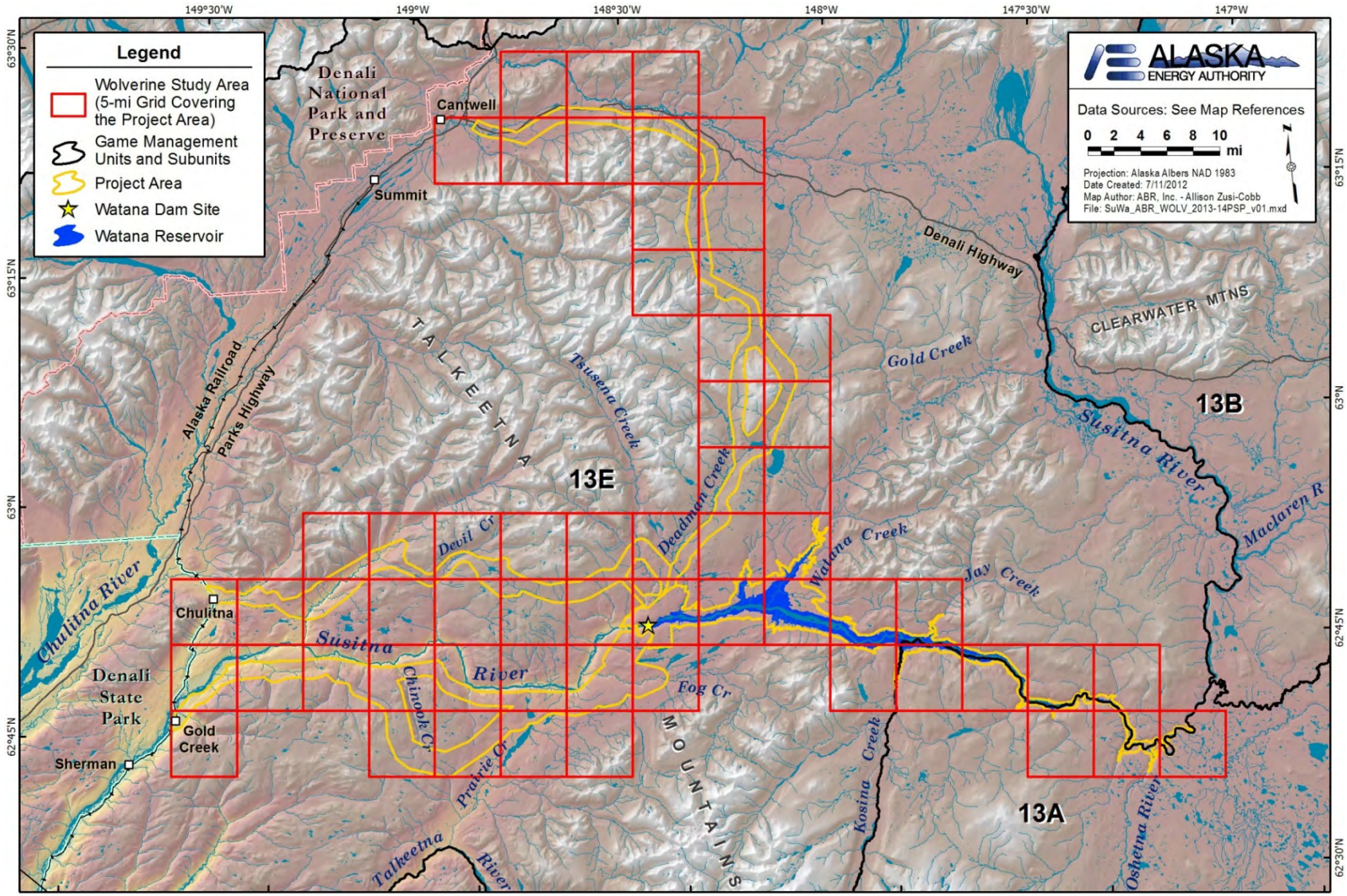

Figure 8.9-1. Wolverine study area.

8.10. Study of Terrestrial Furbearer Abundance and Habitat Use

8.10.1. General Description of the Proposed Study

Terrestrial furbearer studies were initiated in 2012 and, as outlined here, will continue in 2013 and 2014. The terrestrial furbearer studies will be conducted as part of a thesis project by UAF Professor Laura Prugh and her graduate student. Data and reports pertinent to the goals of this Project will be provided by Dr. Prugh; elements of the larger UAF thesis project lie outside the context of impact assessment and mitigation and are not included in this study plan or in the FERC licensing process.

8.10.1.1. Study Goals and Objectives

The goal of this study is to provide current information on the abundance and habitat use of terrestrial furbearers (coyote [*Canis latrans*], red fox [*Vulpes vulpes*], lynx [*Lynx canadensis*], and marten [*Martes americana*]) for use in evaluating potential Project-related impacts and identifying appropriate mitigation. The potential impacts of the Project include habitat loss and fragmentation, increased human harvest and disturbance, and changes in prey populations (AEA 2011). Accurate population estimates and habitat-use data are important for adequately determining the amount of habitat loss and identifying the relative likelihood and magnitude of changes in harvest. This information will be used to assess the potential effects of the Project on furbearer populations, which will inform development of any necessary protection, mitigation, and enhancement measures, which may include management and monitoring plans.

Red fox, lynx, and marten are ecologically important and valuable furbearers; coyotes are also ecologically important but they are not as highly valued as furbearers. Although coyotes are widely distributed throughout Alaska, little is known about their abundance or ecological effects. The coyote is considered to be a "human commensal" species, benefiting from human activities such as road construction and agriculture (Young and Jackson 1951). Coyotes may increase in abundance as a result of the Project, and because they prey on a wide variety of large and small game, and compete with and prey on foxes and lynx, changes in coyote abundance could have substantial effects on other wildlife resources. Trapper surveys show that Alaskans who trap in GMUs 11 and 13 are particularly concerned about the impact of coyotes on Dall's sheep populations (Schwanke 2010) and several studies have found that coyotes are a major predator of Dall's sheep lambs (Hoefs and McTaggart-Cowan 1979, Scotton 1998, Arthur and Prugh 2010).

This study has seven specific objectives:

1) Develop population estimates of coyotes and red foxes through collection of scats along trails and rivers throughout the study area during winter months (January–March) in 2013 and 2014;
2) Develop a population estimate of marten through collection of hair samples in the reservoir inundation zone using hair snag tubes;
3) Develop a population estimate of lynx through collection of hair samples throughout the study area using hair snag plates;
4) Develop indices of prey abundance in the study area by recording snowshoe hare (*Lepus americanus*) sign and estimating vole abundance;

5) Conduct genetic analyses of fecal and hair samples to confirm species identity and to differentiate individual animals;

6) Calculate furbearer population estimates using genotype data and capture–mark–recapture statistics; and

7) Compile habitat-use data for the furbearer species being studied.

The habitat-use data and species population estimates will be used to assess the potential impacts of the Project on these populations, and for use in developing any necessary potential PM&E measures.

8.10.2. Existing Information and Need for Additional Information

The original APA Susitna Hydroelectric Project study program collected data on use of the Project area by marten (Gipson et al. 1982, 1984; Buskirk 1983, 1984; Buskirk and MacDonald 1984; Buskirk and McDonald 1989) and red fox (Hobgood 1984), but no information was collected on coyotes or lynx, aside from incidental sightings. The APA Susitna Hydroelectric Project studies indicated that marten may be especially impacted by the reservoir, because a substantial amount of their preferred habitat (mature spruce forest) occurs within the inundation zone. ADF&G has not conducted population estimates of small furbearers in GMU 13. Trapping reports indicate that populations have experienced normal annual and cyclic fluctuations, but no indications of long-term increases or decreases have been apparent (Schwanke 2010).

Major advances in the estimation of predator population sizes have occurred since the original APA Susitna Hydroelectric Project studies were conducted in the 1980s. A large body of literature has accumulated on the use of noninvasive genetic techniques to obtain population estimates for numerous species around the world. Many studies of wolves, bears, wolverines, coyotes, foxes, lynx, marten, river otters (*Lontra canadensis*), and other species have successfully used noninvasive techniques to estimate population sizes (Mowat and Paetkau 2002, Waits and Paetkau 2005, Petit and Valiere 2006, Long et al. 2008).

Marten is the most economically valuable furbearer in GMU 13 (Schwanke 2010). Loss of habitat combined with increased access could lead to unsustainable levels of harvest and population declines in marten and other furbearers. Thus, current population estimates are needed to serve as a baseline for assessing the impact of Project activities and for developing any necessary protection, mitigation, and enhancement methods, as well as management and monitoring plans.

The wildlife data gap analysis completed for the Project (ABR 2011) recommended using a combination of aerial track surveys and non-invasive capture–mark–recapture surveys to determine current habitat use, movement patterns, and population sizes of furbearer species. In general, aerial track surveys techniques are appropriate and will be adopted, in particular for assessing habitat use. However, aerial tracking methods may be inappropriate for estimating population sizes of small terrestrial furbearers and mark-recapture studies are preferred. The aerial snow-track survey method that provides estimates of population size is known as the survey-unit probability estimator (SUPE; Becker et al. 1998, 2004) and the SUPE model was recommended by the ADF&G for the Project to obtain population information on wolverines. The method is appropriate and has been well-tested for large furbearers such as wolves and wolverines, which often travel over long distances in open habitats where tracks are possible to

follow from the air. Similarly, beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) sign are also easy to see from the air. However, the SUPE method has several assumptions and requirements that make it impractical for population surveys of smaller terrestrial furbearers and the ADF&G, in comments on the gap analysis and preliminary study plans, recommended against its use for species other than wolverine for the following reasons. First, the method requires following the full length of a track from its end, where the animal is seen, back to its start, when the last snowfall ended. Small furbearers often travel in tightly meandering routes within dense brush or forests and their tracks can be obscured by snowshoe hare tracks. Coyotes prefer to travel on trails broken by other species (e.g., wolf and moose trails) because they have high foot loading and avoid traveling in deep snow (Murray and Boutin 1991), making their tracks easy to lose. Second, aerial tracking relies on weather conditions that are uncommon (a fresh snowfall followed by several days of calm weather) and an SUPE survey can take several days per species to conduct (Becker et al. 1998). Therefore, it is unlikely that weather conditions and availability of experienced personnel would allow sufficient time to complete SUPE estimates for other furbearers in the study area in addition to the planned SUPE estimates for wolves and wolverines. In addition, the SUPE has not been tested on smaller furbearers. Validations of SUPE population estimates in areas with known population sizes have occurred for wolves and cougars (*Puma concolor*) only, with mixed results (Vansickle and Lindzey 1991, Patterson et al. 2004, Choate et al. 2006). Thus, although aerial track transects may be useful for obtaining information on habitat use and movement patterns of smaller furbearer species, accurate estimation of population sizes requires different methods. As outlined below, mark-recapture methods are preferred for estimating population size of terrestrial furbearers smaller than wolves or wolverine.

8.10.3. Study Area

The terrestrial furbearer study area (Figure 8.10-1) will include all terrestrial areas that are safely accessible by snowmachine within a 10-kilometer (6.2-mile) buffer zone surrounding the areas that will be directly altered or disturbed by Project construction and operations, including facility sites, laydown/storage areas, the reservoir inundation zone, and access road and transmission-line corridors. Carnivores are wide-ranging animals that occur in low densities, so sampling will need to extend upstream on the Susitna River above the inundation zone and as far as 10 kilometer on either side of the inundation zone and access/transmission corridors. This wider sampling is needed to obtain adequate sample sizes to calculate population density estimates of furbearers. While density estimation of furbearers requires wide sampling, all samples will be georeferenced so that a total count of furbearers occupying the Project-affected areas can be determined.

8.10.4. Study Methods

The methods for the study components are described below.

8.10.4.1. Sample Collection

Snowmachine trails will be established along creeks and rivers throughout the study area (i.e., along road and transmission corridors and the inundation zone). Trails will be traveled approximately every 2 weeks during January–March in 2013 and 2014, and all canid and felid scats will be collected. Scats will be collected with ziplock bags and then placed within autoclave

bags to prevent cross-contamination. Scats will be stored frozen, which preserves DNA for analysis.

Unlike canids, lynx and marten do not preferentially travel on rivers and trails. Therefore, hair snags will be used to obtain genetic material from those species. Lynx habitat within the study area (i.e., areas with tree or shrub cover) will be divided into approximately 50 blocks. Each block will be 25 square kilometers (9.65 square miles) in size, approximately the average size of a lynx home range (Slough and Mowat 1996, Vashon et al. 2008). Two hair snag plates will be placed in each block, in locations that are accessible and likely to be encountered by any lynx occurring in the area. Hair snag plates will consist of an attractant that will cause lynx to rub and a barb to collect a hair sample (Zielinski et al. 2006). Hair-snag stations will be checked monthly during January–March in 2013 and 2014, and all hairs found on barbs will be placed in coin envelopes and stored in a dry location to preserve the DNA. Because marten home ranges are small and a survey of the entire study area would be impractical, the marten survey will be restricted to the inundation zone. This zone, which is approximately 125 square kilometers (48.26 square miles) in size, will be divided into 25 5-square kilometer (1.93-square mile) blocks, roughly corresponding in size to the 3 to 6 square-kilometer (1.16 to 2.32 square-mile) home range of female marten reported in this area during the 1980s (Buskirk 1983). Two hair-snag tubes will be placed within each block in locations likely to be used by marten, as described by Williams et al. (2009).

Snowshoe hare abundance will be determined by counting their fecal pellets in 8–10 plots within the Project area. Pellet counts have been shown to correspond closely to snowshoe hare density (Krebs et al. 1987). The Project area will be stratified into 4–5 blocks, and two pellet count plots will be randomly placed within each block, one in spruce forest and one in riparian habitat. Fifty circular plots with a radius of 0.5 meters (1.64 feet) will be spaced 15 meters (49.21 feet) apart at each site, and all pellets will be counted and cleared from the plots. In the first year of the study, pellets will be aged, based on appearance, to estimate whether they are more or less than a year old (Prugh and Krebs 2004).

The abundance of voles will be estimated by using live-trapping and mark–recapture methods in 8–10 plots. Two trapping grids will be established in spruce forest and in grassy meadow habitats. Each grid will consist of 50 live-trap sites spaced 10 meters (32.81 feet) apart. The traps will be operated for 1–3 nights. Captured voles will be weighed, ear-tagged, identified to species and sex, and released. The proportion of recaptured tagged individuals to unmarked individuals will be used to calculate an estimate of population abundance.

8.10.4.2. Genetic Analyses

The outer surface of each frozen scat will be scraped with a scalpel, and shavings will be placed in 2-mL vials. DNA from hair samples will be extracted using Qiagen® kits (a commercially available DNA assay). Mitochondrial analyses will be used to determine the species identification and sex of individuals that deposited each hair and scat sample. Genotypes will be determined by amplifying DNA at 6 loci. Amplification will be repeated 2–3 times to verify accuracy because DNA from feces and hairs sometimes are degraded and errors can occur (Miller et al. 2002).

8.10.4.3. Habitat Use

Habitat use will be evaluated by conducting aerial surveys of tracks in snow. Experienced observers (such as ADF&G biologists) will fly pre-determined transect lines and record GPS receiver locations of tracks encountered. These locations will be overlaid on habitat maps using ArcGIS® software (ESRI, Redlands, California) to examine patterns of habitat use in the Project area for each furbearer species.

8.10.4.4. Statistical Analyses and Data Interpretation

Once reliable genotypes are obtained, each genotyped sample is considered to be a "capture" event. Mark–recapture population estimates and confidence intervals will be obtained using the program *rMark* (Laake and Rexstad 2008). Survival, recruitment, and population growth rates will be estimated between years using open mark-recapture estimators such as Pradel models (Laake and Rexstad 2008).

Natural cycling of snowshoe hare numbers and wolf control efforts by ADF&G in the Project area may influence furbearer abundance in the study area, making it difficult to isolate the effects of Project activities. To assess these confounding factors, abundance estimates and trends found in this study will be compared with findings from a similar study in nearby Denali National Park and Preserve (DNPP). Trends found in DNPP will indicate how furbearer populations are fluctuating in response to the hare cycle in the absence of wolf control and in the absence of Project activities. Hare pellet counts will be conducted in DNPP as well as in the Project area. Comparing baseline furbearer surveys in the Project area with surveys in DNPP will indicate how wolf control is affecting furbearers in the Project area. This comparison will be useful in subsequently determining which changes in furbearers may be due to the Project activities and which changes may have occurred due to other factors.

8.10.4.5. Data Products

This terrestrial furbearer study will provide preconstruction baseline data for the Project area, including habitat-use data for use in developing habitat evaluation criteria. The terrestrial furbearer study will provide a basis for impact assessment; developing appropriate protection, mitigation, and enhancement measures as needed; and developing resource management and monitoring plans.

The following data will be produced from this study:

1) Population estimates, with confidence intervals, for coyote, red fox, lynx, and marten in 2013 and 2014;
2) Estimates of survival, recruitment, and population growth for coyotes, red foxes, lynx, and marten between 2013 and 2014;
3) Habitat use and selection data based on aerial track surveys;
4) Snowshoe hare pellet-count data in spruce and willow habitats; and
5) Genetic samples from furbearers in the study area, which will be stored for at least 5 years after the study is completed.

A final report presenting all study results will be produced that includes an examination of the population dynamics and habitat use of terrestrial furbearers in the study area. GIS mapping with layers showing the locations of study transects, furbearer snow tracks, and genetic samples collected during the study will also be created.

8.10.4.6. Impact Assessment

All four species of terrestrial furbearers are predators and would be affected both directly by Project activities and features and indirectly by effects on prey species. The primary impacts of the Project on terrestrial furbearers include:

- Direct and indirect habitat loss and alteration, including potential effects on prey species,
- Potential direct behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation,
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development,
- Potential direct mortality due to vehicle strikes, exposure to contaminants, and attraction to garbage and human activity,
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development, and
- Potential physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions.

For terrestrial furbearers, all impacts including direct and indirect habitat loss and alteration, behavioral effects, altered movements, and mortality primarily will occur in the impoundment area, access and transmission corridors, and other facility footprints.

Data on the distribution, abundance, and habitat use of terrestrial furbearers in the study area can contribute to the assessment of Project impacts. Using GIS software, species abundance data recorded among different habitat types can be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans. The direct impacts of habitat loss and alteration by the Project can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map and then calculating direct impacts. Indirect impacts also can be assessed by applying various buffer distances, estimated from the available information on the anticipated effects. Data collected in this study of terrestrial furbearers can be used in combination with information from the literature conduct a GIS analysis of the geographic extent, frequency, duration, and magnitude of Project effects on terrestrial furbearer populations. For coyotes, foxes, lynx, and marten, population data from the terrestrial furbearers study will allow an assessment of population-level impacts of direct and indirect habitat loss. For snowshoe hares, pellet counts conducted by the terrestrial furbearer study will provide semi-quantitative assessment of population effects. Any necessary PM&E measures will be developed by

examining the distribution and abundance of species among habitats in relation to the geographic extent and seasonal timing of various Project activities.

Separate studies of prey species ion the Project area, including Dall's sheep, ptarmigan, and small mammals, will provide additional information on the impact of predatory terrestrial furbearers on prey species and will improve the assessment of potential Project-related impacts for all species. Surveys to estimate wolf numbers will improve our understanding of the relationship between large and small furbearer populations and will help to determine whether future changes in furbearer abundance may be related to changes in wolf density, prey availability, or Project-related impacts.

8.10.5. Consistency with Generally Accepted Scientific Practice

Noninvasive genotyping is a well-established technique to obtain reliable population estimates of coyotes, red foxes, lynx, and marten. Fecal genotyping has successfully been used to monitor coyote population dynamics from 2000 to 2002 in the central Alaska Range (Prugh and Ritland 2005, Prugh et al. 2005, Prugh et al. 2008).

8.10.6. Schedule

This is a multi-year study that includes data collection 2012–2014.

2012:

August — Fieldwork to collect prey abundance data.

- Establish 8–10 hare pellet plot grids
- Conduct hare pellet counts
- Establish vole trapping grids
- Conduct vole trapping for population estimates

2013:

January–March — Final selection of sampling sites; fieldwork to collect genetic samples.

April–August — Preliminary genetic analyses.

June — Snowshoe hare pellet counts.

December — Initial Study Report

2014:

January–March — Fieldwork to collect genetic samples.

April–October — Final genetic analyses.

June — Snowshoe hare pellet counts.

December 2014 — Updated Study Report

8.10.7. Level of Effort and Cost

This study will require at least two field seasons to adequately assess furbearer abundance prior to Project construction. Fieldwork will be conducted by a crew of two personnel. Supervision,

data analysis, writing reports, and attending meetings are expected to require one month of the study lead's time per year. Genetic analyses will be conducted by an experienced technician. Several fixed-wing airplane trips will be needed during each winter field season for access to field sites and to conduct aerial track surveys and to haul snowmachine fuel and miscellaneous field supplies. Materials to make hair snag stations and other consumables for genetic analyses will be required. Genetic analyses for fecal and hair samples cost more than traditional genetic analyses (~$50/sample instead of ~$30) because samples need to be analyzed 2–3 times to check for errors due to low DNA quality or quantity. The total cost for the study is estimated to be $350,000–375,000.

8.10.8. Literature Cited

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8.10.9. Figures

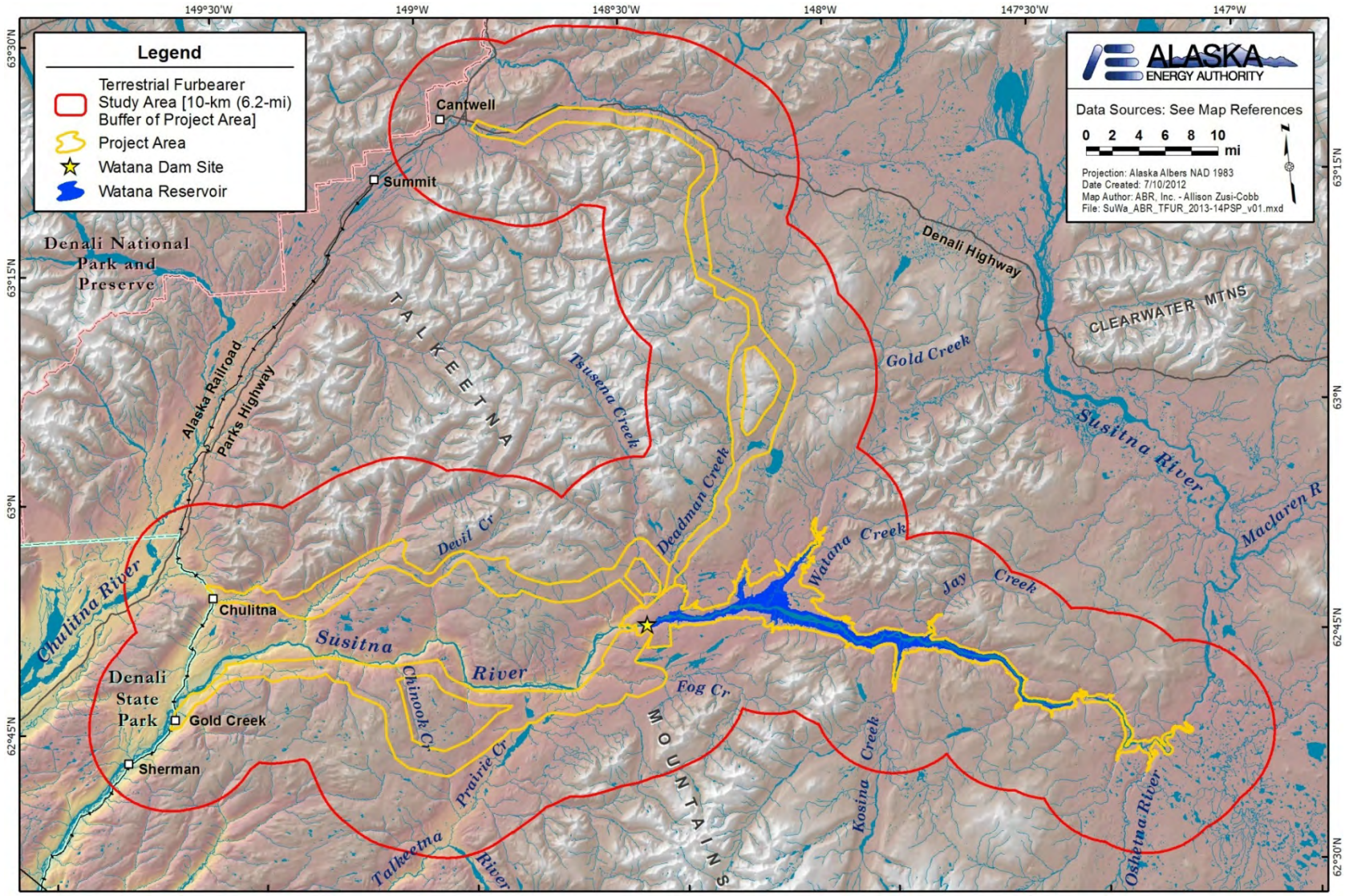

Figure 8.10-1. Terrestrial furbearer study area.

8.11. Study of Aquatic Furbearer Abundance and Habitat Use

8.11.1. General Description of the Proposed Study

The aquatic furbearer study will be conducted in 2013 and 2014. The study was designed to determine the distribution of aquatic furbearers among habitats, to estimate population sizes for beavers and relative abundance of other aquatic furbearers. Additional effort will be made to provide information on food habits and diets of piscivorous furbearers to the Project assessment of mercury bioaccumulation.

8.11.1.1. Study Goals and Objectives

The goal of the aquatic furbearer study is to collect baseline data on aquatic furbearers in the Project area to enable assessment of potential Project-related impacts. This information will be used to develop appropriate mitigation measures. Four species of aquatic furbearers occur in the Project area. The beaver is the most prominent aquatic furbearer statewide in terms of ecological and economic importance. Other aquatic furbearers in the Project area include river otter, mink (*Neovison vison*), and muskrat (AEA 2011).

Five specific objectives have been identified for this study:

1) Delineate the distribution and estimate the current population size of beavers;
2) Describe the distribution and relative abundance of river otter, mink, and muskrat;
3) Document habitat use by aquatic furbearers;
4) Review available information on food habits and diets of piscivorous furbearers (river otter and mink) as background for the Mercury Assessment and Potential for Bioaccumulation Study (See Section 5.12); and
5) Collect and analyze fur samples from river otters and mink to characterize baseline tissue levels of mercury for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.12).

8.11.2. Existing Information and Need for Additional Information

Studies of aquatic furbearers for the original APA Susitna Hydroelectric Project proposed in the 1980s focused primarily on beavers and secondarily on muskrats; limited track surveys were conducted for river otters and mink. Beavers, which were selected to predict downstream impacts of the APA Susitna Hydroelectric Project on furbearers, were studied mainly downstream of the proposed dam site (Gipson et al 1982, 1984; Woolington et al. 1984, 1985; Woolington 1986). Aerial surveys were used to locate lodges and caches and to estimate population levels and overwinter survival, and boat surveys in summer were used to detect beaver sign. Surveys were conducted using boats and airplanes between Devils Canyon and Cook Inlet during summer 1980 and 1982; in general, beaver sign increased substantially with distance downriver from Devils Canyon (Gipson et al. 1982, 1984). Side channels and sloughs were the habitat types used most often. Caches, lodges, and dens were found most often in habitats that had silty banks, willows, and poplars nearby. Little or no sign of beaver activity was found in the mainstem Susitna River during summer surveys (Gipson et al. 1984). Away from the Susitna River, beaver sign was found along slow-flowing sections of most tributaries,

including Portage Creek, Indian River (especially along a tributary flowing out of Chulitna Pass), streams along the access-road route alternative between Gold Creek and Devils Canyon, and Prairie Creek (Gipson et al. 1984).

Fall and spring counts of beaver lodges and food caches were conducted between Devils Canyon and Talkeetna (Gipson et al. 1984; Woolington et al. 1984, 1985; Woolington 1986). Fall counts were conducted annually during 1982–1985 and spring counts were conducted in 1984 and 1985. Between 1982 and 1985, the population in that area was estimated at 70–220 beavers. Aerial surveys for beavers (and muskrats) were conducted in the upstream study area during spring and summer 1980 (Gipson et al. 1982). Beaver colonies in the APA Susitna Hydroelectric Project impoundment zones occurred mostly in lakes between 610 and 730 meter (2,000 and 2,400 feet) elevation. Colonies also were present in slow-moving sections of most of the larger tributaries, particularly Deadman Creek. No active beaver lodges or bank dens were found on the Susitna River upstream of Devils Canyon (Gipson et al. 1982), however.

Aerial surveys for muskrat pushups were flown upstream from Gold Creek during spring 1980 (Gipson et al. 1982). Muskrat sign was observed most often in lakes on plateaus above the river valley, at 610–730 meter (2,001–2,395 feet) elevation. Muskrats in the upstream area appeared to depend on fairly small, isolated areas of wetland habitats. Muskrats also were seen along slow-moving sections of creeks and at locations where creeks drained into larger streams, particularly near the Stephan Lake–Prairie Creek and Deadman Lake–Deadman Creek drainages.

Tracks of river otters and mink were recorded in the upper Susitna basin during the APA Susitna Hydroelectric Project studies in the 1980s, but the number of animals present was not estimated. Tracks were widespread but not abundant, although several unusually heavy concentrations of tracks (presumably representing a small number of animals spending an extended period in one area) were noted near river ice in early winter, the time of year when track surveys were conducted.

Data on distribution, population densities, and movements of aquatic furbearers in GMU 13 is limited to that collected for the APA Susitna Hydroelectric Project, and that information is now 25–30 years old. Annual furbearer reports produced by ADF&G contain general abundance information obtained from trapper questionnaires (Schumacher 2010), but reports do not include drainage-specific population data. Current data on the abundance and distribution of aquatic furbearers is unavailable for GMU 13.

Current data on the abundance, distribution, and habitat use of aquatic furbearers is needed to enable analysis of Project impacts. A large body of research demonstrates that the beaver is a keystone species that exerts profound ecological effects on hydrology, geomorphology, vegetation, nutrient cycling, the productivity of aquatic and riparian habitats, and the distribution and abundance of fishes and other aquatic organisms (Butler 1995, Collen and Gibson 2001, Müller–Schwarze and Sun 2003, Rosell et al. 2005). As was the case for the APA Susitna Hydroelectric Project, current information on the abundance and distribution of beavers will be required. Additional data also will be needed to assess the current abundance and distribution of river otter and mink, including an effort to enumerate individual animals, particularly along the mainstem Susitna River and its clearwater tributaries. These baseline data are collected as input for the *Mercury Assessment and Potential for Bioaccumulation Study* (Section 5.12), which was recommended by the USFWS in response to the request for comments and study requests on the

Pre-Application Document/FERC Scoping Document 1 for the Project (letter from USFWS to AEA dated 31 May 2012).

8.11.3. Study Area

The study area for aquatic furbearers will vary according to the species being surveyed (see Figure 8.11-1). Because of their ecological importance to riparian habitats, beavers will be surveyed from the reservoir impoundment zone downstream to the confluence of the Susitna and Chulitna rivers, as well as along access road corridors. In contrast, surveys of muskrats will be restricted to waterbodies and wetland areas likely to be affected by Project facilities and activities in the area of the dam and associated infrastructure, including the impoundment area. Surveys for river otters and mink will focus on the reservoir impoundment and nearby river stretches downstream from the proposed dam site, potentially using the same transect locations that were surveyed in the 1980s to obtain comparative data. Surveys will extend upstream along tributaries to provide comparative data on the extent of use of those drainages in comparison with the Susitna mainstem.

8.11.4. Study Methods

Aerial surveys of beaver lodges and food caches would be conducted in a small helicopter to assess the abundance and distribution of beaver in the middle reach of the Susitna River below the proposed dam site (downstream extent to be informed by instream flow modeling), the reservoir impoundment zone in the upper basin, the proposed facilities and laydown/storage areas, and access road and transmission-line corridors. Surveys would be flown in fall shortly before freeze-up to document the distribution and abundance of active colonies, as indicated by lodges and food caches (Hay 1958, Payne 1981). Aerial surveys of active colonies would be flown again in spring to estimate the overwinter survival of those colonies.

Aerial surveys of ponds and lakes would be conducted in winter to enumerate muskrat pushups in the portions of the Project area in the upper basin that would be affected directly by Project infrastructure and activities.

Aerial surveys in a small helicopter would focus on winter snow-tracking of river otters and mink soon after fresh snowfalls by adapting the methods of Reid et al. (1987) and Sulkava and Liukko (2007) for aerial surveys. Tracks of river otters would be followed to obtain an accurate count of group size, to delineate the length of river and streams traversed by the group, and to evaluate the extent of use of the mainstem river and tributaries. All sightings of aquatic furbearers would be recorded with Global Positioning System (GPS) receivers for entry into a geospatial database for use in the wildlife habitat evaluation for the Project.

Additional data on aquatic furbearers (primarily river otter and mink) would be collected during winter track surveys of terrestrial furbearers being conducted for that separate study. In addition, historical and current data on harvest of aquatic furbearers in GMU Subunits 13A, 13B, 13E, 14B, 16A and 20A will be synthesized for the separate wildlife harvest study, beginning in 2012 (AEA 2012) and continuing in 2013 and 2014. Details of incidental sightings of aquatic furbearers would be requested from other Project researchers working on fish and aquatic resources studies.

ADF&G management objectives are to maintain accurate annual harvest records based on sealing documents for those species that require sealing of hides and to develop specific

population and harvest objectives. ADF&G requires that the pelts of river otters be sealed by an authorized ADF&G representative. This pelt-sealing requirement would provide an ideal opportunity to obtain hair samples from otters harvested in the study area for characterization of baseline mercury levels in tissues. Small amounts of hair will be taken from otter pelts for which reliable location information is available and will be sampled for methylmercury. Hair samples from mink would be more difficult to obtain, unless local trappers are working in the Project area. Another possibility for obtaining mink hair samples would be as incidental snags from the sampling being conducted for marten as part of the terrestrial furbearer study.

In addition to fur sampling, the scientific literature will be reviewed to locate and synthesize information on the food habits and diets of river otters and mink in freshwater aquatic systems, to support the pathways analysis being planned for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.12).

8.11.4.1. Impact Assessment

The primary impact mechanisms of the proposed Project on aquatic furbearer populations would likely involve

- direct and indirect habitat loss and alteration, and
- changes in mortality rates that may result from increased subsistence and recreational harvest facilitated by the improved access.

For aquatic furbearers, direct and indirect habitat loss and alteration will occur in the impoundment area, access and transmission corridors, and other facility footprints as well as downstream of the dam site, where altered flow regimes will alter riparian habitats. Variable winter flows in the Susitna River may result in direct or indirect mortality of beavers. Other potential impacts, including death or injury due to vehicle strikes or exposure to contaminants, may affect relatively small numbers of aquatic furbearers.

Data on the distribution, abundance, and habitat use of aquatic furbearers in the study area can be used to assess Project impacts. Location data that are collected for all four species of aquatic furbearers will identify important habitats in the Project area for each species. For beavers and muskrats, additional quantitative data on the abundance of beaver colonies, muskrat pushups, and river otter groups can be used to obtain estimates of the number of animals potentially affected by Project development. For all four species, direct habitat loss and habitat alteration that would result from the Project can be evaluated by overlaying furbearer location data and the Project features (including the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors) onto the habitat map that will be developed under the botanical resources study plans (See Sections 9.5, 9.6, and 9.7). Additional indirect habitat loss and alteration also can be estimated by applying various buffer distances from proposed Project features, as determined from the available information on the anticipated effects. In this way, the GIS analysis can incorporate information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on aquatic furbearers. Any necessary PM&E measures will be developed by examining the distribution and abundance of species among habitats in relation to the geographic extent and seasonal timing of various Project activities.

An analysis of harvest data that are collected by ADF&G (described in Section 8.20) can provide baseline information with which to assess the potential effects of increased subsistence and recreational harvest of aquatic furbearers.

Documentation of the distribution and relative abundance of piscivorous furbearers and characterization of their dietary habits will provide information for the pathways analysis being planned for the Mercury Assessment and Potential for Bioaccumulation Study.

8.11.5. Consistency with Generally Accepted Scientific Practice

Aerial survey methods for beaver colonies and winter track surveys will follow standard practices for recording aquatic furbearers and their sign and will be largely similar to surveys conducted for the APA Susitna Hydroelectric Project during the 1980s (Hay 1958, Payne 1981, Reid et al. 1987, Sulkava and Liukko 2007). Habitat availability and use analyses allow an ecosystem approach to impact assessment and GIS-based analysis has become a standard and straightforward method of evaluating the impacts of habitat loss and alteration.

8.11.6. Schedule

This study will be conducted in 2013 and 2014, as described below:

2013:

February–April	Monthly aerial surveys of river otters and mink (following fresh snowfall); literature review of food habits and diets of piscivorous furbearers in freshwater aquatic systems; collection of furbearer hair samples for mercury analysis
April	Aerial survey of muskrat pushups
May	Aerial survey of beaver colonies to assess overwinter survival; preliminary report on first winter survey results and literature review
October	Aerial survey of active beaver colonies
November	Aerial track survey of river otters and mink (following fresh snowfall)
December	Initial Study Report

2014:

February–April	Monthly aerial surveys of river otters and mink (following fresh snowfall); collection of furbearer hair samples for mercury analysis
April	Aerial survey of muskrat pushups
May	Aerial survey of beaver colonies to assess overwinter survival
October	Aerial survey of active beaver colonies
November	Aerial track survey of river otters and mink (following fresh snowfall)
December	Data analysis
	Updated Study Report

8.11.7. Level of Effort and Cost

Aerial surveys using a small helicopter would be conducted in fall, winter, and spring beginning in 2013 and extending through 2014 to assess the relative abundance and habitat use of aquatic furbearers in the Project area.

Beaver surveys would require up to a week of survey effort in October each year. Winter track surveys, estimated to require approximately 3–5 days each, would be conducted in early winter (November) and monthly in mid- to late winter (February to April), pending the availability of suitable fresh snowfall for tracking. Surveys of muskrat pushups would be conducted in late winter (April) each year.

Collection of hair samples from river otters would be solicited from ADF&G as part of their required pelt-sealing procedure. Collection of hair samples from mink would be more challenging, involving collection of hair samples from marten traps during the terrestrial furbearer survey, or through direct contact with local trappers, or both.

Annual Project costs in 2013 and 2014 are anticipated to be less than $150,000.

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8.11.9. Figures

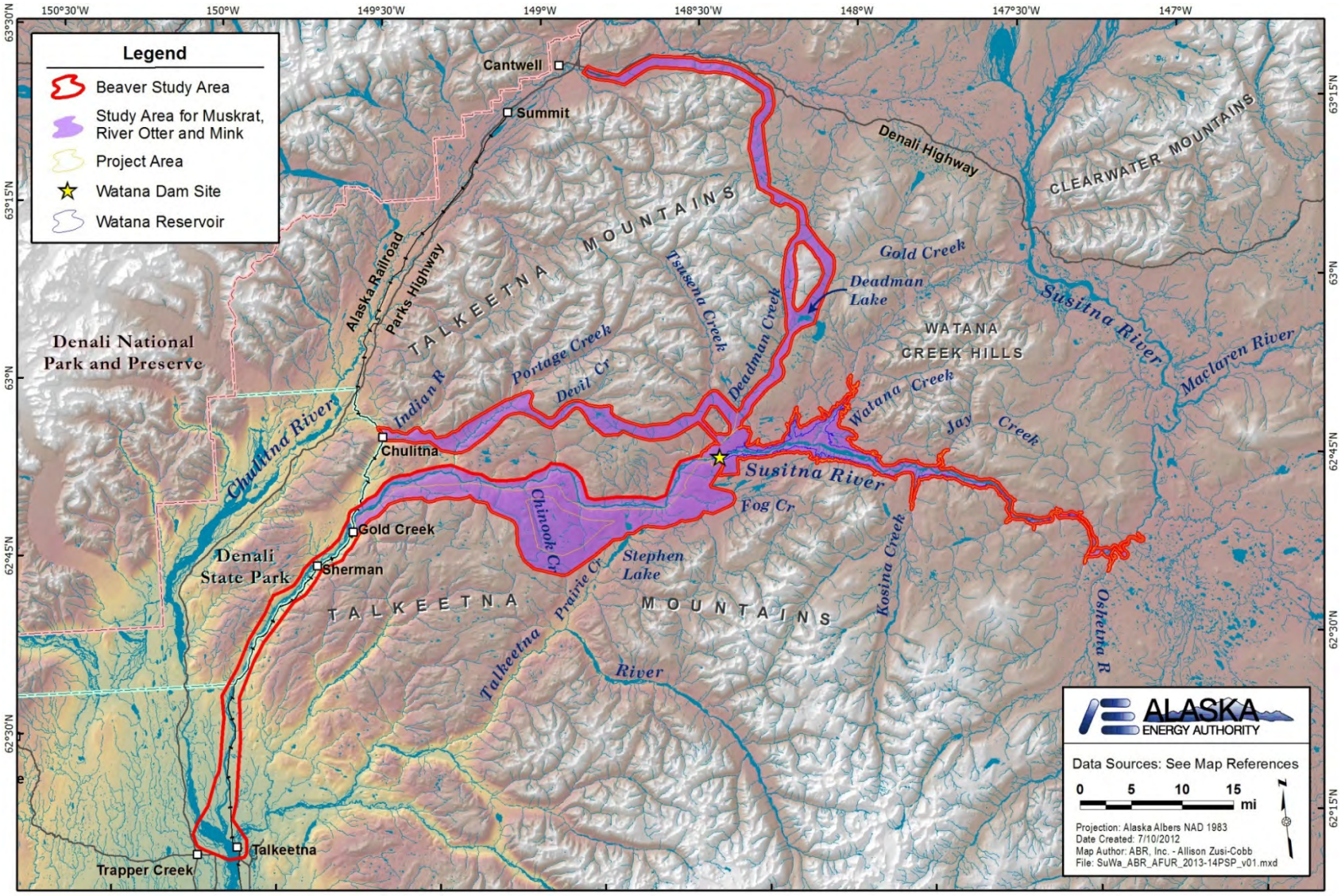

Figure 8.11-1. Aquatic furbearer study areas.

8.12. Study of Species Composition and Habitat Use of Small Mammals

8.12.1. General Description of the Proposed Study

The small mammal study will be a one-year effort (2013), with an option of a second year of sampling in 2014 if it is determined that more data are needed to adequately describe baseline conditions. The study was designed to determine what species of small mammals occur in the project area, where they occur in relation to proposed Project infrastructure, and what habitats they are using. Other small mammals, including snowshoe hares (Section 8.10) and little brown bats (*Myotis lucifugus*; Section 8.13) are covered in other study plans.

8.12.1.1. Study Goals and Objectives

The goal of the small mammal study is to collect baseline data on small mammals in the Project area to enable habitat-based assessments of the impacts expected to occur from development of the Project.

Two specific objectives have been identified for the small mammal study:

- Describe the species composition and relative abundance of small mammals in the Project area; and
- Describe the habitat associations of small mammals within the Project area.

8.12.2. Existing Information and Need for Additional Information

Small mammal species in the Susitna River basin include porcupine (*Erethizon dorsatum*), hoary marmot (*Marmota caligata*), arctic ground squirrel (*Spermophilus parryii*), red squirrel (*Tamiasciurus hudsonicus*), collared pika (*Ochotona collaris*), and several species each of voles, mice, and shrews. Species composition, relative abundance, and habitat use by small mammals were studied for the APA Susitna Hydroelectric Project in 1980 and 1981 along 49 trapline transects (using both snap-traps and pitfall traps) located in a variety of different habitat types in the middle and upper Susitna River basin (Kessel et al. 1982). The APA Susitna Hydroelectric Project study area for small mammals (Kessel et al. 1982) extended from Sherman (near Gold Creek) on the west to the mouth of the Maclaren River on the east and for approximately 16 km (10 miles) on each side of the Susitna River; no surveys of small mammals were conducted downstream from Sherman.

Since completion of the APA Susitna Hydroelectric Project studies in the 1980s, a new species of small mammal—the Alaska tiny shrew (*Sorex yukonicus*)—was recognized and described (Dokuchaev 1997, MacDonald and Cook 2009). The earliest specimen known was trapped in 1982 near the upper Susitna River during the APA Susitna Hydroelectric Project study. By 2007, the total number collected statewide had increased to 38 specimens from at least 22 widely separated locations (Cook and MacDonald 2009), indicating the species was more widespread than originally thought. Early information indicated it occurred primarily in riparian habitats but, as trapping efforts expanded, it also was captured in scrub habitats. The Alaska Natural Heritage Program classified the Alaska tiny shrew as "unrankable" globally (GU), presumably because little information was available, and as "vulnerable" in the state (S3; AKNHP 2011), probably

due to restricted range and relatively few populations. The species was included on BLM's Alaska list of sensitive species (2010).

No recent reports on small mammal studies in the middle or upper Susitna basin are available. Other studies in surrounding regions included species inventories in Denali National Park and Preserve (Cook and MacDonald 2003) and on Fort Richardson near Anchorage (Peirce 2003), and long-term population monitoring (1992–2005) of three species of voles that was conducted in Denali National Park and Preserve by Rexstad and Debevec (2006).

The APA Susitna Hydroelectric Project studies provided a thorough sampling of the small mammal populations in the Project area. Although 30 years have elapsed since those studies, it is unlikely that species distributions or habitat-use patterns have changed significantly in the interim. Because of the often cyclical population fluctuations of small mammals and the lack of effective mitigation to offset population losses in the impoundment zone, the wildlife data gap analysis report (ABR 2011) questioned whether additional studies are warranted for the Project. However, a current field survey of small mammals, focused on the reservoir impoundment zone, access and transmission corridors, and associated areas of infrastructure, would provide useful information for evaluating the direct effects of habitat loss on small mammals to the Project.

8.12.3. Study Area

Field trapping surveys for small mammals will be conducted in the reservoir impoundment zone, access and transmission corridors, and areas of associated infrastructure (Figure 8.12-1).

8.12.4. Study Methods

8.12.4.1. Field Surveys

In combination with the wildlife habitat mapping effort (see Section 9.5), the small mammal survey would provide data with which to evaluate the potential impacts of the Project. As in the landbird and shorebird study, sampling locations would be distributed across the landscape and allocated by habitat type to ensure that all the prominent habitats are sampled. Sampling locations would be allocated using a pseudo-stratified random plot allocation procedure, using aerial photosignatures as the sampling strata because a current and complete habitat map likely will not be available by the time sampling would begin in 2013. Alternatively, the field survey could be postponed until 2014 to take advantage of the vegetation and habitat mapping that will have advanced by that time.

Standard trapping and survey methods for small mammals would be used (e.g., Jones et al. 1996), including both pitfall traps and snap-traps for voles, lemmings, and shrews. Pitfall traps will be plastic, as opposed to metal, to improve trapping success for the Alaska tiny shrew. Trapping data will include the relative abundance of each species in each habitat, allowing a quantitative assessment of habitat loss and habitat connectivity.

Additional information on small mammals will be collected in support of the terrestrial furbearer study (Section 8.10). Beginning in fall 2012, the abundance of voles will be estimated by using live-trapping and mark–recapture methods in 8–10 plots. Two trapping grids will be established in spruce forest and in grassy meadow habitats. Each grid will consist of 50 live-trap sites spaced 10 meters (32.81 feet) apart. The traps will be operated for 1–3 nights. Captured voles will be weighed, ear-tagged, identified to species and sex, and released. The proportion of recaptured

tagged individuals to unmarked individuals will be used to calculate an estimate of population abundance.

8.12.4.2. Impact Assessment

All small mammals would be affected both directly by Project activities and features and indirectly by effects on predator species. The primary impacts of the Project on small mammals include:

- Direct and indirect habitat loss and alteration,
- Potential direct mortality due to vehicle strikes, exposure to contaminants, and attraction to garbage and human activity,
- Potential changes in mortality due to changes in the abundance or distribution of predators,
- Potential physical and/or behavioral blockage of movements due to reservoir water and ice conditions.

For small mammals, the primary impact of direct and indirect habitat loss and alteration will occur in the impoundment area, access and transmission corridors, and other facility footprints. To the extent that regional predator abundance may be altered by the project (as determined by other studies, including the large carnivore, terrestrial and aquatic furbearer, and raptor studies, Sections 8.8, 8.9, 8.10, 8.11, and 8.14), small mammal populations would also be affected over a larger region.

Data on the distribution, relative abundance, and habitat use of small mammals in the study area can be used to assess Project impacts on these populations through geospatial analysis and evaluation of the responses of the study species to other similar projects, as documented in the scientific literature. Using GIS software, species presence/absence data or relative abundance data recorded among different habitat types can be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans (see Sections 9.5, 9.6, and 9.7). The direct and indirect impacts of the Project can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to evaluate direct impacts and indirect impacts on preferred habitats. The GIS analysis can be combined with information from the literature to estimate the potential geographic extent, frequency, duration, and magnitude of Project effects on small mammal populations. For those habitats in which mark-recapture population estimates are available (spruce forest and grassy meadow habitats, as described above for the Terrestrial Furbearer study), it will be possible to estimate the number of animals affected. Additional information collected for the various studies of predators can be used to evaluate the potential area over which small mammal populations may be affected by changes in predation rates.

8.12.5. Consistency with Generally Accepted Scientific Practice

The small mammal study will be conducted using standard trapping techniques as described in Jones et al. (1996). Habitat availability and use analyses allow an ecosystem approach to impact assessment and GIS-based analysis has become a standard and straightforward method of evaluating the impacts of habitat loss and alteration.

8.12.6. Schedule

Small mammal trapping will be conducted in late summer 2013 during a 1–2 week period in late summer. After vegetation habitat mapping is complete, the sampling will be reviewed to determine if it adequately represents the habitat types present in the study area. If deemed necessary, additional sampling will occur in 2014. Two field crews of two biologists working for 10–14 days would ensure adequate spatial and habitat coverage.

Data management will be ongoing during the field season but will be finalized after all sampling has been completed in late summer. Initial and Updated Study Reports will be issued in December 2013 and 2014, respectively.

8.12.7. Level of Effort and Cost

Detailed estimates of effort have not yet been developed, but a single season of trapping effort, consisting of 1 to 2 weeks of field trapping by two crews (two biologists each) in late summer 2013 or 2014 (when small mammal populations should have reached their highest seasonal levels), would be adequate to satisfy the study objectives for most small mammals. The study area would consist of the same area covered by the vegetation mapping effort to provide a landscape context in which to evaluate the study results.

Total study costs are anticipated to be approximately $150,000.

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8.12.9. Figures

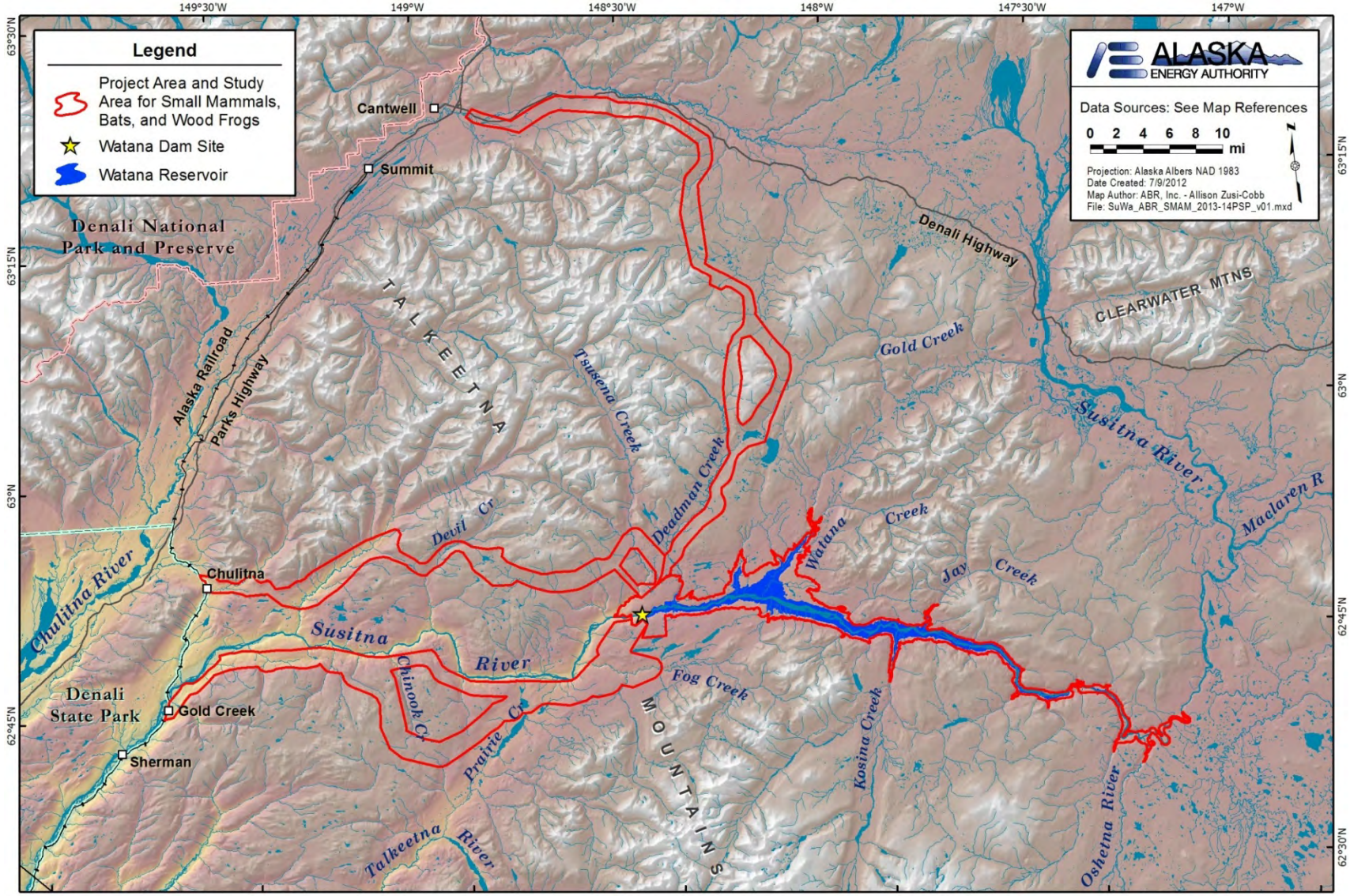

Figure 8.12-1. Study area for small mammals, little brown bats, and wood frogs.

8.13. Study of Distribution and Habitat Use of Little Brown Bat

8.13.1. General Description of the Proposed Study

The little brown bat study will be a one-year effort (2013) to determine whether bats occur in the Project area and, if so, their patterns of habitat use. Biologists will also look for evidence of breeding and overwintering to better understand how bats might be affected by the Project. Bats are small mammals and although this study shares similar objectives to the small mammal study (see Section 8.12), the two studies require substantially different methodologies and require separate efforts. AEA is proposing the following study plan for little brown bats but AEA would like to consult further with licensing participants to re-evaluate the level of effort based on more discussions regarding the potential presence of this species.

8.13.1.1. Study Goals and Objectives

The overall goal of the bat study is to collect baseline data on little brown bats in the Susitna-Watana Hydroelectric Project (Project) area to evaluate potential impacts to little brown bats from development of the proposed Project.

The specific objectives of the bat baseline study are to:

- Assess the occurrence of little brown bats and the distribution of habitats used by bats within the impoundment zone and infrastructure areas for the Project;
- Review geologic and topographic data for potential roosting and hibernacula sites; and
- Examine human-made structures (bridges and buildings) for potential roosting or hibernacula.

This information will be used to assess the potential impacts of the Project.

8.13.2. Existing Information and Need for Additional Information

Sampling for bat activity was not conducted during the APA Susitna Hydroelectric Project in the 1980s, and no bats were captured during the small-mammal study for that project. The little brown bat was included in the list of mammal species in the Project area on the basis of a single sighting (Kessel et al. 1982). No other documentation of bats in the Project area is known to exist, but this species is distributed throughout Southcentral Alaska (Parker et al. 1997).

Implementation of the proposed study will document bat occurrence (passes/detector-night) in the study area and contribute to identification of potential roosting and hibernation locations present in the Project area.

8.13.3. Study Area

Field surveys will be conducted in the reservoir impoundment zone, access and transmission corridors, and associated areas of anticipated infrastructure (see Figure 8.12-1).

8.13.4. Study Methods

8.13.4.1. Field Surveys and Data Management

Acoustic surveys of bats using echolocation detectors are used to assess bat activity patterns and habitat associations (O'Farrell and Gannon 1999, Hayes 2000, Parsons and Szewczak 2009). Anabat® broadband acoustic detectors (Titley Electronics, Ballina, New South Wales, Australia) are used to detect and produce audible output from the ultrasonic sounds generated by bats to echolocate. These detectors are widely used for passive detection of free-ranging, echolocating bats (O'Farrell et al. 1999). Interpretation of bat acoustic data is subject to several important caveats. The number of recorded "bat passes" is an index of relative activity, but may not correlate to individual numbers of bats (e.g., 10 bat passes may represent a single bat recorded 10 different times or 10 bats each recording a single pass; Hayes 1997). Activity also may not be proportional to abundance because of variability attributable to (1) detectability (loud vs. quiet species); (2) species call rates; (3) migratory vs. foraging call rates; and (4) attraction to or avoidance of the sampling area by bats (Kunz et al. 2007, Hayes et al. 2009). However, interpreted properly, the index of relative activity may provide critical information of bat use by characterizing temporal (hourly, nightly, and seasonal) and spatial (height and location) patterns of bat activity (Parsons and Szewczak 2009).

To the extent possible during June–September 2013, bat activity will be monitored during crepuscular and nocturnal hours (~1 hour before sunset to ~1 hour after sunrise), providing data when bats are most active (Hayes 1997). What constitutes crepuscular and nocturnal times of day fluctuates throughout summer Alaska, so the duty cycle of the detectors will be adjusted periodically. Anabat detectors are regularly used in Southeast Alaska where bats are more prevalent. Data will be downloaded and analyzed using Anabat CFC Read and AnalookW software (Corben 2011). A bat pass will be defined as a search-phase echolocation sequence of ≥2 echolocation pulses with a minimum pulse duration of 10 milliseconds (ms) within each sequence separated by >1 second (Fenton 1970, Thomas 1988, Gannon et al. 2003). Bat activity will be reported as bat passes/detector-night, the standard metric for measuring bat activity (Kunz et al. 2007). The spatial and habitat relationships among detectors will likely be compared statistically using non-parametric (Kruskal-Wallis) techniques.

To maintain quality assurance and quality control (QA/QC), acoustic monitoring equipment will be checked and data cards downloaded into a database every 1–2 weeks to minimize data loss from equipment failures or other factors. The database will be checked periodically by the study project manager for inconsistencies and errors, and the entire database will be proofed again for errors before data analyses. All data will be stored on a network server with frequent backups to prevent loss of data.

Results of bat surveys will be used in conjunction with habitat data to evaluate habitat use and activity levels across the study area, allowing a quantitative assessment of habitat loss for little brown bats.

The potential for roosting sites and winter hibernacula to occur in the Project area will be assessed by reviewing geological literature regarding the occurrence of suitable bedrock (e.g., limestone) in the Project area that would be conducive to the formation of caves, which are favored by little brown bats during hibernation (Parker et al. 1997). Forest inventory information will be gathered from respective landowners if available, to assess presence of large diameter

dead trees for roosting habitat. Human-made structures (buildings, bridges) will also be investigated for potential roosting sites. Due to the extremely limited number of human-made structures within the Project area, identification and location of potential search areas will be coordinated with the findings of the historic properties surveys (Section 11).

Anticipated work products include characterization of overall bat activity, identification of areas of concentrated bat activity, and documentation of locations of potential maternity roosts or hibernacula.

Through the successful completion of the proposed study, AEA will document bat use (passes/detector-night) and identify potential roosting and hibernating structures present in the Project area.

ADF&G's review of the study request for the bat study includes recommendations for better documentation of seasonal variation in bat occurrence and activity, expanded sampling that would provide habitat-specific indices of abundance, and more thorough searching for naturally occurring roosts, maternity colonies, and hibernacula. Because we share ADF&G's opinion that "The Watana development is unlikely to impact large numbers of bats or affect a significant portion of the population either directly or indirectly," it would be appropriate to initiate the bat study with the more limited objectives for 2013, as described above. If seasonal concentration areas such as maternity colonies or hibernacula are located, a second season of field work would be conducted in 2014, and further consideration of ADF&G's recommendations for an expanded field effort could be made at that time.

8.13.4.2. Impact Assessment

Data on the distribution of bats and their presence/absence in various habitats in the study area will be used to assess Project impacts through geospatial analysis and evaluation of the responses of the study species to other similar projects, as documented in the scientific literature. Using GIS software, species presence/absence recorded in different habitat types will be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans (Sections 9.5, 9.6 and 9.7). Although the wildlife habitats defined for this study will not be at a scale to include caves or structures used for hibernacula, we will include known locations of concentrated bat activity on the map. The direct and indirect impacts of the Project will be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate direct impacts of habitat loss and alteration and by applying various buffer distances, as determined from the available information on the expected effects, to estimate indirect impacts. The GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on bat populations. Any necessary PM&E measures will be developed by examining the distribution and abundance of bats and their habitats in relation to the geographic extent and seasonal timing of various Project activities.

8.13.5. Consistency with Generally Accepted Scientific Practice

The bat study will be conducted using standard acoustic monitoring techniques as described in Hayes et al. (2009). The USFWS endorses the use of acoustic monitoring to help predict impacts to bats at other industrial developments (i.e., wind energy sites [USFWS 2012]). Anabat®

broadband acoustic detectors are proposed for use in this study, and they are widely used for passive detection of free-ranging, echolocating bats (O'Farrell et al. 1999).

8.13.6. Schedule

Acoustic monitoring would commence by the beginning of June 2013 and continue through September 2013. Evidence of reproductive females (e.g., pregnant or lactating) in Alaska have been documented in mid-June (Parker 1996) and swarming behavior (high concentrations of bat activity) in September can be indicative of the presence of hibernacula. The proposed study duration will capture activity patterns during these important life cycle stages.

Data management will be ongoing during the field season, but will be finalized after all sampling has been completed in September. Data analyses will be conducted in October and November. The Initial Study Report will be submitted in December 2013. An Updated Study Report that incorporates data gathered from other ongoing studies (e.g. botanical studies) will be issued in December 2014.

8.13.7. Level of Effort and Cost

Development of a preliminary wildlife habitat map in 2012 (see Section 9.5) will help with designing a stratified acoustic monitoring plan based on major habitat types. Up to 20 Anabat detectors will be deployed between June and September 2013 to ensure adequate spatial coverage.

After initial deployment in June, field crews will service each Anabat detector approximately twice per month during the anticipated 4-month field season. Hence, eight helicopter-supported site visits will be scheduled, in addition to employing the services of other field crews to download and inspect the detectors when possible to reduce program costs. Up to two additional field days will be scheduled for a helicopter-supported survey of sites determined to have potential for supporting hibernating bats.

Project costs in 2013 are anticipated to be less than $200,000.

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8.14. Waterbird Migration, Breeding, and Habitat Study

8.14.1. General Description of the Proposed Study

The waterbird study will be conducted for two years, 2013 and 2014, and will include staging and migration surveys, breeding waterbird surveys, Harlequin Duck (*Histrionicus histrionicus*) surveys, and brood-rearing surveys. Waterbirds may use lakes, ponds, rivers, and flooded wetland areas throughout the Project area during migration. Aerial surveys for staging and migration will follow a lake-to-lake pattern and also will parallel river courses. Surveys for breeding waterbirds, primarily waterfowl, would follow the current USFWS Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys (USFWS and CWS 1987). Aerial surveys for Harlequin Ducks will focus on river habitats during the pre-nesting and brood-rearing seasons. Brood-rearing surveys will be conducted by observation of open water and shoreline habitats of lakes and ponds by ground-based biologists in the Project area.

8.14.1.1. Study Goals and Objectives

The goal of the waterbird study is to collect baseline data on waterbirds migrating through and breeding in the Susitna-Watana Hydroelectric Project (Project) area to enable assessment of the potential impacts of the Project and to inform the development of appropriate protection, mitigation, and enhancement measures. As used here, "waterbirds" is applied broadly to include swans, geese, ducks, loons, grebes, cranes, cormorants, herons, gulls, and terns. Shorebirds frequently are included in the general category of waterbirds, but they are addressed separately for this Project under the landbird and shorebird study plan (Section 8.16) because the field survey methods for shorebirds are ground-based and they can be surveyed along with landbirds. This study plan includes breeding surveys for the Harlequin Duck, a species of conservation concern that requires specific stream-survey techniques.

The specific objectives of this study are to:

- Document the occurrence, distribution, abundance, productivity, and habitat use of waterbirds breeding in the Project area;
- Document the occurrence, distribution, abundance, habitat use, and seasonal timing of waterbirds migrating through the Project area in spring and fall; and
- Review available information to characterize food habits and diets of piscivorous waterbirds documented in the study area as background for the *Mercury Assessment and Potential for Bioaccumulation Study* (Section 5.12).

The information gained from this study will be used to evaluate waterbird habitat loss and alteration quantitatively, in conjunction with the separate wildlife habitat mapping and habitat evaluation studies (see Sections 9.5 and 8.19, respectively), and to estimate the number of migrating and breeding waterbirds that may be affected by the Project.

8.14.2. Existing Information and Need for Additional Information

Existing information on the distribution and abundance of waterbirds in the Project area during the breeding and migration seasons is mostly based on studies conducted in 1980 and 1981 for

the APA Susitna Hydroelectric Project (Kessel et al. 1982). Data from those studies were used to quantify the level of use of waterbodies by migrating and breeding waterbirds. A relative "importance value" was determined for each waterbody surveyed in each migration season, incorporating the number of species, the number of birds, and the density of birds found on the waterbody in relation to the overall numbers and densities recorded on the surveys (Kessel et al. 1982). Those study results provide a good knowledge base concerning waterbird use of the Project area three decades ago but, because the population numbers of numerous species have changed in the past 30 years, new waterbird surveys are needed to elucidate the current distribution and abundance of breeding and migrating waterbirds in the Project area.

More recent survey data on breeding waterbirds in the upper Susitna River basin has been collected annually during USFWS waterfowl breeding population surveys (Mallek and Groves 2011a), but only a few transects of the Stratum 2–Nelchina survey area (Mallek and Groves 2011b) are located within the Project area. Those transects occur east of the proposed Watana reservoir near the Oshetna River, where the density of lakes and wetlands is relatively high.

The population of Trumpeter Swans (*Cygnus buccinator*) is an example of a waterbird species whose population has changed substantially in the last 30 years (Conant et al. 2007). A complete census of Trumpeter Swans on their breeding grounds in Alaska began in 1968 and was repeated at 5-year intervals between 1975 and 2005 (Conant et al. 2007). Together, two survey areas (Unit 3–Gulkana and Unit 5–Cook Inlet) include the entire Susitna River basin (Conant et al. 2007). The population of Trumpeter Swans summering in Alaska has increased since 1975 and breeding has expanded into peripheral habitat. No census was conducted in 2010, so information on the distribution and abundance of Trumpeter Swans in the Project area is out of date and new surveys are needed.

Waterbird productivity was evaluated in 1981 using ground surveys of waterbodies within proposed impoundment areas and access routes associated with the APA Susitna Hydroelectric Project. Those surveys provide historical data for the area 30 years ago, but need to be updated. Current surveys addressing waterbird productivity need to be conducted in areas of proposed facility locations, road and transmission corridors, and any areas affected by the Project within and near the inundation zone.

No existing information exists on the distribution and abundance of Harlequin Ducks in the rivers of the Susitna River drainage. The Harlequin Duck is a species of conservation concern that nests and raises broods almost exclusively in mountain stream drainages. New surveys need to be conducted to assess the distribution and abundance of Harlequin Ducks in the Project area.

8.14.3. Study Area

The study area for waterbirds will include all rivers, lakes, ponds, and wetland habitats that could be affected by the Project within the inundation zone and a 3-mile buffer area around this affected area (Figure 8.14-1). Additionally, all waterbody habitats occurring in areas of proposed Project facility locations and along proposed road and transmission corridors will be included in the study area for waterbirds. All rivers and streams that are part of the affected and buffered areas will be surveyed for staging waterbirds and breeding Harlequin Ducks, including the Oshetna River and Kosina, Watana, Deadman, Prairie, and Devil creeks. These features all occur within the study area boundary proposed to be used for the mapping of vegetation and wildlife habitats (see Section 9.5, Figure 9.5-1).

8.14.4. Study Methods

8.14.4.1. Migration Surveys

The most effective means of assessing the distribution and abundance of waterbirds over a large area is through aerial surveys. Waterbirds may use lakes, ponds, rivers, and flooded wetland areas throughout the Project area during migration.

Standard methods for surveying staging waterbirds in an area where waterbodies are irregularly spaced, like in the Project area, is a lake-to-lake pattern, where each lake is circled to count waterbirds on the shore and in the lake. Waterbirds often use rivers for staging during spring because nearby lakes can be covered with ice. Surveys of rivers are flown parallel to the river course to allow observers to view waterbirds on the water and along the shoreline.

Aerial surveys of staging waterbirds in Alaska are conducted with either a fixed-wing aircraft or a helicopter and the platform used can depend, in part, on the topography of the survey area. Because of the canyon and mountain terrain of the Project area, a helicopter is the recommended survey platform for waterbird migrations surveys to ensure good visibility and for maneuvering safely.

To determine the period of peak of migration, surveys will be conducted at 7-day intervals during the spring (May–early June) and fall (late August–October) migration periods, resulting in about 4 surveys in spring and about 10 surveys in fall. Each survey is expected to take approximately two days to complete. A single observer will record all data on a hand-held digital recorder, which is later transcribed into a computer database for analysis. Data can be summarized by species, species-group, lake-group or river segment, date of survey, and survey area. Surveys results determine species composition, the timing of migration, and identify areas important to migrating waterbirds.

8.14.4.2. Breeding Population Surveys

Surveys for breeding waterbirds, primarily waterfowl, would follow the current USFWS Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys (USFWS and CWS 1987). The survey is designed to follow transect lines that are spaced approximately 800 meters (2,625 feet) apart and aligned to cover the largest possible number of waterbodies and wetlands. The placement of the transect lines are determined prior to the survey using aerial imagery or topographic maps.

The survey is traditionally conducted in a fixed-wing aircraft; however, if the canyon and mountain terrain of the Project area proves to be too difficult to maneuver a fixed-wing aircraft safely and for acquiring survey data effectively, a helicopter may be used. Two observers, one on each side of the aircraft, will look for waterbirds in a 400-meter (1,312 feet) swath on either side of the aircraft while the pilot navigates the transect line using a GPS. Observations will be recorded on hand-held digital recorders and with a GPS waypoint, and will later be transcribed into a computer database for analysis. Survey data will be used to calculate annual densities for each species of waterfowl and identify areas important to breeding waterfowl.

Surveys will be flown in early June when breeding pairs are visible on territories and not yet on nests. Survey timing can affect survey results because the nesting phenology of dabbling ducks is slightly earlier than diving ducks, and some dabbling duck species can be missed if the survey

occurs too late, after the cryptically colored females are on nests and more brightly colored males have left the area. Two surveys, spaced about two weeks apart, will be conducted to target the peak timing of breeding for dabbling and diving ducks. Each survey is expected to take approximately two days to complete.

8.14.4.3. Harlequin Duck Surveys

Harlequin Ducks predominantly use streams for foraging and they nest in adjacent shoreline habitats. Male Harlequin Ducks are only present on breeding streams during a short period in spring when courting females. Accordingly, a pre-nesting survey is scheduled at that time to quantify the number of nesting pairs occupying a stream. After nesting, successful females are visible on streams with their broods, and failed breeders often group together.

Surveys for pre-nesting and brood-rearing Harlequin Ducks will be flown in a helicopter with two observers seated on the same side. Surveys will be generally flown in an upriver direction with the helicopter positioned over the bank of the river to give the observers an unobstructed view of the entire width of the watercourse. Observations will be recorded on hand-held digital recorders and with a GPS waypoint, and will later be transcribed into a computer database for analysis. Survey data will be used to calculate linear densities (ducks per kilometer) and to identify streams important to breeding Harlequin Ducks.

To account for the annual variation that may occur in the occurrence of the peak number of breeding pairs and brood-rearing females on a stream, two years of pre-nesting and brood-rearing surveys will be conducted. Two pre-nesting surveys, spaced 7–10 days apart, will be flown in late May–early June each year and two brood-rearing surveys, spaced 7–10 days apart, will be conducted in late July–early August each year. Each survey is expected to take approximately two days to complete.

8.14.4.4. Brood-rearing Surveys

Information on waterbirds breeding in specific areas that would be directly affected by the Project infrastructure or activities will be collected by biologists conducting foot surveys at suitable lakes, ponds, and wetlands. These surveys will be conducted in midsummer during the brood-rearing period to record the presence of adults accompanied by broods of juveniles. The study area will be determined based on the location of proposed Project infrastructure.

Two to four observers will traverse all wetlands and circumnavigate all ponds and lakes on foot within the study area to search for waterbirds, particularly ones with broods. All waterbirds observed will be recorded on field data sheets and brood ages for waterfowl (primarily ducks) will be classified into one of seven age classes based on chick plumage patterns. Survey data will be used to calculate densities of broods and to determine nest initiation dates by back-dating (subtracting the age of young and the incubation period).

8.14.4.5. Review of Food Habits and Diets of Piscivorous Waterbirds

The scientific literature will be reviewed to locate and synthesize information on the food habits and diets of piscivorous waterbirds (e.g., loons and grebes) in freshwater aquatic systems to support the pathways analysis being conducted as part of the *Mercury Assessment and Potential for Bioaccumulation* (Section 5.12), which was recommended by the USFWS in response to the

request for comments on the Pre-Application Document for the Project (letter from USFWS to AEA dated 31 May 2012).

8.14.4.6. Impact Assessment

The primary impact mechanisms of the Project on waterbirds may include:

- Permanent direct and indirect habitat loss and alteration;
- Temporary direct and indirect habitat loss and alteration;
- Direct behavioral impacts, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development;
- Mortality due to increased subsistence and recreational harvest that may be facilitated by improvements in human access that result from Project development;
- Changes in mortality due to predation that may result from changes in the abundance and distribution of waterfowl predators, including both mammalian and avian carnivores; and
- Direct mortality due to strikes with vehicles, powerlines, towers, or other project facilities; exposure to contaminants; and attraction to garbage and human activity.

Impacts associated with habitat loss and alteration, attraction and avoidance, and direct mortality will occur primarily in the Project area, including the impoundment area, access and transmission corridors, and other facility footprints. Impacts associated with increased harvest\ and changes in predator abundance may occur over a larger area in which changes in both competing mammalian predators and prey species abundance may occur.

Data on the distribution, abundance, productivity, and habitat use of waterbirds in the study area will be used to assess Project impacts on these populations. Impacts of direct and indirect habitat loss and alteration can be assessed through geospatial analysis. When plotted on the wildlife habitat map, developed under the botanical resources study plans, the locations of breeding, brood-rearing, and staging waterbirds will allow identification of high value or critical seasonal habitats for each species. Using GIS software, the direct and indirect impacts of the Project can be evaluated for each waterbird species by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate loss of preferred or critical habitats. Additional indirect impacts of habitat loss and alteration and behavioral reactions (such as avoidance) can be estimated by applying various buffer distances, as determined from the literature on the effects of similar projects. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on waterbird populations. Density estimates for breeding and brood-rearing waterbirds in each habitat and linear densities of Harlequin Ducks can be used to estimate numbers of birds potentially affected by habitat loss and alteration and by behavioral reactions that may result in avoidance. Location data for each species can be used to assess risks from powerline and other bird strikes for various alternative Project configurations. Any necessary PM&E measures will be developed by examining the distribution and abundance of species among habitats in relation to the geographical extent and seasonal timing of various Project activities.

8.14.4.7. Reporting and Deliverables

Study products will include:

- **Electronic copies of field data.** A geospatially-referenced relational database will be developed that incorporates all historic and current data, including nesting and brood-rearing locations for each species. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Study Reports.** In December 2013, an Initial Study Report, and in December 2014, the Updated Study Report, will be provided. The Updated Study Report will summarize the results for both years.

8.14.5. Consistency with Generally Accepted Scientific Practice

The Waterbird Study will be conducted using standard waterfowl aerial survey techniques including those described in the current USFWS Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys (USFWS and CWS 1987). These same techniques have been successfully used to survey for migrant and breeding waterbirds on other large-scale projects (PLP 2011).

8.14.6. Schedule

The same seasonal schedule will be followed in both 2013 and 2014. The timing of some surveys, particularly in spring and summer, will depend on ice break-up and the nesting phenology for the year.

May:	Up to 4 migration surveys at intervals of 7–10 days (depending on time of river breakup and lake moat formation); 2 Harlequin Duck pre-nesting surveys in second half of month.
June:	Up to 2 breeding population surveys in first half of month.
July:	Brood-rearing survey (2nd week); Harlequin Duck brood-rearing survey (4th week).
August:	Harlequin Duck brood-rearing survey (1st week); 2 migration surveys in second half of month.
September:	Migration surveys at intervals of 7–10 days.
October:	Migration surveys at intervals of 7–10 days.
November:	All survey data are reviewed and checked after each survey. During the data collection period from April through October, data is entered into a computer database program and reviewed and checked again. Data analysis would be ongoing throughout the summer and fall, and completed by November of the survey year.
October - December:	Data analysis and report preparation.
December	Initial Study Report (2013) and Updated Study Report (2014) issued by AEA.

8.14.7. Level of Effort and Cost

The waterbird field surveys will require an estimated minimum of 72 person days, not including weather delays or changes in project study design, as indicated below.

- Migration Surveys = 28 person days
- Breeding Waterfowl Population Surveys = 8 person days (assuming 2 surveys per year)
- Harlequin Duck Pre-nesting Surveys = 8 person days
- Harlequin Duck Brood-rearing Surveys = 8 person days
- Waterbird Brood-rearing Survey = 20 person days

The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting. The projected cost for this study in each year is on the order of $250,000, for an approximate estimated total of $500,000 for both years.

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8.14.9. Figures

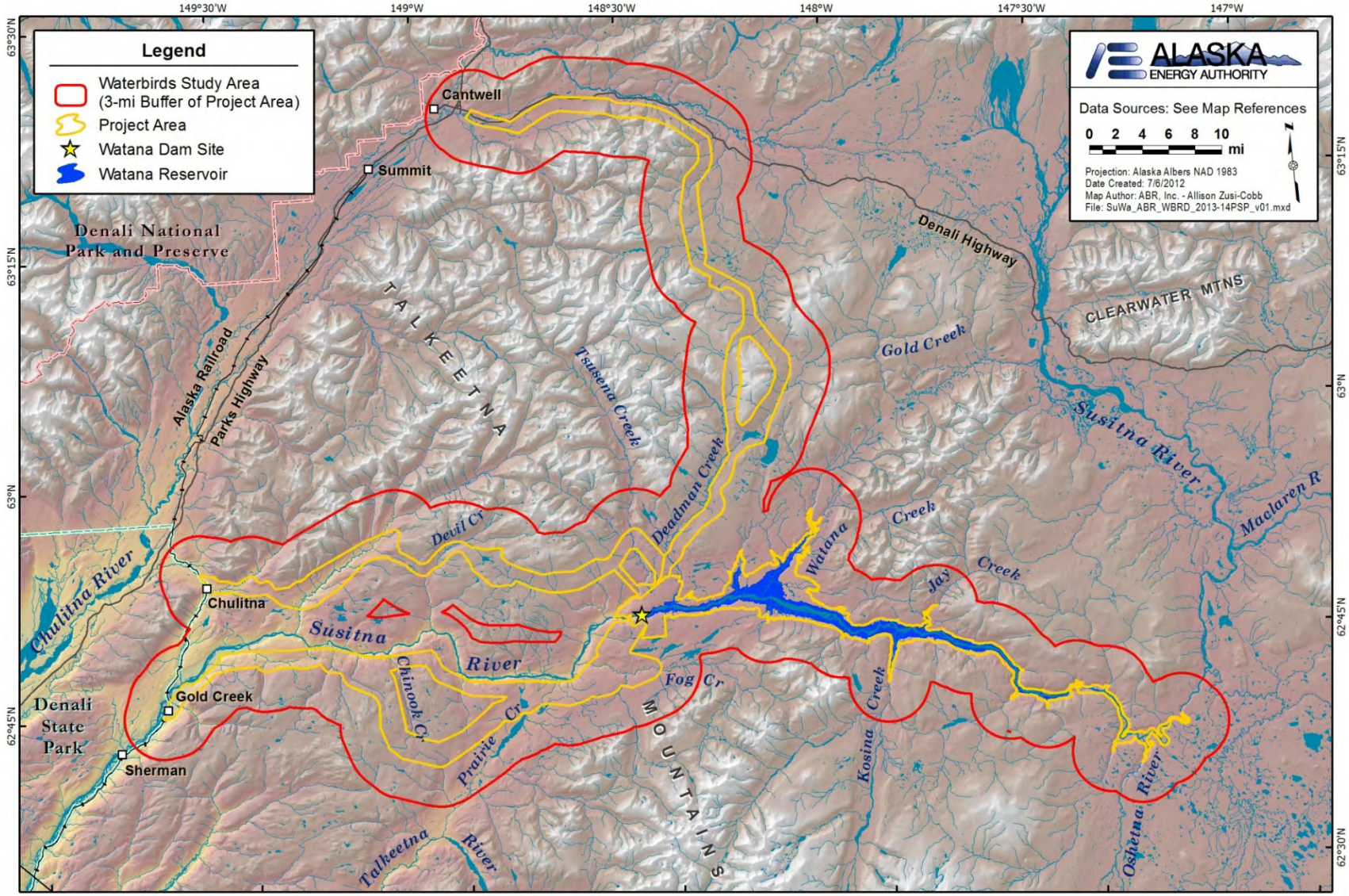

Figure 8.14-1. Waterbird study map.

8.15. Survey Study of Eagles and Other Raptors

8.15.1. General Description of the Proposed Study

The raptor study was initiated in 2012 to prevent inadvertent take of raptors by providing information on raptor avoidance zones to Project personnel in the field in 2012. The raptor study will continue in 2013 and 2014, providing data both for the avoidance of raptor take and for the assessment of Project impacts.

8.15.1.1. Study Goals and Objectives

The goal of the raptor study is to characterize population size, productivity, nesting phenology, and habitat use of local raptor species to (1) inform the prediction and quantification of impacts that may result from the proposed Project, and (2) provide information required for a possible application(s) for federal Eagle Take (lethal or disturbance take, see below) and/or Eagle Nest Take Permits. Common and scientific names of raptors that may occur in the Project area are listed in Table 8.15-1.

The specific study objectives are:

- Enumerate and identify the locations and status of raptor nests and territories that could be affected by Project construction and operations. Specific tasks associated with this objective include:
  - — Review and synthesize existing nest data for eagles and other raptors: Identify and determine status of previously-recorded nest locations of various species, including geographic coordinates, annual nest activity, descriptions of nest site characteristics, and general descriptions of cliff habitat in proximity of each site;
  - — Conduct field surveys to locate and characterize nests: Locate and map all existing Bald Eagle and Golden Eagle nests in the Project study area, identifying all active and inactive nests and alternative nest sites. Locate and map all existing active and inactive nests of other tree- and cliff-nesting raptor species (as well as Common Ravens) in the inundation area;
  - — Create a geospatial database of all nests and territories: The database will be used to calculate inter-nest distance, estimate local average territory size, and, with overlays of project footprint and habitats, determine number of nests and territories potentially affected; and
  - — Calculate local average territory size for Bald Eagle and Golden Eagle: Estimates of average territory sizes (and mean inter-nest distance) are required for application for federal Eagle Nest Take permits.
- Estimate Project effects on productivity of raptors. Specific tasks associated with this objective include:
  - — Review existing productivity data (if any);
  - — Determine the average and range of productivity of nests of each eagle/other raptor/raven species; and
  - — Consider impacts on productivity at the local and larger population level using current and historical data.
  - — Additionally, an Eagle Take permit for disturbance would require pre- and post-construction productivity comparisons to determine if realized take is consistent with

the permitted take, and to ensure that the level of take is compatible with the preservation of eagle populations.

- Estimate effects on nesting and foraging habitats by delineating suitable habitat features in a GIS (this work will be conducted in the habitat-use evaluation study, see Section 8.19). Characterize and map the habitat as suitable or not suitable for nesting and foraging for the various raptor species. These characterizations will be used to:
  - Calculate percent local habitat lost;
  - Calculate numbers of breeding pairs and productivity;
  - Determine whether or not a partial loss of a territory may functionally result in abandonment of the entire territory; and
  - Identify whether or not habitats adjacent to the project area may potentially be available for displaced nesting birds.
- Conduct field surveys and literature reviews to identify, map, and characterize the habitat-use patterns at any fall and winter communal roost sites and foraging sites of Bald and Golden eagles and other raptor species. Describe seasonal habitat use, highlighting areas or conditions which may result in impacts on raptors.
- Conduct a risk assessment study to determine if any section of planned overhead transmission lines may pose a collision risk to migrating or nesting raptors and to identify any nests and/or migratory corridors (including altitudes of raptor movements) in the areas planned for overhead power transmission lines.
- Provide information on distribution, abundance, and diet of piscivorous (fish-eating) raptors and information on known effects of mercury on raptors to the *Mercury Assessment and Potential for Bioaccumulation Study* (see Section 5.12).

8.15.2. Existing Information and Need for Additional Information

Historical information from aerial surveys of raptors in the early 1980s provided the first assessment of the distribution, abundance, and vulnerability of many raptor nests located within the proposed Project impoundment zone. Those surveys highlighted Bald and Golden eagles and Common Ravens, and, to a lesser extent, other raptors such as Northern Goshawks. Extensive information on raptors was collected during the 1980s for the original APA Susitna Hydroelectric Project and for other surveys in the region (discussed in ABR 2011). Hard-copy maps are available of eagle nests located during the APA Susitna Hydroelectric Project studies in the early 1980s (LGL 1984). Other nest site records may exist in the files of the University of Alaska Museum of the North (AEA 2011). Other investigators and agency personnel may have information on raptor nest sites and important habitats, such as roosting sites, in or near the Project area. Similar regional databases of nest site information have been developed (Wildman and Ritchie 2000).

Surveys completed in the middle and upper Susitna area during the 1980s identified 23 Golden Eagle, 10 Bald Eagle, 3 Gyrfalcon, 3 Northern Goshawk, and 21 Common Raven nest sites (some sites include more than one nest site, if they are close together) (APA 1985). Although Common Ravens are not raptors, they construct both cliff and tree nests similar to raptors, are culturally significant, and are protected by the MBTA. Of the eagle nest sites identified in the 1980s, five Golden Eagle and three Bald Eagle sites were expected to be completely inundated by the original APA Susitna Hydroelectric Project, Phase 1 Watana Impoundment (LGL 1984).

New raptor studies are needed because most of the existing information is almost 30 years old and it is unknown how distribution, status, or other conditions may have changed. Also, historical surveys did not cover the entire area of current interest including access roads and power transmission corridors. More sophisticated geospatial analyses are now available that allow for more accurate assessments of the potential effects of the Project on raptors and their habitats. Finally, current data will be necessary for compliance with Federal laws, especially the BGEPA and the MBTA, as well as the FERC–USFWS MOU (2011).

A limited field survey for raptors was conducted in 2011 (ABR 2011) and more extensive surveys of the Project area were initiated in 2012 (AEA 2012) to provide current information needed to protect raptors by restricting project activities near active raptor nests during pre-license field studies and construction. In 2011, surveys on 27 June were limited to the area near borehole sites drilled for the geotechnical program in the vicinity of the proposed Watana dam. In 2012, occupancy surveys for nesting raptors were performed twice in May and productivity surveys were performed twice in July. The 2012 survey area comprised the area within a 2-mile buffer of the Project area (impoundment, access and transmission corridors, and facilities/infrastructure). Surveys were conducted from a Robinson R44 "Raven II" helicopter (Quicksilver Air). Dozens of raptor nests were observed and occupied nest sites were located and mapped. Nest of four species of raptors were identified in the project area: Golden Eagle, Bald Eagle, Peregrine Falcon, Red-tailed Hawk, and Merlin. GPS files, PDF maps, and avoidance guidelines were distributed to Project personnel and contractors to avoid "take" of nests by disturbance.

Although some transmission lines are a persistent source of raptor and eagle mortality by electrocution and collision, it is assumed that all new transmission lines and power transfer stations for the Project will be built to the "eagle-safe" standards developed by the Avian Power Line Interaction Committee (APLIC 2006), and therefore will not likely constitute a significant source of electrocution risk for raptors. However, significant lengths of new transmission lines will be constructed across the previously open and undisturbed landscape. As discussed in the Avian Protection Plan (APP) Guidelines (APLIC and USFWS 2005), collision risk assessments are recommended in the siting of overhead power transmission lines.

Some survey protocols recommend searching for Golden Eagle nests within 10 miles of a project boundary (Pagel et al. 2010). The resulting search area for the Susitna-Watana Hydroelectric Project may be unreasonably large, costly, and logistically difficult to complete during the optimal survey window for nesting phenology, however. Because the 10-mile survey area recommendation was developed by USFWS primarily for projects that may cause regular mortalities, such as collisions with wind turbines, a survey area within 2–3 miles of Project facilities has been deemed adequate for the 2012 survey effort, in consultation with USFWS (see consultation record of the 12 April 2012 Eagle/raptor Agency Technical Group Meeting in Section 8.4, Table 8.4-1, and Appendix 8-1). The 2013–2014 survey area will be expanded to 10 miles surrounding the reservoir impoundment zone, as described earlier.

8.15.3. Study Area

The survey area for occupancy and productivity of eagles consists of all appropriate habitat within a 10-mile radius around the reservoir impoundment zone, and within a 3-mile radius of proposed facilities and the centerlines of the potential access road and transmission-line corridors (Figure 8.15-1). Ten miles is the USFWS's interim recommendation for survey radius for

Golden Eagles (Pagel et al. 2010) in areas with suitable habitat (i.e., the middle Susitna River basin), and is necessary also for Bald Eagles around the impoundment zone to get an adequate determination of mean inter-nest distance. For species besides eagles, and for foraging and roost sites of eagles and other raptors, a radius of 3 miles around the reservoir impoundment zone, proposed facilities and centerlines of the potential access road and transmission-line corridors is sufficient.

All Bald and Golden eagle habitat within the study area boundary will be surveyed. For Bald Eagles, surveys will cover the area within a half-mile of the centers of all drainages with suitable timber and within a half-mile of all shorelines of lakes with similar characteristics in the impoundment zone and wherever these habitats cross proposed road and transmission-line corridors. Information on other large tree-nesting birds will also be collected. Survey routes for cliff-nesting raptors will be flown in a cliff-to-cliff survey pattern focused on cliffs suitable for Golden Eagle nests during this period.

The survey methodology will obtain information for an area larger than the 1980s survey coverage, will gather information on key species in a more well-defined study impact area, and will provide AEA with information potentially needed for eagle permitting and to develop avoidance areas and mitigation protocol to reduce the potential disturbance of nesting raptors from Project construction and operations activities. The nesting survey may be sectioned to include segments that match the extent of the 1980s survey to the extent appropriate for comparison purposes to evaluate trends in raptor populations and/or habitat use.

The study area for migration route surveys may be limited to specific locations along planned transmission line routes that may pose risks to migrating birds (e.g., ridgelines). These study areas will be determined in consultation with the USFWS and based on review of existing raptor migration data, topographical and wind current information, and other relevant factors.

8.15.4. Study Methods

8.15.4.1. Field Surveys

Inventory and monitoring methodologies for nest occupancy and productivity surveys will follow established aerial and ground-based protocols for eagle nest surveys (USFWS 2007, Pagel et al. 2010), using appropriately trained observers and suitable survey platforms (helicopter, fixed-wing aircraft). Modifications may be necessary to extend to the objective (1.3.1 A.2.a., above) of identifying and monitoring the nests of other raptors. Cliff-nesting raptors (including Golden Eagle, Peregrine Falcon, Gyrfalcon, as well as Common Raven and potentially Bald Eagle) and raptors using large stick nests (including Bald Eagle, Great Horned Owl, Northern Goshawk, Red-Tailed Hawk, Osprey, Common Raven, and potentially Golden Eagle) will be inventoried and monitored. Small to medium-sized raptor species (e.g., Short-eared Owl, Boreal Owl, Northern Hawk Owl, Northern Harrier, American Kestrel, Merlin, and Sharp-shinned Hawk) will require ground-based surveys (these studies can be integrated with landbird point counts and shorebird surveys). Details regarding survey extent and methods will be developed in coordination with the USFWS prior to initiating surveys.

Nest occupancy surveys will begin in spring before leaf-out (late April to late May), focusing on primary habitats for Bald and Golden eagles, but also considering primary habitat of resident

species nesting in woodland (e.g., Great Horned Owl and Northern Goshawk) and on cliffs (e.g., Gyrfalcon and Peregrine Falcon).

The nest productivity survey period will occur during mid-June to late July for surveys to verify and monitor nesting activity and to search for additional nests of later nesting raptors. Because of the wide range of breeding dates for all raptors considered in the study (mid-February for resident owls through early September for dispersal of Bald Eagles from nesting areas), the second survey period will encompass a broad timing window from mid-June through mid-July. The nesting chronology of each focal raptor will be considered during survey scheduling. Helicopter protocols described for the spring nest occupancy surveys would be employed during these occupancy and productivity surveys.

A helicopter will be used, carrying two observers in addition to the pilot. Flight altitude and speed will follow standard survey protocols for each habitat type (Pagel et al. 2010). Observers will be seated on the same side of the aircraft during surveys. Location and nest attribute data including substrate, nest species, and status will be collected for inclusion in the geodatabase.

In any aerial survey, a key concern is quantifying the sightability of the target species to adjust density estimates for targets missed. The actual sightability of nests depends on many factors, including nest size, location, survey weather/light conditions, substrate and tree density, habitat type, observer experience, and survey platform. Although Golden and Bald eagles often construct large, conspicuous stick nests, some inconspicuous nests are still likely missed when conducting surveys. Resurveys of subsamples of the survey area will be performed to assess the sightability of raptor nests in the project area.

To prevent disturbance to Dall's sheep during the lambing period, or near the Jay Creek and Watana Creek mineral lick sites, standard eagle survey protocols may need to be modified (Pagel and Whittington 2011) and helicopter surveys will avoid these areas. If necessary, additional ground surveys for nesting raptors will be conducted in these areas. Observations would be completed during the nest occupancy and nest productivity periods described above, but would be made at safe distances from sheep lambing areas. Spotting scopes would be required to search cliff areas; in addition, broadcast calls may be used to help determine the use of cliffs by Peregrine Falcon and Gyrfalcon. Helicopters would be used to drop off and pick up observers.

Intensive winter surveys would be required for early nesting owls but are not likely practicable because they would require logistically difficult and potentially dangerous winter work in remote areas. Additionally, they would only yield information on two species (Boreal Owl and Northern Hawk Owl) that are relatively rare/uncommon and not species of high concern. Instead, utilizing the wildlife habitat map, results from landbird surveys (point-counts and shorebird surveys) in concert with thorough literature review could be used to estimate distribution and abundance and habitat use and potential habitat loss for these species. Final details regarding survey methods will be developed in coordination with the USFWS prior to initiating any surveys.

Surveys for foraging and roost locations will be conducted primarily in winter. Repeated surveys of suitable protected forest stands may be necessary due to the high mobility of wintering Bald Eagles. Three to five aerial surveys of foraging habitat and communal roosts, primarily for Bald Eagles, will be conducted each year at intervals of 7 to 21 days between mid-October and early December. Survey numbers and timing may be adjusted in 2014, based on the results of the surveys planned for 2012. A helicopter or a fixed-wing aircraft carrying two observers will be used for these surveys. Surveys will be conducted near dawn or dusk. Information on fall fishery

concentrations will be requested from Project fisheries researchers and from agency biologists to more effectively monitor potential Bald Eagle concentration areas.

Surveys to determine if migration routes exist that may put migrating raptors at risk for collision with Project power transmission lines would generally follow the USFWS's recommended point count protocol, based on standard hawk migration counting protocols as described in Appendix C of the Draft Eagle Conservation Plan Guidance (USFWS 2011).

8.15.4.2. Reporting

Reporting of inventory and monitoring data will comply with the protocols and standards described in the Memorandum of Understanding between the Federal Energy Regulatory Commission and the USFWS (FERC and USFWS 2011). Survey reports will include:

- Maps and associated metadata for historical eagle and other raptor nest and communal roost locations with survey extents to compare to current survey data.
- Maps and associated metadata with coordinates for current nest locations, nest activity status, fall and winter communal roost areas, and migration routes.
- Summary and mapping of suitable forest, riparian, and cliff habitats to evaluate extent of suitable nesting habitats and facilitate nest searches within the Project area.

Observations will be recorded and geo-referenced with associated habitats during surveys. Raptor nests and observations will also be recorded during landbird and shorebird point-count surveys and all raptor observations will be plotted on wildlife habitat maps using a Geographic Information System (GIS) and Global Positioning System (GPS) receiver coordinates. Nest characteristics will be recorded according to protocol developed in consultation with the USFWS, including the protocol of the USFWS Alaska Bald Eagle Nest Atlas (http://alaska.fws.gov/mbsp/mbm/landbirds/alaskabaldeagles/default.htm).

The wildlife habitat maps will provide the basis for an ecosystem approach to assessing the effects of development-related habitat impacts on raptors. The habitat maps will facilitate quantitative analyses of raptor habitat availability and changes therein that result from development; and, in combination with raptor survey data, will allow a means to assess the potential for changes in local raptor populations during construction and operations. The maps will help in calculations of percent local habitat lost; calculations of numbers of breeding pairs and productivity; determination of whether or not a partial loss of a given territory may functionally result in abandonment or failure of the entire territory; identification of whether or not habitats adjacent to the project area may potentially be "available" (notwithstanding occupancy) for displaced nesting birds; and risk assessments for collisions with overhead transmission lines.

8.15.4.3. Data Analysis

A geo-spatially referenced relational database will be developed which incorporates the historic and current data, including nest and roost locations for each species, occupancy/activity/productivity, nest type and characteristics, stand characteristics, and photographs. Suitable raptor nesting habitat will be delineated using ArcGIS software. Existing nest locations and distribution of timber stands with suitably sized nest trees in coordination with Project studies involving vegetation surveys and mapping and three dimensional topographic

modeling will be incorporated into the identification and delineation of suitable raptor nesting habitats. Foraging habitats will also be delineated whenever possible. Distribution of spawning salmon as determined by collaborating with Project salmon studies will be used to identify Bald Eagle foraging locations and potential fall eagle aggregation areas. Distribution of fall waterfowl staging areas as determined in coordination with the waterfowl Project study will provide information valuable for locating fall Bald Eagle foraging locations and potential communal roost areas. Distribution of Dall's sheep lambing areas and caribou calving areas as determined in coordination with the terrestrial wildlife Project studies will provide information for Golden Eagle foraging habitat analyses.

Local Bald Eagle and Golden Eagle territory sizes will be estimated using inter-nest distances as described in the Draft Eagle Conservation Plan Guidance (USFWS 2011). Recommendations will be developed for future data gathering needs and analyses designed to evaluate potential Project-related impacts to eagles and other raptors.

As noted above, pertinent data gathered from other studies will be incorporated into the evaluation of potential Project-related impacts to eagles and other raptors.

8.15.4.4. Impact Assessment

The primary impact mechanisms of the Project on raptors may include:

- Permanent direct and indirect habitat loss and alteration, including loss of nesting sites and loss and alteration of foraging habitat;
- Temporary direct and indirect habitat loss and alteration, including indirect impacts resulting from altered distribution and abundance of prey;
- Potential direct behavioral impacts, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development; and
- Potential direct mortality due to strikes with vehicles, powerlines, towers, or other project facilities; exposure to contaminants; and attraction to garbage and human activity.

Impacts associated with habitat loss and alteration, attraction and avoidance, and direct mortality will occur primarily in the Project area, including the impoundment area, access and transmission corridors, and other facility footprints. Impacts associated with altered distribution and abundance of prey may occur over a larger area in which changes in both competing mammalian predators and prey species abundance may occur.

Data on the distribution, abundance, productivity and habitat use of raptors in the study area will be used to assess Project impacts. Impacts of direct and indirect habitat loss and alteration can be assessed through geospatial analysis. When plotted on the wildlife habitat map, developed under the botanical resources study plans, raptor nest location data will allow the identification of critical or high value breeding habitats. Similarly, important habitats for prey species, identified in association with parallel studies of prey distribution and abundance, also will be identified. Using GIS software, the direct impacts of habitat loss can be evaluated for each raptor species by

overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate loss of preferred or critical habitats. Additional indirect impacts of habitat loss and alteration and behavioral reactions (such as avoidance) can be estimated by applying various buffer distances, as determined from the literature on the effects of similar projects, including responses of both raptor and their prey. In this way, the GIS analysis can be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on raptor populations. Data from studies of prey populations also can be incorporated into the impact assessment for raptors, including distribution and abundance data from the aquatic furbearer, small mammal, waterbird, landbird/shorebird, and ptarmigan studies. Any necessary PM&E measures will be developed by examining the distribution and abundance of raptor species and habitats in relation to the geographic extent and seasonal timing of various Project activities. PM&Es will be developed to minimize impacts to raptors, with particular emphasis on eagles.

Data collected for the raptor study will allow calculation of the numbers of nests and territories that will be lost per species per sub-area; the numbers of nests and territories otherwise affected per sub-area; the type and level of impacts to forage and roost areas; the locations of any potential collision hazard areas for migrating raptors; and other potential impacts, including large increases in the availability of open water habitats created by the impoundment.

8.15.4.5. Deliverables

Study products will include:

Geospatially-Referenced Relational Database. A geospatially-referenced relational database will be developed that incorporates all historic and current data, including nest, forage and roost locations for each species, occupancy/activity, nest type and characteristics, stand characteristics, and photographs. This database will be expanded from the work done for the 2012 Raptor Study. All field data must be associated with location information collected using a Global Positioning System (GPS) receiver in unprojected geographic coordinates (latitude/longitude) and the NAD 83 datum (or convertible as such). Migratory corridor information will be included for specific areas of concern as discussed above.

Delineation of Suitable Eagle and Raptor Nesting and Foraging Habitats. Habitat delineation will be completed using ArcGIS software as part of the wildlife habitat mapping study (see Section 9.5) and the habitat use evaluation study (see Section 8.19).

Study Reports. In 2012, a Technical Memorandum summarizing the 2012 results will be provided. In 2013, an Initial Study Report, and in 2014, the Updated Study Report will be provided. The Updated Study Report will summarize the results for all three years. These reports will include:

- Discussion of nest mapping results
- Calculations of:
    - — Local average territory size for Bald Eagle and Golden Eagle; and
    - — Productivity (annual, mean, ranges of) per raptor species and Common Raven, per Project sub-area (reservoir impoundment zone, access roads, power transmission corridors)
- Discussion of migration corridor results

- Preliminary discussions and calculations of potential Project impacts including:
  - Numbers of nests and territories that will be lost per species per sub-area;
  - Numbers of nests and territories otherwise affected per sub-area;
  - Type and level of impacts to forage and roost areas;
  - Locations of any potential collision hazard areas for migrating raptors;
  - Other potential impacts, including large increases in the availability of open water habitats created by the impoundment.

8.15.5. Consistency with Generally Accepted Scientific Practice

The study methods described above are consistent with generally accepted scientific practice. The field protocols may be modified to address logistic constraints imposed by the size and remoteness of the study area. The field protocols for raptor surveys will generally follow established techniques for cliff- and tree- nesting raptors in North America (e.g., Anderson 2007). In addition, survey protocols and study areas will be tailored for specific species. For example, inventory and monitoring methodologies for nest occupancy and productivity surveys will follow established aerial and ground-based protocols for eagle nest surveys (USFWS 2007, Pagel et al. 2010), using appropriately trained observers and suitable survey platforms (helicopter, fixed-wing aircraft). Nest characteristics will be recorded according to protocol developed in consultation with the USFWS, including the protocol of the USFWS Alaska Bald Eagle Nest Atlas (http://alaska.fws.gov/mbsp/mbm/landbirds/alaskabaldeagles/default.htm). Local Bald Eagle and Golden Eagle territory sizes will be estimated using inter-nest distances as described in the Draft Eagle Conservation Plan Guidance (USFWS 2011). Surveys to determine if migration routes exist that may put migrating raptors at risk for collision with Project power transmission lines would generally follow the USFWS's recommended point count protocol, based on standard hawk migration counting protocols as described in Appendix C of the Draft Eagle Conservation Plan Guidance (USFWS 2011).

8.15.6. Schedule

This is a multi-year study that was initiated in 2012 and will continue through 2014. The data gathering and reporting schedule is described below.

- Draft Technical Memorandum: November 30, 2012. A brief interim report, including updated locations of all nests located to date, will be prepared and presented to AEA and the licensing participants to describe the status and progress of the study and identify any issues that have occurred.
- Field Surveys: Early May through late July 2013 and 2014. Surveys will be conducted in early to mid-May and early to late July. A minimum of two aerial surveys at least 30 days apart are recommended for the Golden Eagle protocol (Pagel et al. 2010). Early reporting of potentially active raptor nest sites after the initial surveys in May (or potentially earlier depending on USFWS recommendations) will be used to develop avoidance timing and areas for Project-related field activities that could potentially disturb active nests. Active eagle and other raptor nest sites will be reported to AEA as soon as they are found to develop avoidance areas for field studies.
- Update the geospatially referenced, relational database of historical and current data: August 2013 and 2014.

- Update the delineation of suitable eagle and raptor nesting habitat, old and active nest locations, historical fall and winter roost locations in ArcGIS software: August 2013 and 2014.
- Conduct roosting and staging surveys: Mid-October through early December 2013 and 2014. Surveys will be conducted periodically to identify use of winter foraging and communal roost sites along the Susitna River. Four aerial surveys will be flown at intervals of 2 to 3 weeks, depending on weather and the results of preceding surveys.
- Initial Study Report and Updated Study Report: December 2013 and 2014, respectively. The Initial and Updated Study Reports will include a summary of the study results to date.

8.15.7. Level of Effort and Cost

Occupancy/productivity and winter roost/forage surveys for nesting raptors in 2013–2014 will take an additional ~10–12 days of field work beyond the 2012 surveys due to the extended study area, therefore costs for these surveys (including helicopter time, analysis and reporting) will be approximately $500,000 per year.

Transmission line collision risk surveys for migrating raptors in 2013–2014 will take approximately 30 field days, and estimated costs for these (with helicopter drop-offs, literature search, analysis and reporting) will be approximately $80,000.

8.15.8. Literature Cited

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8.15.9. Tables

Table 8.15-1. Raptors in the Vicinity of the Middle Basin of the Susitna River (adapted from Tables 4.6-2 and 4.8-2 in AEA 2011).

Common Name	Scientific Name	Conservation Status[1]	Seasonal Status[2]	Relative Abundance[3]
Bald Eagle	*Haliaeetus leucocephalus*	FS	B	uncommon
Boreal Owl	*Aegolius funereus*	PIF, FS	R	rare
Golden Eagle	*Aquila chrysaetos*	BLM, FS	B	fairly common
Great Gray Owl	*Strix nebulosa*	PIF, FS	?	rare
Great-horned Owl	*Bubo virginianus*	FS	R	uncommon
Gyrfalcon	*Falco rusticolus*	PIF, FS	R	uncommon
Merlin	*Falco columbarius*	FS	B	uncommon
Northern Harrier	*Circus cyaneus*	FS	B	fairly common
Northern Goshawk	*Accipiter gentilis*	FS	B	uncommon
Northern Hawk Owl	*Surnia ulula*	FS	R	uncommon
Osprey	*Pandion haliaetus*	FS	M	rare
Peregrine Falcon	*Falco peregrinus anatum*	BCC, FS	M	unknown
Red-tailed Hawk	*Buteo jamaicensis*	FS	B	uncommon
Short-eared Owl	*Asio flammeus*	BLM, FS	B?, M, S	uncommon
Sharp-shinned Hawk	*Accipiter striatus*	FS	B	uncommon

Notes:

1 Conservation Status: FS = Featured Species (ADF&G 2006); BCC = Birds of Conservation Concern (USFWS 2008); BLM = BLM Sensitive Species (BLM 2010); PIF = Boreal Partners in Flight Working Group (BPIF 1999).

2 Seasonal Status: M = migrant (transient); B = breeding; S = summering; R = resident; ? = uncertain (Kessel et al. 1982; APA 1985: Appendices E5.3 and E6.3).

3 Relative Abundance: From Kessel et al. (1982) and APA (1985: Appendices E5.3 and E6.3).

8.15.10. Figures

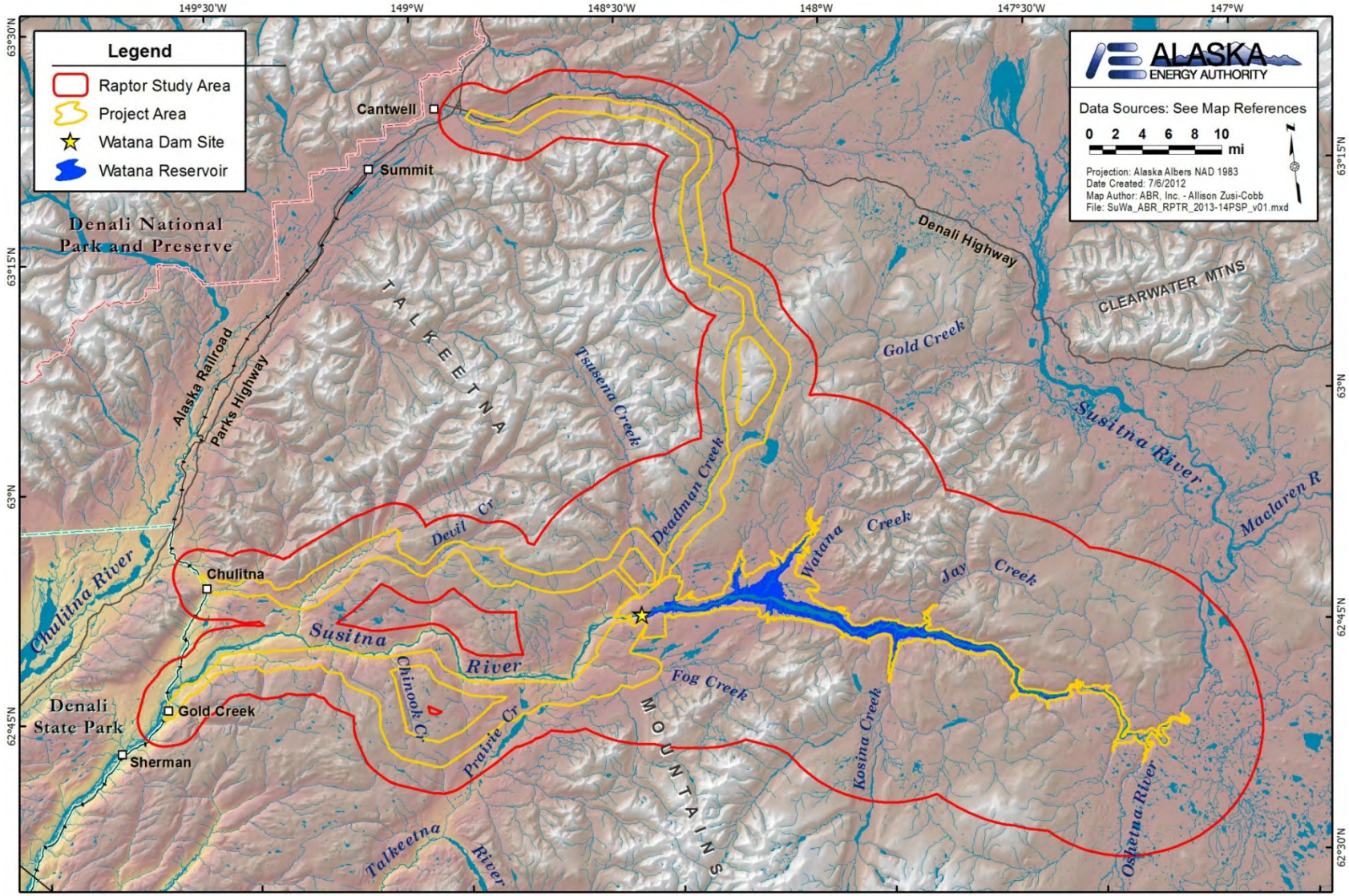

Figure 8.15-1. Raptor study area.

8.16. Breeding Survey Study of Landbirds and Shorebirds

8.16.1. General Description of the Proposed Study

The landbird and shorebird study is planned as a two-year study (2013–2014) and will be formally initiated in 2013. Results from the first year of work in 2013 will be used to update existing information and fine-tune the field survey methods and survey areas. The proposed methods for the breeding landbird and shorebird study are ground-based point-count surveys, in which all birds seen or heard are recorded, along with the horizontal distance to each bird observed. Point-count surveys, which were designed for counting singing male passerine birds, are now the preferred method for inventory and monitoring efforts for landbirds in remote, roadless terrain in Alaska (Handel and Cady 2004, ALMS 2010). These methods have been adopted for shorebirds (ASG 2008), and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations even with a relatively large survey effort.

8.16.1.1. Study Goals and Objectives

The goal of this study is to collect baseline data on the occurrence and habitat use of breeding landbirds and shorebirds in the Project area to enable assessments of the direct, indirect, and cumulative impacts on these birds from construction and operation of the proposed Project. This study will address several species of conservation concern, both landbirds and shorebirds, that are known or expected to occur in the Project area (see AEA 2011), as well as numerous other species that are protected under the federal Migratory Bird Treaty Act (see Section 8.3).

The specific objectives of the study are to:

- Conduct point-count surveys to collect field data on the distribution and abundance of landbirds and shorebirds in the Project area during the summer breeding season;
- Collect habitat-use data for landbirds and shorebirds during the point-count surveys to feed into the habitat-use evaluation study, which will be the first step in quantifying habitat change (i.e., gain/loss and alteration for landbirds and shorebirds from the proposed Project (see Section 9.5);
- Conduct additional habitat-specific point-count surveys in riverine and lacustrine areas to collect distribution and abundance data on piscivorous species and other species typical of fluvial habitats, which are often under-represented in standard point-count surveys;
- Review the literature on the foraging habits and diets of piscivorous landbird species (e.g., Belted Kingfisher; *Cerryle alcyon*), which will be used by researchers conducting the mercury risk-assessment study (see Section 5.12 *Mercury Assessment and Potential for Bioaccumulation*); and
- Review historical (APA Susitna Hydroelectric Project) data on landbirds and shorebirds for comparison with the current data from this study, to evaluate any changes in distribution, abundance, and habitat use over the intervening 30-plus years. Many species of migratory birds have suffered population declines in recent decades, so these comparisons will provide information on the population trends for these species in the Project area.

8.16.2. Existing Information and Need for Additional Information

In 1981, breeding landbirds and some shorebirds were surveyed for the APA Susitna Hydroelectric Project using modified territory-mapping methods, which involved repeated visits between May 20 and July 3 to 12 study plots, each 10 hectares (24.7 acres) in size (Kessel et al. 1982, AEA 2011). Each plot was placed in an area of homogeneous habitat, as defined using Kessel's avian habitat classification (Kessel 1979). At that time, territory mapping was the standard method for surveying landbirds. Because each plot was surveyed repeatedly, substantial information on bird occurrence and habitat use was obtained for the limited area encompassed by those 12 plots. However, because only 12 plots were sampled in homogeneous habitats, the data do not adequately address variability in bird occurrence and habitat use across the broader study area. Some additional information on shorebird occurrence was obtained during ground-based surveys of lakes, ponds, and wetlands for waterbirds (Kessel et al. 1982), but focused surveys for breeding shorebirds were not conducted. No studies of landbirds or shorebirds have been conducted more recently in the Project area (AEA 2011).

Because of the limitations in extrapolating results from intensive surveys of territory-mapping plots to the larger Project area, it will be necessary to study these species groups again using currently accepted protocols (point-count surveys), which allow large landscapes to be sampled adequately and which provide more data on variability in habitat use. Because the most recent surveys for landbirds and shorebirds were conducted over 30 years ago, and because populations of these birds and their habitats have likely changed during that period, new studies are recommended. Current data on the distribution, abundance, and habitat use of landbirds and shorebirds is necessary to be able to adequately assess the impacts from the proposed Project on these species.

8.16.3. Study Area

The proposed study area is the same as that for the mapping of vegetation and wildlife habitats (see Section 9.5, Figure 9.5-1), which will allow the field data for landbirds and shorebirds to be tied directly to the mapped wildlife habitats in this study area (also see Figure 8.16-1). The affected areas include the proposed reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites. All direct and indirect effects of the proposed Project on landbirds and shorebirds and their habitats in the upper Susitna basin are expected to be encompassed in a 5-mi buffer on each side of those affected areas. Changes in riparian vegetation and wildlife habitats in areas downstream of the proposed dam also are possible, and will be addressed in the riparian study (see Section 9.6).

8.16.4. Study Methods

The proposed methods for the breeding landbird and shorebird study are ground-based point-count surveys, in which all birds seen or heard are recorded, along with the horizontal distance to each bird observed. Point-count surveys, which were designed for counting singing male passerine birds, are now the preferred method for inventory and monitoring efforts for landbirds in remote, roadless terrain in Alaska (Handel and Cady 2004, ALMS 2010). These methods have been adopted for shorebirds (ASG 2008), and are especially appropriate in forested landscapes,

where shorebirds typically occur in low densities and where plot-based methods would yield few observations even with a relatively large survey effort.

Point-count surveys are appropriate for large development projects which cover a large area and that include many different types of habitats. The sample points can be spread across the landscape and allocated by habitat type to ensure that all the prominent habitat types are sampled. In 2013, point-count sampling locations will be distributed using a pseudo-stratified random plot allocation procedure based on aerial photosignatures as the sampling strata (because a current and complete habitat map likely will not available by spring 2013. The plot allocation methods may be changed in 2014 (see below). This procedure will result in adequate sampling of habitats, over 2 years of surveys, so that habitat-use evaluations for landbirds and shorebirds will be supported sufficiently by Project area-specific data. These habitat-use evaluations (see Section 8.5) are a critical link in conducting quantitative assessments of habitat loss and alteration for breeding landbirds and shorebirds.

Because several species of landbirds and shorebirds are not commonly recorded in standard point-count surveys allocated randomly across available habitats, but are known to be closely associated with riverine and lacustrine habitats which will be lost during Project development, (e.g., Belted Kingfisher, American Dipper [*Cinclus mexicanus*], Semipalmated Plover [*Charadrius semipamatus*], Solitary Sandpiper [*Tringa solitaria*], Spotted Sandpiper [*Actitus macularia*], Wandering Tattler [*Heteroscelus incanus*]), an additional set of point-count surveys will be conducted specifically in riverine and lacustrine habitats that are expected to be affected by Project development. In these surveys, the Belted Kingfisher is of additional interest because it is a piscivorous species (see below). These additional surveys were recommended by the USFWS (see Section 8.4, Table 8.4-1).

Point-count survey data with distance estimates (which equate to variable circular plots) can be used to calculate densities for breeding landbirds and shorebirds using distance-sampling methods, which are based on detection functions calculated for each species (Buckland et al. 2001, Rosenstock et al. 2002). Those detection functions, however, are reliable only when a sufficient number of species-specific observations are obtained for analysis (i.e., sufficient data may be available to calculate densities for the more common species in the Project area, but for rare species, with few observations, it will not be possible to calculate reliable densities). Moreover, there is evidence that, because of the difficulty in estimating accurate distances to vocalizing birds, that the resulting density estimates can be unreliable (Alldredge et al. 2007a,b, 2008, Efford et al. 2009). For these reasons, AEA is not proposing to calculate densities of landbirds and shorebirds, and will rely on assessments of the amount of habitat expected to be lost and altered for each species when conducting impact assessments.

The landbird and shorebird study will be coordinated with the other wildlife studies being performed for the Project, especially the raptor and waterbird studies, so that sightings of bird species that apply to other studies can inform the survey and reporting efforts for all studies.

8.16.4.1. Field Surveys

Point-count field surveys will be conducted following standardized protocols for point-counts in Alaska (Handel and Cady 2004, ALMS 2010). These methods are based on the variable circular-plot point-count methods described by Ralph et al. (1995) and Buckland et al. (2001). As prescribed, the surveys will be conducted during the early morning hours to maximize the

detection of breeding species, especially singing male passerines. Standard 10-minute observation periods will be used and, to facilitate the collection of habitat-use data, the specific habitat being used by each bird observed will be recorded whenever possible.

As noted above, in 2013, it is expected that the point-count plot locations will be selected using a pseudo-stratified random plot allocation procedure based on aerial photosignatures as the sampling strata (because it is unlikely a current and complete habitat map will be available by spring 2013). In 2014, point-count locations will be selected again using a pseudo-stratified random plot allocation procedure, but in this case, based on the mapped wildlife habitat types as the sampling strata (to the extent the wildlife habitat mapping is complete by spring 2014). In both cases, the plot allocation will be constrained so that an adequate number of plots are placed in each mapped habitat or photosignature type. Without this constraint, an excessive number of plots would be located in the most common habitat types and far fewer would occur in the uncommon types, resulting in an undersampling of uncommon habitat types. In all cases, sample points will be located in a random fashion (using GIS) within each mapped habitat or photosignature type, subject to the restriction of maintaining a minimum distance of 500 meters (1,640 feet) between sample points in open habitats and 250 meters (820 feet) in closed habitats. This sampling scheme will result in a selection of point-count locations that is unbiased with respect to the distribution of breeding birds on the landscape. The goal in the plot allocation procedure is to derive a set of sample points that are spread broadly across the study area and are replicated within each photosignature/habitat type to try to capture any spatial variability in habitat use by breeding birds. Replicate sampling also is important to be able to locate the often patchy occurrences of the less common species of conservation concern.

Two field surveys are planned in each summer season (2013 and 2014). The first survey will be conducted in mid-May with a focus on breeding shorebirds and early nesting landbirds (e.g., Rusty Blackbird (*Euphagus carolinus*), which is a species of conservation concern for Alaska [USFWS 2008]). It is likely that data on early nesting resident birds also can be collected in this first survey because nesting should start a bit later at the higher elevations in the Project area. The second survey will be conducted in early June and will be focused on neotropical migrant landbirds. These surveys are scheduled for early June so that the late arriving flycatchers (e.g., Alder Flycatcher; *Empidonax alnorum*) will be present. In practice, however, some data on nesting resident birds and shorebirds can be collected during early June as well.

For the mid-May survey, point-count plots will be allocated preferentially in open habitats that are used by breeding shorebirds. These include open, wetland habitats in forested areas as well as open, dwarf-scrub dominated habitats in upland and alpine terrain. Woodland bog and tall-scrub habitats in poorly drained lowland terrain also will be sampled as these areas are used by breeding shorebirds and Rusty Blackbirds. During the mid-May surveys, an additional set of point-count plots will be allocated specifically in riverine and lacustrine habitats that are expected to be affected by Project development. These surveys will be conducted to address those species that are known to use riverine and lacustrine habitats, but are not often recorded on point counts allocated randomly across all available habitats. In addition to the point-count surveys, researchers will walk the length of the stream drainages and lake/pond shorelines sampled as they move between point-count locations, and all birds observed in transit will be recorded. An additional goal of these surveys will be to collect data on the distribution and abundance of piscivorous species (Belted Kingfisher) in the inundation zone and immediately

below the location of the proposed dam. This information will be used in the mercury risk-assessment study (see Section 5.12 *Mercury Assessment and Potential for Bioaccumulation*).

For the early June survey, point-count plots will be allocated across all available habitats in the study area. As noted above, this survey will be focused on neotropical migrant landbirds.

8.16.4.2. Integration of Existing Information with Current Study

The landbird and shorebird data collected in the APA Susitna Hydroelectric Project area in the 1980s (Kessel et al. 1982, AEA 2011) will be reviewed and incorporated into the analyses of habitat use by these species presented in the Initial Study and Updated Study reports (see below). The primary focus will be to evaluate the habitat-use patterns in the historical data and determine whether those patterns are consistent with those found in analyses of current data. The abundance and distribution information for landbirds and shorebirds from the work of Kessel et al. (1982) also will be reviewed to evaluate any changes in abundance and distribution over the intervening 30-plus years. These historical comparisons will provide information on the recent trends for these species in the Project area, which will be useful for impact predictions and assessments.

8.16.4.3. Mercury Risk Assessment

To assist in the mercury risk assessment study (see Section 5.12 *Mercury Assessment and Potential for Bioaccumulation*), and to complement the field data gathered on the distribution and abundance of piscivorous landbird species (Belted Kingfisher) in the study area (see above), the scientific literature on the foraging habits and diets of Belted Kingfishers will be reviewed. As much as possible, the information gathered will be focused on data from Alaska studies.

8.16.4.4. Impact Assessment

Landbirds and shorebirds are expected to be affected indirectly primarily by the loss of breeding habitat from the placement of fill and from the conversion of terrestrial habitats to lacustrine habitats in the proposed reservoir. Additional indirect impacts could occur from the alteration of habitats due to erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Disturbance effects (displacement from breeding habitats) from construction and operations activities represent another source of indirect impacts. Direct impacts could occur through injury and mortality in various ways (e.g., if exposed to fuel from accidental spills or from in-flight collisions with infrastructure). Alterations in riparian wildlife habitats downstream of the proposed dam due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River also are possible. These downstream effects on wildlife habitats will be addressed in the Riparian Study (see Section 9.6).

The impact assessment for landbirds and shorebirds will be conducted by first conducting habitat-use evaluations (see Section 8.19 and 9.5) to determine habitat values for each landbird and shorebird species for each of the wildlife habitats mapped in the vegetation and wildlife habitat mapping study (see Section 9.5). Then the Project footprint will be overlayed, in GIS, on the mapped wildlife habitat types to quantify the acreages of important breeding habitats for each species that would be lost directly to fill. The determination of acreages of landbird and shorebird habitats that could be affected by habitat alteration and behavioral disturbance will be conducted similarly by overlaying habitat alteration and disturbance buffers (surrounding the

proposed Project infrastructure) to identify which habitats are likely to be affected by ancillary impacts associated with Project construction, operations, and maintenance. The size and number of habitat alteration and disturbance buffer(s) to be used will be determined based upon the final specifications for Project construction, operations, and maintenance activities, which will be provided in the Project description. Direct impacts to landbirds and shorebirds will be assessed qualitatively by evaluating the likelihood of injury and mortality from various sources during Project construction and operations.

Cumulative effects on landbirds and shorebirds in the region of the proposed Project will be assessed by evaluating the extent of the direct and indirect impacts expected from the Project in conjunction with the existing impacts to landbirds and shorebirds in the region.

8.16.4.5. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of historic (APA Project) data and data collected during the 2013 and 2014 field seasons, including representative photographs of breeding bird habitats at point-count plots will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The landbird and shorebird study results will be presented in the Initial and Updated Study reports, according the schedule indicated below. The reports will include descriptions of the field methods, a map of the point-count locations surveyed, and results of the point-count surveys with tables indicating abundance by species and habitat type.

8.16.5. Consistency with Generally Accepted Scientific Practice

The landbird and shorebird study will involve point-count surveys, and will be conducted following the currently accepted standardized protocols for the monitoring of landbirds in remote, roadless terrain in Alaska (Handel and Cady 2004, ALMS 2010). In recent years, these methods also have been adopted for shorebird surveys in Alaska (ASG 2008), and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations even with a relatively large survey effort.

8.16.6. Schedule

This is a two-year study. The schedule for the 2013 and 2014 activities is presented below.

2013:

- Review of aerial imagery and point-count site selection: March–April
- Field survey: May 12-17 and June 5-12 (four crews of two persons each); survey timing and duration may need to be modified depending on the extent of the shorebird nesting habitats available and the snow melt and plant phenological findings from the 2012 field surveys for botanical studies in the Project area
- Data analysis: September–October
- Delivery of electronic copies of field data: November

- Initial Study Report: December

2014:

- Review of habitat mapping, aerial imagery, and point-count site selection: March–April
- Field survey: May 12–17 and June 5–12 (four crews of two persons each); survey timing and duration may need to be modified based on the findings in the 2013 studies
- Data analysis: September–October
- Delivery of electronic copies of field data: November
- Updated Study Report: December

8.16.7. Level of Effort and Cost

The landbird and shorebird study is planned to be conducted over two years (2013–2014). Two field survey efforts (late spring and early summer) will be conducted each year by a crew of eight observers (four crews of two persons each). Point-count surveys would be conducted for approximately 14 days each year, with the goal of obtaining at least 400 point-count samples each year. Helicopter-support will be required for this study with drop-off and pick-ups each day in the field. The surveys will start at first light in the morning, which in the Project area will mean approximately 3:30 a.m. The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting. The projected cost for this study in each year is on the order of $250,000, for an approximate estimated total of $500,000 for both years.

8.16.8. Literature Cited

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8.16.9. Figures

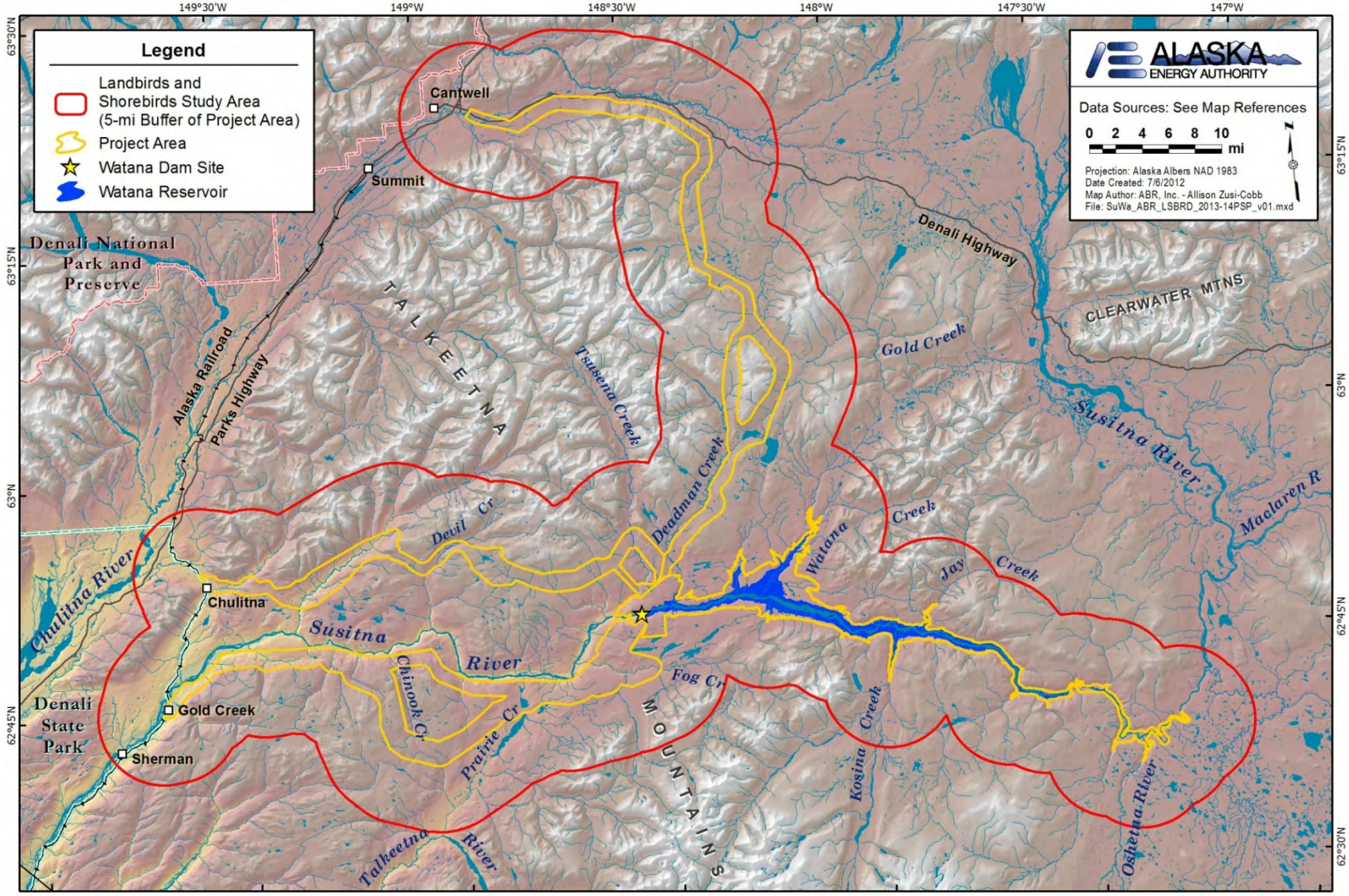

Figure 8.16-1. Landbird and shorebird study area.

8.17. Study of Population Ecology of Willow Ptarmigan in Game Management Unit 13, Southcentral Alaska

8.17.1. General Description of the Proposed Study

The ptarmigan study will be conducted by ADF&G. The ptarmigan study will be a two-year investigation, initiated in spring 2013 and continuing through winter 2014. ADF&G may continue the study through 2016, corresponding to the anticipated lifespan of the radiotelemetry necklaces. AEA is proposing the following study plan for ptarmigan, but AEA would like to consult further with licensing participants to re-evaluate the level of effort.

8.17.1.1. Study Goals and Objectives

The goal of this study is to provide the necessary data to evaluate the potential effects of the proposed Susitna-Watana Project on Willow Ptarmigan (*Lagopus lagopus*), the predominant species of upland game bird in the Project area and surrounding areas. The area of interest consists of Subunits 13A and 13E of Game Management Unit (GMU) 13 (Figure 8.17-1).

The study has four objectives:

- Determine the seasonal distribution of Willow Ptarmigan in the Project area;
- Determine the seasonal migratory patterns of Willow Ptarmigan that occur in the Project area;
- Estimate the abundance of ptarmigan in the Project area during the breeding season and during the fall; and
- Estimate seasonal survival of Willow Ptarmigan.

The data gathered during the study will be integrated to determine potential effects of the Project on Willow Ptarmigan.

8.17.2. Existing Information and Need for Additional Information

The Willow Ptarmigan is the most common and widespread ptarmigan in Alaska, constituting an estimated 65–70 percent of all ptarmigan statewide, followed by Rock Ptarmigan *(L. mutus*) at 25–30 percent, and White-tailed Ptarmigan (*L. leucurus*) at <10 percent (Taylor 1994). All three ptarmigan species occur in GMU 13 (Taylor 2000).

Ptarmigan hunting is a very popular activity in the fall and winter months in GMU 13 due to the accessibility of the unit from the state highway system. Since 1997, the Alaska Department of Fish and Game (ADF&G) has conducted ptarmigan surveys in spring along the Denali, Parks, and Richardson highways to quantify the relative abundance of territorial males. All survey efforts have centered on road-accessible areas within GMU 13. Those surveys suggested that Willow Ptarmigan along the road system portions of GMU 13 are declining in abundance or have remained at low abundance since 2000 (Bill Taylor, pers. comm.). Due to this continued low abundance, ADF&G recommended that the Alaska Board of Game reduce the bag limit of ptarmigan from 10 per day to 5 per day in Subunits 13A, 13B, and 13E between December 1 and March 31, and this recommendation took effect during the 2005–2006 regulatory year. Continued low abundance resulted in further harvest restrictions in Subunit 13B, and beginning in 2009, the ptarmigan season has been closed after November 30 each year. ADF&G has been

unable to commit additional resources to better understand the life history of GMU 13 ptarmigan populations and there is little information on the habitat value of the Project area for ptarmigan.

Ptarmigan that winter in the Project area may be either resident or migratory birds. To better predict the potential effects of the proposed Project on Willow Ptarmigan, information needs to be collected to determine the annual ranges of ptarmigan that may use habitats in GMU 13. In particular, information is needed to evaluate the relative importance of the Project area to resident and to migratory ptarmigan and the seasonal ranges of migratory birds need to be determined.

8.17.3. Study Area

Willow Ptarmigan will be captured within a 15-mile buffer around the proposed dam site and reservoir and the access and transmission corridor alternatives (Figure 8.17-1). Capture locations will be in the headwaters of several major river drainages. The study area is composed of alpine habitats at higher elevations and subalpine spruce habitats at lower elevations. Areas in which Willow Ptarmigan will be captured are roadless, although periodic, but infrequent, all-terrain vehicle use can occur year-round.

The areas selected for capture have been identified previously as locations with relatively high breeding densities of Willow Ptarmigan. Initial capture efforts will focus on three areas, including upper Fog Creek (tributary to the upper Susitna River), upper Busch Creek (tributary to Goose Creek), and the pass between upper Jay and Coal creeks.

Radio-tagged Willow Ptarmigan are expected to remain within 50 miles of the original capture site, although, in some cases, movements may exceed that distance (Irving et al. 1967). Aerial surveys to locate birds with radios will be conducted in appropriate habitats within 50 miles of the original capture locations.

8.17.4. Study Methods

8.17.4.1. Capture of Ptarmigan

Beginning in April 2013, 50–100 Willow Ptarmigan will be captured annually at three sites within Subunits 13A and 13E (Figure 8.17-1) and fitted with radiotransmitter-equipped necklaces. All three sites are within 15 miles of either the proposed reservoir or alternative access corridors (AEA 2012). Alternative capture sites may be needed based on conditions each spring, depending on factors such as ptarmigan abundance, snow depth, and fixed-wing airplane access. Potential alternative capture sites (Figure 8.17-1) will be considered during ADF&G field operations in the spring and summer of 2013.

Capture sites and future alternative sites have and will be identified based on several criteria.

- Willow Ptarmigan abundance;
- Proximity to the future reservoir or access routes;
- Ease of access using either fixed-wing or helicopter; and
- Observed springtime conditions (i.e., snow depth, and habitat availability during the capture time period).

During the breeding season in April and May of each year, several 2-person teams will be deployed to various capture locations using wheel-ski equipped fixed-wing aircraft. Teams will

attempt to capture 25–50 Willow Ptarmigan during the spring effort. Several teams will again be deployed in mid-August to September, using fixed-wing aircraft, in an effort to capture an additional 25–50 adult and fledged juveniles before brood dispersal occurs (Weeden and Watson 1967).

When capture efforts begin in April, male Willow Ptarmigan will be located visually or by using a playback recording of a territorial male Willow Ptarmigan (Taylor 1999, Peyton 1999, Savage et al. 2011). Playback recordings will be used effectively under low wind conditions (≤ 5 miles per hour) with no precipitation during early morning or late evening hours. Once ptarmigan are known to be in the vicinity, a Styrofoam decoy and remotely powered caller will be placed within the defensive range (<100 meter [328 feet]) of a territorial male. A mist net will be deployed around the decoy and remotely powered caller in an attempt to capture the territorial male when he responds defensively to the call and decoy. Mist nets designed by Avinet (www.avinet.com) for capturing small hawks and large shorebirds will be used (Silvy and Robel 1968). These black nylon nets have a 100-millimeter (~4-inch) mesh and are 2.6 meters (8.5 feet) tall, with 4 shelves (Browers and Connelly 1986). When circumstances allow during spring capture efforts, a handheld Coda net gun (www.codaenterprises.com) with a 12-square foot net and 3-inch mesh also will be used opportunistically to capture territorial male birds on the ground, primarily as a backup to the mist net method. This method has been used from a helicopter to capture short-eared owls (*Asio flammeus*) in northern Alaska and has proven to be safe and effective (T. Booms, ADF&G, pers. comm.). The use of decoys and calls is a novel adaptation to attempt to increase the number of captures typical of previous netting methods (>30 ptarmigan annually; Skinner et al 1998, Kaler et al. 2010). No attempt to capture nesting or brood-rearing females will occur.

Post-breeding resident and migrant birds will be targeted for capture during a second annual capture effort in mid-August through September. Flocks of ptarmigan will be located visually, mist nets will be strategically placed around or in the vicinity, and ptarmigan of all age/sex classes will be flushed into the mist nets. Fall captures will be similarly outfitted with radiotransmitter necklaces.

At least two people will be present for any single capture event to remove birds from mist nets, handle, and release birds as quickly as possible. After capture, Willow Ptarmigan will be restrained in a capture bag or by holding their wings against their bodies. Birds will be instrumented with a necklace-mounted A3950 VHF radio transmitter with a 10-inch whip antenna (Raymond 1999, Paragi et al. 2012; Figure 8.17-2) from Advanced Telemetry Systems (ATS, www.atstrack.com). The entire radio and necklace package will weigh up to 10.7grams (0.4 ounce) (1.7 percent of the body mass based on known weights of hunter-harvested Willow Ptarmigan; Hudson 1986, Thirgood et al. 1995). Radios will transmit on a frequency of 148.000 Mhz. The transmitter is secured by a rubber-sheathed wire fitted over the bird's neck and crimped on either end to ensure its fit (Figure 8.17-2). The transmitter will be adjusted to compensate for crop expansion. No tissue samples will be collected from captured Willow Ptarmigan. Birds will be handled for 5–10 minutes and released at their point of capture.

Age and sex, based on plumage characteristics (Bergerud et al. 1963, Weeden and Watson 1967, Braun and Rogers 1971, Hudson 1986) will be recorded for each bird captured. Individually numbered leg bands will be placed on each radio-tagged bird. These tags will be useful for ground observations and to identify human-harvested birds or prey remains that may be found during field efforts. A GPS will be used to record the location of capture. Date, time, and

weather conditions also will be recorded. If a territorial male is captured, an attempt will be made to identify and record the location(s) of his territory post(s).

Radio tags will not be removed at the conclusion of the study, nor will tags drop off. There is little evidence to suggest that radio tags have a negative effect on the survival or breeding success of ptarmigan and other galliformes (Thirgood et al. 1995, Palmer and Wellendorf 2007, Terhune et al. 2007). Radio-tagged Willow Ptarmigan will be closely monitored within 24 hours of capture to document capture myopathy or other obvious handling-induced stresses. All potential capture and marking methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee (IACUC) certification. ADF&G will ensure compliance with all IACUC policies.

8.17.4.2. Relocation of Radio-tagged Ptarmigan

Radio-tagged ptarmigan will be relocated during aerial surveys conducted throughout the year to record habitat use, movements, and mortality. Birds will be tracked and relocated using a fixed-wing airplane equipped with wheel-skis, which will decrease search time and increase the area that can be covered. The first aerial survey will be performed within 10 days of capture to document survival rates of the birds recently radio-tagged. At least six additional aerial surveys will be performed annually: two in late summer (August–September), two in mid-winter (November–February), and two in early spring (late March to mid-April).

Range of radio tags will be tested before deployment. However, temperature may affect transmission range (T. Paragi and B. Taylor, ADF&G, pers. comm.). Therefore, to ensure a systematic search pattern, aerial surveys will be flown using a preselected 5-mile grid and flown at an altitude of 1,500–2,000 feet within Subunits 13A and 13E.

An ATS 4520 receiver will be used to locate radio-tagged birds. Two 4-element Yagi antennas will be mounted to each strut of the aircraft. A GPS receiver mounted at the windshield of the aircraft and connected to the 4520 receiver will provide a location for each data record. Upon completion of each aerial survey, receivers will be downloaded to a field laptop or Local Area Network (LAN) at the ADF&G office in Palmer for future analysis and specific location determination of each tagged bird.

During September and March, aerial transect surveys will be flown to estimate distribution and abundance using line-transect or repeat-count techniques (Royle and Dorazio 2008, Thomas et al. 2010). In addition to abundance, these surveys will provide data on the overall distribution of ptarmigan in Subunits 13A and 13E.

8.17.4.3. Analysis of Radiotelemetry Data

After the radio receivers have been downloaded, data will be transferred into a Microsoft Access database for analysis. Maps will be created using GIS software (ArcMAP) for each aerial survey day, indicating the location of each relocated Willow Ptarmigan. These data will be catalogued and used for spatial analyses.

Movement and survival rates of tagged birds will be estimated using multistate models (Brownie et al. 1993). Occupancy models of aerial survey data will be used to estimate the probability that an area is used and to identify changes in the probability of use between fall and spring surveys (Nichols et al. 2008).

The combination of telemetry transmitters and large-scale aerial surveys will provide both specific information on individual movements and habitat use and general information on species distribution. These survey techniques are being developed and implemented for another study of ptarmigan north of the Brooks Range (K. Christie, pers. comm.)

8.17.4.4. Impact Assessment

The ptarmigan study is designed to provide relevant information to be able to assess potential direct, indirect, and cumulative effects, which may include the following:

- Permanent habitat loss caused by project facilities, including the reservoir, powerhouse, and other permanent Project facilities;
- Temporary loss or alteration of habitats affected by clearing, dust fallout, gravel spray, persistent snow drifts, impoundments, thermokarst, contaminant spills, and other indirect effects of project construction and operation;
- Behavioral disturbance of ptarmigan by project construction and operation activities, including vehicle and heavy equipment traffic, geophysical investigations, and other human activities in the Project area;
- Indirect habitat loss through displacement of birds that avoid project facilities or transportation routes;
- Increase predation of birds or their eggs that may result from attraction of predators to anthropogenic foods or artificial structures (such as perches on power poles or powerlines, for example);
- Injury and mortality of birds from collisions with aircraft, vehicles, or structures (such as powerlines, for example);
- Injury and mortality of birds due to contact with or ingestion of contaminants (including fuels), including potential indirect effects of forage plants;
- Increased harvest of ptarmigan resulting from improvements in access to humans.

Data on the distribution, abundance, movements, productivity, and habitat use of Willow Ptarmigan in the study area will be used to assess Project impacts through geospatial analysis and evaluation of the responses of the species to other similar projects, as documented in the scientific literature. Using GIS software, species abundance data recorded among different habitat types will be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans to assess direct and indirect impacts of habitat loss and alteration and behavioral disturbance. The direct and indirect impacts of the Project will be evaluated by overlaying the Project features (including the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors), and the seasonal ranges of ptarmigan on the Project habitat map. Seasonal ranges will be delineated with radiotelemetry, using the recorded movements of a sample of birds to which radios have been attached. By plotting ptarmigan locations on the habitat map, high-value or high-density habitats can be identified. Indirect impacts will be estimated by applying various buffer distances on Project features, as determined from the available information on the anticipated effects of construction disturbance and habitat-related changes due to infrastructure and development and identifying areas of high-value habitats that are affected. The GIS analysis will be combined with results from the telemetry study and transect surveys, as well as from the scientific literature, to estimate the geographic extent, frequency, duration, and magnitude of

Project effects on ptarmigan. Any necessary PM&E measures will be developed by examining the distribution and abundance of Willow Ptarmigan among habitats in relation to the geographic extent and seasonal timing of Project activities.

8.17.5. Consistency with Generally Accepted Scientific Practice

Habitat availability and use analyses allow an ecosystem approach to impact assessment and GIS-based analysis has become a standard and straightforward method of evaluating the impacts of habitat loss and alteration. Ptarmigan captures will be conducted by adapting fairly standard capture methods to the situation. With continuous improvements in technology, particularly in battery and transmitter weights, radiotelemetry is an important and increasingly standard method of obtaining movement data even for small birds and mammals. All potential capture and marking methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee (IACUC) certification. ADF&G will ensure compliance with all IACUC policies. There is little evidence to suggest that radio tags have a negative effect on the survival or breeding success of ptarmigan and other galliformes (Thirgood et al. 1995, Palmer and Wellendorf 2007, Terhune et al. 2007). Radio-tagged Willow Ptarmigan will be closely monitored within 24 hours of capture to document capture myopathy or other obvious handling-induced stresses.

8.17.6. Schedule

Field work will begin April 2013 and continue through late winter of 2014. ADF&G may continue the study through 2016, corresponding to the anticipated lifespan of the radiotelemetry necklaces. Project milestones will follow the schedule below:

2013:	
April–May, August	First field season – capture and tag ptarmigan
August–December	Conduct aerial surveys (through May 2014)
December	Initial Study Report
2014:	
January–May	Conduct aerial surveys birds collared in 2013 season
April–May, August	Second field season – capture and tag ptarmigan
August–December	Conduct aerial surveys
December	Updated Study Report

8.17.7. Level of Effort and Cost

This is a multi-year study that will be conducted by ADF&G. The estimated cost of the study from 2013-2014 is $415,000.

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8.17.9. Figures

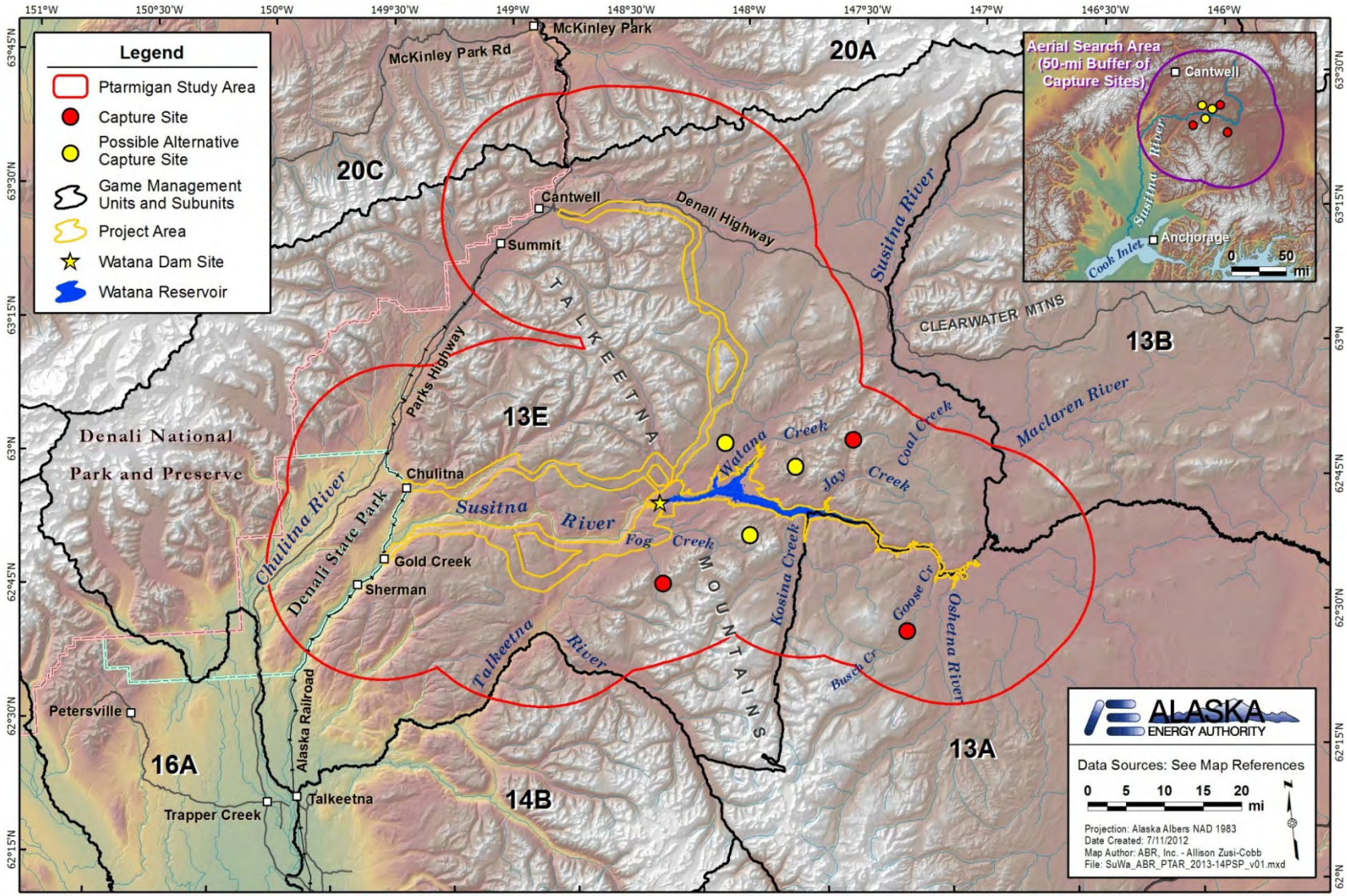

Figure 8.17-1. Ptarmigan study area, capture sites (red circles), and possible alternative capture sites (yellow circles) under consideration in summer 2012.

8.18. Study of Distribution and Habitat Use of Wood Frogs

8.18.1. General Description of the Proposed Study

The wood frog (*Rana sylvatica*) study will be conducted over two years in 2013 and 2014, with field work scheduled for May of each year. The study will focus on evaluating the distribution of wood frogs in the Project area using both field surveys and habitat modeling. AEA is proposing the following study plan for wood frogs, but AEA would like to consult further with licensing participants to re-evaluate the level of effort based on more discussions regarding the potential for a Project nexus to this species as well as whether the chytrid fungus is a factor for this species so far north of the Kenai.

8.18.1.1. Study Goals and Objectives

The goal of the wood frog study is to characterize the use of the Project area by breeding wood frogs to facilitate an assessment of potential impacts on wood frogs from development of the proposed Project.

The specific objectives of the study are to:

- Compile and review existing habitat use and distribution data for breeding wood frogs (*Rana sylvatica*) in a broad region surrounding the Project area;
- Determine the current distribution of breeding wood frogs in the Project area through a combination of field surveys and habitat-occupancy modeling; and
- Use information on current habitat use and distribution to estimate the habitat loss and habitat alteration expected for the species from development of the Project.

The wood frog study is planned as a two-year study (2013–2014). Results from the first year of work in 2013 will be presented in the Initial Study Report and will be used to update this study plan for 2014, as needed, to fine-tune the field survey methods and survey areas, based on comments on the Initial Study Report by FERC, resource agencies, and other licensing participants.

8.18.2. Existing Information and Need for Additional Information

Because amphibians were not included in the original APA Susitna Hydroelectric Project environmental program studies in the 1980s, data on the occurrence of wood frogs in the upper Susitna drainage is lacking. It is likely that wood frogs occur in the Project area because they occur in suitable habitats throughout southern Alaska and in the interior north to the southern slopes of the Brooks Range; they have also been documented in Denali National Park and Preserve, near Healy, and in the lower Susitna drainage (Cook and MacDonald 2003; Anderson 2004; Gotthardt 2004, 2005; Hokit and Brown 2006; MacDonald 2010). Amphibian populations appear to have been declining worldwide for several decades (Blaustein and Wake 1990, McCallum 2007) and, although populations may be healthy in Alaska (Gotthardt 2004, 2005), concern has been expressed about the conservation status of wood frogs in Alaska (ADF&G 2006). Because of this and because their status in the Project area is unknown, field surveys for wood frogs will be conducted in areas likely to be affected by Project facilities and activities.

Batrachochytrium dendrobatidis (Bd) is a chytrid fungus that causes the disease chytridiomycosis in amphibians. Since it was first discovered in amphibians in 1998, it has devastated amphibian populations around the world, including in North America. Bd is sometimes a non-lethal parasite and some amphibian species and some populations of susceptible species are known to survive infection. The fungus is widespread and ranges from lowland forests to cold mountain tops, and is typically associated with host mortality in high altitude environments and during winter, with greater pathogenicity at lower temperatures. Wood frogs have been identified as a frog species susceptible to infection by Bd and Bd was first detected in a dead wood frog in Kenai National Wildlife Refuge in 2002 (Reeves 2008). The only other positive detection of Bd was near Dyea in southeast Alaska in 2006 and was associated with the apparent die-off of western toads in southeast Alaska (Sunday 21 May 2006 Juneau Empire). No sampling for Bd has occurred in the Project area. Bd is believed to spread mainly through contact between infected frogs or with infected water. In comments on Study Requests for the Project, the ADF&G requested that water or frogs at survey locations be tested for the presence of Bd.

8.18.3. Study Area

The proposed study area includes those waterbodies in and adjacent to those portions of the Project area in which habitat loss and disturbance/alteration will occur, consisting of the reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites (see Figure 1.2-1 and 8.19-1).

8.18.4. Study Methods

8.18.4.1. Field Surveys and Occupancy Modeling

Potential waterbodies to survey for wood frogs within the Project area boundary will be identified from photointerpretation of aerial photos or remote-sensed imagery and from the preliminary mapping of vegetation, wildlife habitats, and wetlands (see Sections 9.5 and 9.7). If applicable to the specific waterbodies in the preliminary Project area boundary, data from the Alaska Gap Analysis Project (AKNHP 2012) also will be used to identify the characteristics of individual waterbodies associated with breeding wood frogs. Use of the Alaska Gap Analysis Project data was recommended by the ADF&G in their comments on the wood frog study request. Additional information on habitat use of wood frogs will be gleaned from review of the literature on wood frog studies in Alaska. One important waterbody characteristic for wood frogs is the presence of emergent vegetation (which frogs use for egg laying), and which can be assessed by photointerpretation of high-resolution aerial photos or remote-sensed imagery. With a set of waterbodies identified that have the potential to support wood frogs, a random subset of waterbodies will be selected to survey for breeding frogs. In addition, incidental detections of wood frogs will be documented during data collection efforts for other resources (e.g., fisheries, wetlands).

Ground-based auditory surveys of the randomly selected waterbodies in the study area will be conducted in mid to late May in 2013 and 2014 using standard methods developed by the USGS (2010). These surveys involve auditory detection of frogs calling during the breeding season to detect presence or absence of wood frogs at each waterbody sampled. A double-observer

occupancy survey design with independent (i.e., "blind") observations made by two observers at each waterbody will be used to estimate the detectability of wood frogs; a single visit with two observers will be made to each waterbody. This design will allow a greater number of waterbodies to be surveyed within a given time period and will save on resources. With estimates of the detectability of wood frogs, the observed occupancy rate of frogs in waterbodies in the study area will be corrected (to account for those frogs present but not detected) to yield a corrected occupancy rate.

Habitat characteristics (e.g., size and depth, presence of emergent aquatic vegetation, presence of fish, beaver activity) would be recorded for each sampled waterbody to facilitate the development of a Project-specific occupancy estimation model based on the habitat characteristics of the occupied waterbodies. Data from the vegetation and wetland mapping and wetland functional assessment studies (see Sections 9.5 and 9.7), and the literature (e.g., Stevens et al. 2006) would be assessed as potential model variables to characterize wood frog habitat. The model's predictive accuracy would be evaluated, if possible, during the 2014 field surveys. If the model is deemed reliable, it would be used to classify all waterbodies in the study area with respect to their probability of supporting breeding wood frogs. Spatial analyses using model results then could be used to more accurately predict Project impacts on wood frogs.

8.18.4.2. Bioassays for Batrachochytrium dendrobatidis (Bd)

The specific assay and sampling methods for Bd will be determined through consultation with commercial or research laboratories. Currently available information indicates that no standard methods for bioassay of Bd have been proffered or certified by the EPA or other regulatory or standards agencies. The currently proposed strategy is to assess the presence/absence of Bd in water samples, but further consultations may suggest that swabs of frog skin or frog tissue samples would be preferred. Water (or frogs) will be collected from each waterbody at which frogs are detected during the auditory surveys described above.

Water samples will be collected in pre-cleaned I-Chem Certified ® high-density polyethylene 125 mL bottles, certified by EPA for metals analysis and water-quality testing. Three samples will be collected from each waterbody, all from approximately two inches below the water surface. Samples will be refrigerated and shipped to a commercial or research laboratory, depending on the availability of lab services, within required holding times (if any are specified).

A frog skin swab method also has been described. By this method, a non-destructive Polymerase Chain Reaction (PCR) technique is used to test for chytrid fungus. Frogs are captured and the skin of the abdomen and/or foot webbing is swabbed 25 times with a sterile cotton swab, after which the frog is released unharmed. The samples are then sealed and refrigerated and later laboratory tested for the presence of chytrid DNA.

8.18.4.3. Impact Assessment

Wood frogs are expected to be affected primarily by direct mortality during construction and by the loss of breeding waterbodies from the placement of fill and from inundation in the reservoir impoundment zone. Additional impacts could occur from the alteration of habitats due to erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Aquatic habitats created by the impoundment will not be suitable for wood frogs due to their preference for small ponds.

The impact assessment for wood frogs will be conducted by employing the habitat classification for waterbodies from the occupancy modeling (above) to categorize waterbodies according to their known or predicted probability of supporting breeding wood frogs. Then the project footprint will be overlain, in GIS, on the mapped waterbody types to quantify the acreages of waterbodies that would be lost directly to fill or inundation. The determination of acreages of waterbody habitats that could be affected by habitat alteration will be conducted similarly by overlaying habitat alteration buffers (surrounding the proposed Project infrastructure) to identify which waterbodies are likely to be affected by ancillary impacts associated with Project construction and operations. The size and number of habitat alteration buffer(s) to be used will be determined based upon the final specifications for Project construction and operations activities, which will be provided in the Project description.

Sampling for Bd in 2013 and 2014 will establish a baseline for comparison of occurrence in ponds in the Project area before and after construction of the Project.

Cumulative effects on wood frogs in the region of the proposed Project will be assessed by evaluating the extent of the direct and indirect impacts expected from the Project in conjunction with the existing impacts to wood frogs in the region. Any necessary PM&E measures will be developed based on the acreage of waterbodies with a high probability of supporting wood frogs affected by Project construction and seasonal timing of Project activities.

8.18.4.4. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of field data collected during the 2013 and 2014 field seasons, including representative photographs of waterbody habitats occupied by wood frogs, will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The wood frog study results will be presented in the Initial and Updated study reports, according the schedule indicated below. The reports will include descriptions of the field methods, a map of the waterbodies surveyed, results of the occupancy surveys, and descriptions of the potential impacts to wood frogs from development of the Project.

8.18.5. Consistency with Generally Accepted Scientific Practice

The wood frog study will involve occupancy surveys of randomly selected waterbodies, and will be conducted following the currently accepted standardized protocols for the monitoring of amphibians (USGS 2010). A similar occupancy survey of wood frogs in randomly selected waterbodies was successfully conducted by ABR in 2007 on another large-scale project in southwest Alaska (see PLP 2011).

8.18.6. Schedule

The wood frog study is planned to be conducted over two years. The activities for each year are described below.

2013:

- Review of aerial imagery and Alaska Gap Analysis data, and selection of waterbodies to survey: March–April
- Field survey: May 10–19 (one crew of two biologists); survey timing and duration may need to be modified depending on the snow-melt and lake-thaw findings from the 2012 field surveys for other wildlife resources in the Project area
- Data analysis: September–October
- Delivery of electronic copies of field data: November
- Initial Study Report: December

2014:

- Review of aerial imagery and Alaska Gap Analysis data, and selection of waterbodies to survey: March–April
- Field survey: May 10–19 (one crew of two biologists); survey timing and duration may need to be modified based on the findings in the 2013 studies
- Data analysis: September–October
- Delivery of electronic copies of field data: November
- Updated Study Report: December

8.18.7. Level of Effort and Cost

The wood frog study is planned to be conducted over two years (2013–2014). A single field survey effort will be conducted each year in late spring by a crew of two biologists. Occupancy surveys will be conducted for approximately 10 days each year. Helicopter support will be required for this study with multiple drop-offs and pick-ups each day in the field (i.e., a dedicated helicopter likely will be required). The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting. The projected cost for this study in each year is on the order of $100,000, for an approximate estimated total of $200,000 for both years.

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8.19. Evaluation of Wildlife Habitat Use Study

8.19.1. General Description of the Proposed Study

The wildlife habitat evaluation study is an office-based evaluation of existing information and new survey data to be collected for the Project, which will be used in association with the specific wildlife habitat types to be mapped for the Project (see Section 9.5), to categorically rank habitat values for the mapped habitat types for each bird and mammal species of concern that will be addressed in the impact assessments prepared during the FERC licensing process.

8.19.1.1. Study Goals and Objectives

The goal of the wildlife habitat evaluation study is to provide Project-specific habitat-use information for birds and mammals to facilitate quantitative assessments of the impacts to wildlife habitats from development of the proposed Project.

The specific objectives of the wildlife habitat evaluation study are to:

- Use Project-specific survey data and the scientific literature to determine local habitat associations for those bird and mammal species occurring in the Project area that are of conservation and/or management concern to federal and state management agencies and that are specific to the wildlife habitat types to be mapped in the Project area; and
- Categorically rank habitat-values for each bird and mammal species of conservation and/or management concern for each of the wildlife habitat types that will be mapped in the Project area.

The habitat-association data to be developed in this study, along with the wildlife habitats that will be mapped digitally in the vegetation and wildlife habitat mapping study (see Section 9.5), will be used in quantitative, GIS-based assessments to determine habitat loss, habitat alteration, and disturbance effects for birds and mammals (see below). These assessments will play an important role in the overall evaluations of impacts to wildlife during the FERC licensing process.

8.19.2. Existing Information and Need for Additional Information

Wildlife habitat evaluations for the Susitna basin were conducted in several studies in the early 1980s for the APA Susitna Hydroelectric Project and for another study effort in the lower portions of the drainage (AEA 2011). Those habitat evaluations were based on vegetation cover types that were mapped within 16 km (10 mi) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). That vegetation mapping was conducted over 30 years ago and the subsequent habitat evaluations were conducted at least 27 years ago.

Both the vegetation mapping and the habitat evaluations should be updated for the current Project, for three primary reasons. First, the wildlife habitat evaluations completed in the early 1980s were based on vegetation types, not wildlife habitat types. Wildlife habitat maps provide land cover classifications that are better suited to evaluations of habitat use by birds and mammals than a vegetation map alone, primarily through the incorporation of physiography, landform, and vegetation structure information (see Section 9.5). Second, many populations of wildlife species have undoubtedly fluctuated in size since the early 1980s, and it is known that

habitat use by birds and mammals can be influenced by density (a greater diversity of habitats often is used when densities are high). Third, vegetation cover, structure, and even landforms are likely to have changed to some degree within the Project area because of landslides, erosion, thermokarst, fire, forest succession, expansion/contraction/decadence of birch and aspen clones, and increases in woody shrub cover associated with increased summer temperatures. To provide accurate information to use in assessing the impacts of habitat loss and alteration for wildlife species during the FERC licensing process, it will be imperative that wildlife habitat evaluations be updated for the currently proposed Project, and that those habitat evaluations are based on a recently prepared wildlife habitat map for the Susitna basin.

8.19.3. Study Area

The wildlife habitat evaluation study area will coincide with the area to be mapped for vegetation and wildlife habitats for the Project (Section 9.5, Figure 9.5-1). The study area encompasses a 5-mi buffer surrounding those areas that would be directly affected by Project construction and operations (the proposed reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites).

8.19.4. Study Methods

8.19.4.1. Habitat Evaluation Procedures

The proposed methods for the wildlife habitat evaluation study involve the use of current and Project-specific survey data for birds and mammals in coordination and conjunction with the preparation of a current wildlife habitat map for the Project area. This study would be an office-based effort, performed after the wildlife habitat mapping for the Project area is completed. The methods to be used will follow those outlined in ABR (2008) and Schick and Davis (2008).

The first task in the wildlife habitat evaluation study is the selection of a set of birds and mammals of concern, which would be assessed for habitat impacts for the Project. The procedure for determining which animals are included will be made through consultation with the federal and state resource management agencies and other interested licensing participants. Criteria will be established for the species-selection process, and it is likely that a species will be selected if it meets one or more of the following criteria:

- A federal or state-protected species;
- A species of conservation concern as determined by various management agencies, agency working groups, and non-governmental conservation organizations (see FERC and USFWS 2011);
- A species of management concern for federal and/or state management agencies;
- A species that is an important subsistence resource or is culturally significant for Alaska Natives;
- A sensitive species that can reflect environmental effects through changes in distribution and/or abundance; and
- An ecologically important species (such as a prominent predator or prey species or one with demonstrable ecosystem effects).

For each species of concern selected and for each wildlife habitat type mapped in the Project area, a habitat-value ranking will be assessed. As with the species-selection process, this procedure will be developed through consultation with the federal and state resource management agencies and other interested licensing participants, but it is likely that a habitat-value categorization system would be used (e.g., negligible, low, moderate, and high value). The habitat-value rankings for various bird and mammal groups will be derived in different ways depending on the level of Project-specific data that are available to assess habitat use within each of the mapped wildlife habitat types. Observations of wildlife species will be tagged to mapped habitats in a GIS and the data quality will be assessed for each species and mapped habitat type (e.g., adequately sampled, undersampled, or not sampled). Quantitative evaluations of the observations of the use of mapped habitats will be used whenever possible to discern rankings among the habitat-value categories used, but in cases in which the habitats in question were under sampled or not sampled, habitat-use information from the scientific literature and/or from field experience with the species will be used to derive habitat-value rankings.

Habitats will be ranked for the various life-history stages of each of the species of concern addresssed (e.g., breeding/calving, post-calving, spring and fall migration, overwintering) to encompass the complete use of habitats by those species in the Project area. Additionally, specific habitat-use maps can be prepared for high-value game animals such as caribou, moose, and bears that will illustrate specific use areas and seasons of use in addition to the identification of habitats of importance to those species.

8.19.4.2. Impact Assessment

Data from the wildlife habitat evaluation study will be used directly in quantitative assessments of habitat loss and habitat alteration for each of the bird and mammal species of concern to be addressed in the FERC licensing process. With habitat-value rankings for each bird and mammal species of concern for each mapped habitat type, the areas within the Project footprint which are important for each species of concern can be identified, and the total areas of each to be directly affected (e.g., habitat loss and habitat alteration) by development of the Project can be determined quantitatively in GIS. Similarly, the indirect affects of disturbance will be assessed by applying species-specific disturbance buffers to the Project footprint and determining quantitatively the total areas of important habitats for each species of concern that could be influenced indirectly by disturbance effects during Project construction and operations. Data from the wildlife habitat evaluation study also will be used to help address the potential for fragmentation of habitat patches for species of concern because of Project development.

8.19.4.3. Reporting and Deliverables

The reports and deliverables for this study include:

Study Reports. Because the wildlife habitat evaluation study can be initiated only after the wildlife habitat mapping for the Project area is completed in October 2014, a brief Initial Study Report will be prepared in 2013 and the Updated Study report will be issued in December 2014. The report will include descriptions of the methods used, including summaries of habitat use for each bird and mammal species assessed, and tables indicating habitat-values by species and habitat type.

8.19.5. Consistency with Generally Accepted Scientific Practice

The study methods discussed above have been successfully used for recent wildlife habitat evaluations on several projects in Alaska (e.g., ABR 2008, Schick and Davis 2008, PLP 2011). The methods have been favorably received by agency reviewers.

8.19.6. Schedule

The wildlife habitat evaluation study can be initiated in full only after the wildlife habitat mapping for the Project area is completed in October 2014.

2013:

- Initial selection of species for analysis: November
- Initial Study Report: December

2014:

- Final selection of species for analysis: September
- Data analysis and habitat-value ranking: October–December
- Updated Study Report: December

8.19.7. Level of Effort and Cost

The wildlife habitat evaluation study will be an office-based study, and it is expected to be completed relatively quickly once the wildlife habitat mapping task is finalized. The wildlife habitat evaluation study likely can be completed in several months depending on the size of the area that will be mapped for wildlife habitats (to be determined in consultation with agency reviewers). The habitat evaluation study will be conducted by up to 2 vegetation ecologists and 4 wildlife biologists (with specific expertise with various bird and mammal species groups). The overall cost for this study is on the order of $200,000.

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8.20. Wildlife Harvest Analysis Study

8.20.1. General Description of the Proposed Study

The wildlife harvest anaylsis study is an office-based study of ADF&G and USFWS harvest records for large mammals and furbearers, and small mammals and upland gamebirds (if data are available). In this study, AEA will characterize the past and current hunter effort and harvest levels in the region of the proposed Project by summarizing and analyzing data from the ADF&G harvest database for Alaska, which also includes some harvest data from subsistence users reported to the USFWS.

8.20.1.1. Study Goals and Objectives

Construction and operation of the Project will alter human access to the region through construction of the access road and power transmission corridors, and through the creation of the reservoir. Much of Alaska GMU 13, which encompasses the Project area, is readily accessible by road and provides hunting opportunities for many Alaskans. Creating access points to the project site from the Denali Highway to the north or from the rail corridor to the west may result in increased motorized vehicle access for hunters and recreational users to portions of GMU 13 that are currently remote. The potential for increased human access and activity within GMU Subunits 13A and 13E without additional understanding of the implications for game populations has been identified as a resource management concern by the ADF&G.

The goal of this study is to compile and analyze information on the distribution of big game, furbearers, and small game (including both small mammals and upland gamebirds, assuming data are available) in and near the Project area and to understand patterns of hunting effort and harvest in the area. These data will provide information on identification of past and current trends in hunter access modes, hunting locations, and harvest locations and identify potential Project-induced changes that are likely to alter hunter access or harvest patterns. These findings will help to predict the impacts of those changes on wildlife harvests. This is a multi-year study that was initiated in 2012 (AEA 2012).

Specifically, this study has three primary objectives:

- Identify past and current harvest effort for large and small game including furbearers, harvest locations, access modes and routes;
- Compare current harvest locations of large and small game, including furbearers, with data on the seasonal distribution, abundance, and movements of harvested species, using the results of other, concurrent Project studies on big game and furbearers; and
- Provide harvest data for use in the analyses to be conducted for the recreational study, and, if needed, the socioeconomic and subsistence studies.

The information developed in this study will be used to help develop any necessary measures to address Project impacts on hunting opportunities, hunter distribution, and impacts to game species abundance.

8.20.2. Existing Information and Need for Additional Information

The wildlife data-gap analysis conducted for the Project (ABR 2011) identified the need for an updated drainage-specific compilation of subsistence, sport hunter, and trapper harvest data for big game and furbearers. Hunter access to this region has changed since the 1980s, but potential changes in patterns of harvest at this scale have not been evaluated or compared with distribution of harvested species. Compilation of historic data may be useful for identifying trends in human access and harvest locations over the past decades and will provide information that may inform ADF&G's management goals for big game and furbearers in the Project area.

ADF&G documents legal sport hunting and trapping in Alaska through the collection of harvest reports and sealing records of hides for certain furbearers. Harvest reports are required to be submitted by hunters for some big game species. Hunting effort and harvest success are summarized from harvest reports and sealing records by GMU, subunit, and, when possible, by smaller Uniform Coding Units (UCU) that are delineated based on watersheds at a sub-basin level. These data are compiled and stored by ADF&G in a statewide harvest database. In addition, a trapper questionnaire is issued annually to compile trapper's views of various wildlife species in their area (Schumacher 2010) and some subsistence hunting activity is summarized based on household surveys. Information on harvest as a part of Federal subsistence hunts on Federal land is maintained by USFWS and will need to be obtained through a separate data sharing agreement.

This information from ADF&G is available to be summarized and analyzed to determine spatial and temporal patterns of hunting effort and harvest success. It also provides some information on access types, use of guides, and residency of hunters. These data can be compared with data on the distribution of game mammals and the analyses can be used to help predict the impact of the Project on hunting opportunities, hunter distribution, and impacts on game mammals. Subsistence surveys will be conducted by ADF&G in 2012 and 2013 to gather current information for communities near the project area. Additional information on subsistence harvest will also be available from planned studies.

The following issues identified in the Pre-Application Document (PAD) (AEA 2011) will be address in this study:

- W4: Potential impact of changes in predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development; and
- W5: Potential impacts to wildlife from changes in hunting, vehicular use, noise, and other disturbances due to increased human presence resulting from Project development.

8.20.3. Study Area

The study area (Figure 8.20-1) includes GMU Subunits 13A, 13B, 13E, 14B, 16A and portions of 20A. These GMUs were selected because hunting and trapping activities in portions of each of these GMUs may be influenced directly or indirectly by Project construction and operations, including the reservoir inundation zone, associated facility sites, laydown/storage areas, and access road and power transmission corridors. The study area is based on GMUs to conform with the harvest data available (which is recorded by GMU) and because hunting and trapping in the region of the Project is managed by GMU.

8.20.4. Study Methods

In this project, AEA will use existing data, as well as new data to be collected during concurrent studies, to assess the spatial and temporal patterns and success of hunting and trapping efforts and to examine relationships between effort, harvest, and the distribution of wildlife, as indicated by telemetry studies and other surveys. Existing data from harvest reports will be compiled and reviewed to assess their adequacy to address Project-related changes in human access. These data will be shared with researchers conducting the recreation, socioeconomics, and subsistence studies. The methods used in this study will include the following:

- Compilation and analysis of ADF&G harvest database records;
- Review of ADF&G management reports;
- Review of ADF&G trapper questionnaires;
- Review of ADF&G small game outlook and harvest surveys;
- Review of ADF&G and USFWS subsistence surveys and harvest reports;
- Interviews with regional biologists; and
- Comparison of harvest patterns with development plans and the distribution of game mammals and birds.

Initial efforts will focus on compilation and analysis of hunter effort and harvest success within harvest report units contained within the ADF&G harvest-record database. The spatial resolution, adequacy, and completeness of the harvest data record for detecting potential changes in use of wildlife resources in the Project area will be evaluated.

The study will build on results of the wildlife harvest data analysis initiated in 2012 and will incorporate new harvest data as they become available, as well as the results of the ADF&G moose, caribou, and ptarmigan telemetry studies begun in 2012. Harvest patterns will be compared with seasonal distribution and movements revealed by the telemetry data on moose, caribou, and ptarmigan.

Subsistence surveys will be conducted by ADF&G over several years, beginning in 2012; the questionnaires will be reviewed and modified to incorporate data needs for this analysis.

A relational database of harvest and effort data used in the analysis will be prepared. Naming conventions of files, data fields and metadata descriptions will meet the ADNR standards established for the Project. Hunter effort and harvest success maps showing big game and furbearer species will be developed for UCUs based on the relational database developed from the ADF&G harvest database. All map and spatial data products will be delivered in the two-dimensional Alaska Albers Conical Equal Area projection, and North American Datum of 1983 (NAD 83) horizontal datum consistent with ADNR standards.

Harvest effort and success will be calculated at the highest spatial resolution possible given the quality of the data (GMUs, Subunits, or UCUs) and compared with the best available estimates of game populations, hunting regulations, and access. If possible, a predictive model will be conducted to assess the potential change in harvest effort and harvest success in the project area given potential changes in game populations and hunter access.

8.20.4.1. Impact Assessment

Data on the current distribution of harvest effort and harvest success in the study area will be used to assess potential Project impacts on hunting and trapping effort and harvest success. The

assessment of impacts on hunting and trapping effort and harvest success will be coordinated with other Project studies focused on the human dimension (recreation, socioeconomics, and subsistence) to assess how the expected changes in land use and access in the Project area will affect patterns of hunting and trapping.

The impacts of the Project on game animal populations will be assessed by conducting geospatial analyses and evaluation of the responses of the study species to other similar development projects, as documented in the scientific literature. For most game species (bears, moose, caribou, dall's sheep, wolverine, furbearers, small mammals, and ptarmigan), the impacts of the Project on populations in the region will be conducted in other wildlife studies (see Sections 8.5, 8.6, 8.7, 8.8, 8.9, 8.10, 8.11, 8.12, and 8.17) for which more thorough field data will be collected than can be obtained from harvest records. In those studies, game species occurrence will be assessed in each of the wildlife habitat types to be mapped in the Project area (see Section 9.5) via the habitat-value rankings for each habitat type conducted in the habitat evaluation study (see Section 8.19). Using GIS software, the direct and indirect impacts of the Project will then be evaluated by overlaying the Project footprint and species-specific habitat alteration and disturbance buffers onto the habitat map to compare to habitats of importance for each species. In this way, quantitative measures of habitat loss, habitat alteration, and disturbance to habitats of importance for each species will be determined. Additional information in the impact assessments will be obtained by overlaying the Project footprint and species-specific habitat alteration and disturbance buffers on the known locations of use for these species, as determined from Project-specific survey data.

Similar GIS analyses of impacts on hunting and trapping effort and harvest success will be conducted by overlaying the Project footprint and species-specific habitat alteration and disturbance buffers on the known locations of harvest data obtained in this study.

8.20.5. Consistency with Generally Accepted Scientific Practices

Harvest data will be analyzed according to commonly accepted statistical techniques. Spatial statistics will be conducted with commonly accepted techniques such as fixed-kernel density estimation with least-squares cross validation or plug-in bandwidth selection (Seaman and Powell 1996, Gitzen et al. 2006).

8.20.6. Schedule

This is a multi-year study that was initiated in 2012. The following schedule is anticipated for 2013-2014 activities:

- Transfer of 2012 harvest and subsistence data in July 2013;
- Report and analysis harvest data through 2012 and 2013 activities will incorporated into 2013 Initial Study Report, to be issued December 2013;
- Transfer of 2013 harvest and subsistence data in July 2014; and
- Report analysis of harvest data through 2013 incorporated into Updated Study Report, to be issued December 2014.

8.20.7. Level of Effort and Cost

This study will focus on analyzing existing harvest data and new data collected for other wildlife, subsistence, and recreational studies to maximize the information gained from these data. Thus, basic questions associated with human harvest of game animals in and near the Project area can be analyzed in a cost-effective manner. The total anticipated cost for the study is approximately $100,000.

8.20.8. Literature Cited

ABR, Inc. 2011. Wildlife data-gap analysis for the proposed Susitna-Watana Hydroelectric Project. Draft report, August 16, 2011. Report for the Alaska Energy Authority by ABR, Inc.—Environmental Research and Services, Fairbanks, Alaska. 114 pp.

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8.20.9. Figures

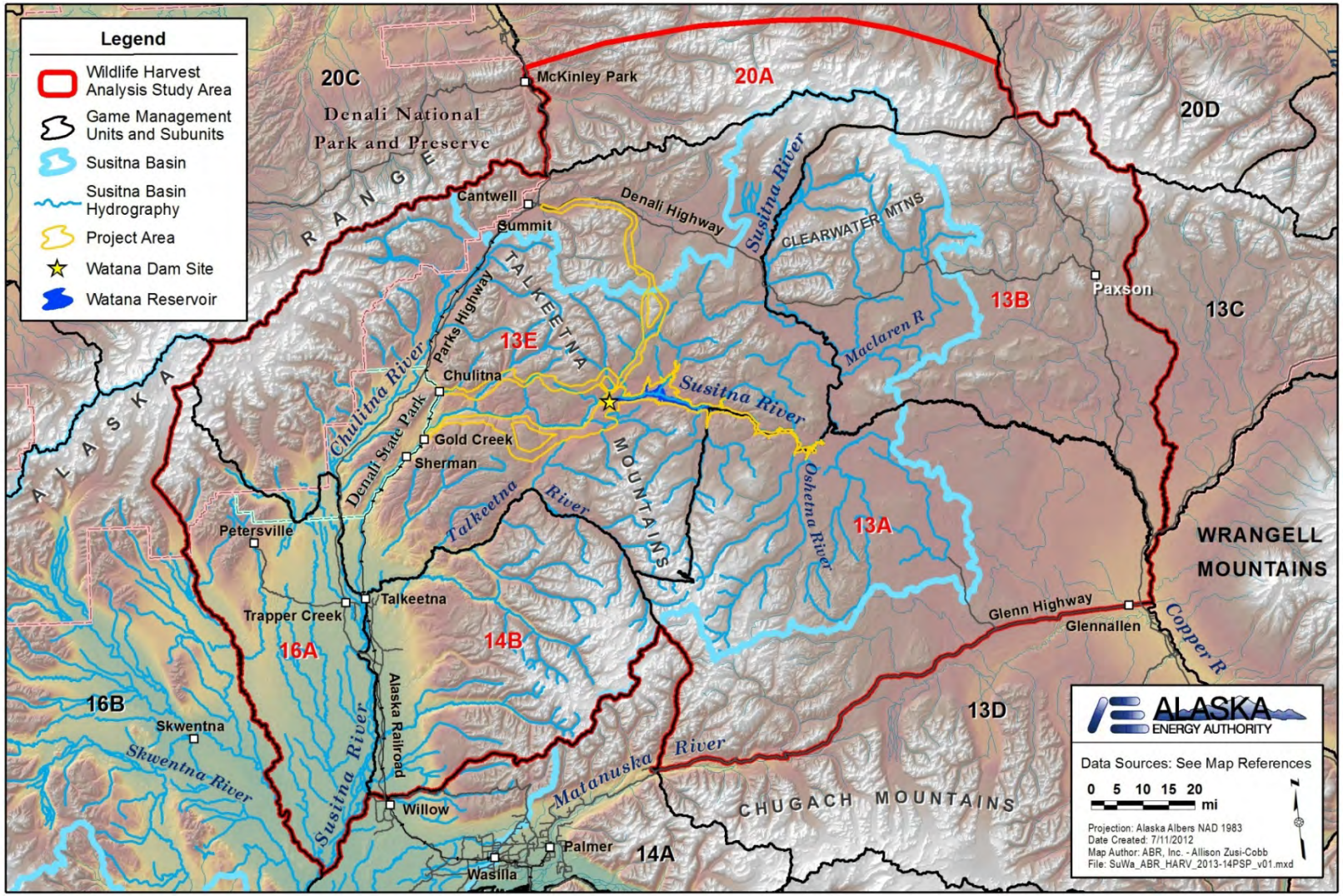

Figure 8.20-1. Wildlife harvest analysis study area.

8.21. Attachments

ATTACHMENT 8-1. DOCUMENTATION OF CONSULTATION ON WILDLIFE RESOURCES STUDY PLANS

ATTACHMENT 8-1

DOCUMENTATION OF CONSULTATION ON WILDLIFE RESOURCES STUDY PLANS

Watana Dam Project Terrestrial Wildlife Research and Monitoring Needs

November 22, 2011

Division of Wildlife Conservation staff identified items #'s 1 – 4 below, as high priority studies or information that staff felt definitely needed to be done and that the ADF&G should do or be involved in. Staff think that items 5 - 7 bear looking at but were of a lower priority. For the most part staff are comfortable with items 5 - 7 being done by other entities and further discussion would be needed to determine if these, or other studies, were items that Wildlife Conservation staff would want to take on.

1) **Moose.** These would be done by ADF&G Region IV staff if funded under an RSA.
    a. Full population estimates upstream and downstream from the dam site. Staff agree with this particularly in the area of the dam and upstream.
    b. Radio-collaring for information on seasonal moose movements and distribution to, from and across the proposed area of inundation, as well as to document baseline moose productivity and survival in the area. No moose are currently collared in the vicinity of this proposed project. GPS collars may also be added to provide more complete information regarding fine-scale seasonal movements.
    c. Hunter access has changed in the years since the original Su-Hydro research and this also likely effects moose movements, so updated info on hunter use and access in the area tied back to moose movements and distribution is warranted.
2) **Caribou.** These would be done by ADF&G Region IV staff if funded under an RSA.
    a. Watana site is on the north border of the Nelchina Caribou calving grounds and the herd moves right through this area during annual migrations. There has been considerable change in the distribution of the Delta Caribou herd since the earlier Su-Hydro research and the 1999-2003 Nelchina movement and distribution work. Evaluation of herd identification, movements, distribution, and mixing is necessary for Watana mitigation as well as pre-, post and construction management of these important resources. This work will require collaring (VHF) additional animals and increasing monitoring flights supplemental to existing monitoring efforts. GPS collars may also be added to provide more complete information regarding fine-scale seasonal movements.
3) **Wolverine.** These would be done by ADF&G Region IV staff if funded under an RSA.
    a. A onetime Sample Unit Probability Estimator (SUPE) and/or occupancy modeling is warranted as this area has been identified as an area of refugia with minimal harvest. Access to this area, general disturbance, and harvest levels will likely change with development.
4) **Small Game - Birds**. ADF&G staff would be interested in doing this if funded under an RSA.
    a. Ptarmigan movement and harvest surveys. Changes in access may increase general disturbance and harvest in this area which is currently lightly

harvested. The area also may provide refugia for adjacent accessible areas with higher harvests. Population studies and relevant ecological studies may be useful. Additionally, staff are interested in studying the effects of increased human access on these small game resources. The area currently has poor to limited access and measuring the rate and extent of human growth in the area as it relates to small game resources and harvests would be useful.

5) **Non game species**. Alaska Natural Heritage Program (AKNHP) is in the latter stages of completing GAP analyses for all terrestrial vertebrates for the entire state of Alaska, and as part of this endeavor, they are modeling species distributions based on known locations using both inductive and deductive modeling approaches. They will have the most up to date distribution data for a number of species, including small non-game species. These would be useful for determining impacts to wildlife species that may be impacted by the Watana development. The Alaska Natural Heritage program will be contacted to request all wildlife species potentially impacted by the project. They will also be asked about the timeline of completion of the Alaska GAP project, and potential access to the Alaska GAP products (species distribution maps) if the information is needed prior to finalization of AK GAP.
6) **Bears.**
    a. A brown bear study in GMU 13 (the proposed Watana lake is the north border of the study area) is ending and does not need to continue. Staff felt the existing historic data from Su-Hydro research and subsequent research (2006-present) is adequate to evaluate impacts.
    b. Information on downstream use of habitat and the importance of salmon in bear diets in conjunction with impacts to salmonids would aid in identifying potential impacts to bear downstream of the dam. Staff are comfortable with this being done through an outside contractor or the University of Alaska. Population estimates are probably not warranted as adequate information exists especially in adjacent areas.
    c. For black bears, staff felt the existing historic data from Su-Hydro research is adequate to evaluate impacts.
7) **Sm. Furbearers / Marten.** Watana impoundment would inundate a central block of marten habitat potentially creating barrier between upstream and downstream populations. This is also likely a problem common to other terrestrial furbearers and small mammals utilizing this old timber block. Staff, however, were not clear that research could be done to avoid or correct it other than just documenting the lost habitats.
8) **Wolves.** Ongoing monitoring work will be sufficient.

Betsy McGregor

From:	Burch, Mark E (DFG) <mark.burch@alaska.gov>
Sent:	Tuesday, December 20, 2011 4:06 PM
To:	Betsy McGregor
Cc:	Dale, Bruce W (DFG); Schwanke, Becky A (DFG); Butler, Lem G (DFG); Klein, Joseph P (DFG); Weiss, Edward W (DFG)
Subject:	FW: Additional Comments on proposed 2012 projects

Hi Betsy,

We recently figured out there were some additional comments that basically slipped through the cracks. I hope these are still helpful at this point.

9 – Vegetation – it notes moose browse survey area establishment, then it should also mention caribou range survey areas as well (especially considering there are historic habitat exclosures out there for caribou that we really could use $ to update and analyze).

As we begin to think about mitigation, we would note that we have a moose habitat controlled burn plan on the books for the SW corner of the Alphabet Hills (sits just east of the Watana dam site, along the upper edge of the West Fork Gulkana River (Alphabet Hills Prescribed Burn Area)). We were able to get 40,000 acres burned in 2003 and 2004, and we would like to have more acreage burned in future years as an ongoing part of our intensive management plan. These areas are close to each other, and prescribed burning is a priority for F&G for this area.

#10 – Habitat use / movement – under sensitive habitats – Should remove the reference to wolf dens. The Susitna River in this area provides a consistent year to year boundary between wolf packs. Considering wolves typically den towards the center of their home ranges, denning locations would not be expected in the inundation area. This is also in the middle of an intensive wolf management area, and wolf den sites aren't something we consider as sensitive in terms of the long-term overall predator/prey management of the area. Likewise, bear dens do not need to be on this list (they aren't). These are very difficult to document, radio/gps collars are necessary, they often change year to year.

We are concerned with general disturbance of all wildlife in some capacity, but wolf and bear dens do not rise to the level of "sensitive" locations in the grand scheme of things, like concentrated caribou calving grounds might. Wolf den sites are sometimes re-used by the same pack year after year, but they are extremely prolific animals regardless of general disturbance. They have the ability to easily find a new den site. Bears re-use their dens even less often. Moose calving sites would be similar to wolf/bear dens. While cow moose may return to the same general location to calve each year – if it's unavailable, they will find somewhere else. They are scattered enough, we can't pinpoint any high-density "sensitive" areas.

We don't have plans to collar bears, sheep, beaver, wolves, wolverine, owls or other species of concern, so the "establish appropriate ... telemetry samples" statement seems inappropriate for most of the species listed. It should only refer to moose and caribou. We should say that we'll "develop or refine monitoring programs and techniques for wildlife species of concern (moose, wolves, wolverine, sheep, etc)

Robin Reich

From: Klein, Joseph P (DFG) <joe.klein@alaska.gov>
Sent: Thursday, February 02, 2012 9:38 AM
To: Betsy McGregor
Cc: Clark, Robert A (DFG); Vincent-Lang, Douglas S (DFG); Benkert, Ronald C (DFG); Burch, Mark E (DFG); Erickson, Jack W (DFG); Fair, Lowell F (DFG); Fink, Mark J (DFG); Holen, Davin L (DFG); Lingnau, Tracy L (DFG); Miller, Monte D (DFG)
Subject: Comments on January Study Planning Meetings

Betsy- We appreciate Alaska Energy Authority conducting Study Planning Meetings last week to provide the latest project and resource information and we offer the following comments.

General

- We recommend a plan to incorporate all fish and wildlife information and data results into a user-friendly, GIS-related format that can be used by anyone with little to no GIS experience. We believe it is important to initiate these efforts early in the licensing process in order to coordinate data collection, formatting, storage and other issues with the upcoming studies.

Water Resources

- We support documentation of ice break up along the Susitna River in the spring 2012 and the objectives identified at the meeting. We recommend the use of high quality photographs and videos that are geo-referenced to help facilitate analyses of these processes.
- We recommend a summary listing of peak floods and associated recurrence intervals that have occurred on the Susitna River between the 1980 studies and the present be included with the "Geomorphic Assessment of Middle River Reach Using Aerial Photography" study. We also recommend a search and analysis of any pre-1980's photographs and an evaluation of potential streambed changes over time at long-term USGS gaging stations on the river.
- Although we were informed from previous discussions that USGS was/will be conducting a comprehensive hydrologic assessment for the Susitna River basin, we did not receive any updates or summary of products to be provided so we are reiterating an earlier request for summaries of seasonal and long-term streamflow characteristics at key locations along the river.

Aquatic Resources

- One of the challenges facing this project will be quantifying flow-habitat relationships for identified target species and associated range of habitats. We support AEA's strategy to synthesize the 1980's instream flow studies and develop preliminary study approaches to facilitate stakeholder discussion and recommendations.

Let me know if you have any questions.

Regards, Joe

Joe Klein, P.E.
Supervisor Aquatic Resources Unit
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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
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IN REPLY REFER TO:
AFWFO

February 10, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided some initial comments on the draft study plans during the work group meetings January 24-26, 2012, and had anticipated providing additional comments after receiving revised and more thorough descriptions of the proposed studies. Since that meeting, we have conducted an initial review of the Instream Flow, Aquatic Resource, Water Resource, and Eagle and Raptor Nest draft 2012 study plans provided at the January 24-26, 2012, meetings. Due to the short turnaround time requested for feedback (11 business days) on the study plans and their ongoing evolution, our comments should be consider cursory. The following represents our overall issues and concerns with the study plans and the enclosure provides a more detailed accounting of our comments and recommendations for each specific study plan.

Expanded Study Framework and Timeframe: The Service and other resource agencies have frequently expressed concerns about the limited temporal and spatial scale, and limited timeframe, for proposed studies in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the lower reaches (as defined by AEA) of the Susitna River for the proposed Susitna-Watana project. As part of the hierarchical framework, an ecologically meaningful space-timing scale should be identified related to project studies. As the spatial scale of studies increases, the time scale of important processes such as ice, sedimentation, and channel formation also increases, because they operate at slower rates,

time lags increase, and indirect effects become increasingly important. Studies related to these dynamic fish habitat forming processes need to be adequate (i.e., 5 years or more) to begin to understand mechanistic linkages (Wiens et al 1986; Wiens 2007). For this purpose, the Service recommends conducting fish habitat forming process studies on the minimum temporal scale of 5 years. This temporal scale equates to the typical life cycle of Chinook salmon, an Alaska Department of Fish and Game designated stock of concern.

To address these concerns, the Service expects that the 2012 studies and future project-related studies will be conducted on a hierarchical framework (Urban et al 1987; Frissell et al 1986) at a variety of scales including meso-habitat, reach, and basin wide. The Service also expects that the 2012 studies will not only help fill data gaps identified in the Preliminary Application Document (PAD), but will also be integrated between each other and with future project-related studies. This framework and integration is necessary to understand existing conditions and predicted changes to fish habitat in relation to changes in physical processes from proposed regulated flows. We recommend you establish a schedule for analysis of data obtained in 2012 and a framework for how to incorporate the 2012 data into 2013-2014 study plans. This is necessary for resource agencies to adequately assess potential project impacts to Alaska's fish and wildlife resources.

Winter Flow Regimes: At the January 24-26 work group meetings, and in the PAD, winter operations were described as load-following with flows ranging from 3,000 to 10,000 cfs in a 24-hour period. Regulated flows, including load-following operation, result in substantial changes to the natural hydrograph of a river. Dam construction and operation globally has resulted in adverse effects to anadromous and resident fish, macroinvertebrates, and their habitats. The Service is particularly concerned with the lack of study focus on Susitna River winter flows under natural and proposed flow operations. We recommend that winter base flows be assessed beginning in 2012 under the Instream Flow 2012 Study Planning, Water Resources Study Planning, and in the Aquatic Resources Study Planning. During colder winter months, glacial river base flows, such as those in the Susitna River, are derived entirely from groundwater inputs resulting in reduced habitat availability. We recommend assessing base flows as they relate to mainstem winter habitats (including adult spawning and juvenile fish overwintering locations, and the potential for stranding or increased mortality or condition related to changes in flow and water temperature), water quality conditions, ice-processes, and habitat and geomorphic processes in the Susitna River under current conditions and underthe proposed operation.

Temperature: In our December 30, 2011, letter we recommended thermal imagery (Torgerson et al. 1999) be conducted in 2012 throughout the Susitna River mainstem to identify important thermal habitats that may be utilized for spawning, refugia, or as overwintering areas. It is important to characterize the Susitna River water temperature profile as it relates to habitat because the proposed dam is expected to significantly alter the water temperatures downstream of the dam. Please review this letter as a reference for this study, as well as other Service recommendations.

Modeling Design: There is currently a lack of information in the draft study plans related to overall modeling approaches that will be used for the Susitna-Watana project. When identifying

instream flow model(s) the purpose and assumptions must be compared to Water Resources and Aquatic Resources study objectives. Model assumptions and model inputs need to be clearly stated and available for review. Spatial pattern should be one of the independent variables in the model analysis. At a minimum, we recommend using 2D hydrodynamic model(s) at a mesohabitat, reach, and basin wide scale (Crowder and Diplas 2000). We specifically recommend a 2D model be included to predict physical processes to spatially represent variation in input variables, and how those variables change temporally and spatially under differing flows. Selected model(s) should also include a sensitivity analysis (Turner et al. 2001). This information is critical to the general project understanding of existing ecological spatial patterns, and predicted spatial patterns under proposed regulated flows from the Susitna-Watana dam.

Mercury: Since the January meetings, it was brought to our attention that fish mercury concentrations frequently increase after impoundment of a reservoir, particularly boreal reservoirs. Soil flooding releases organic matter and nutrients, providing food to bacterial communities that methylate inorganic mercury. Methylation and bioaccumulation are the primary pathways for mercury accumulation in fish (Therriault, 1998). Although not identified in the 2012 draft studies, future studies should include pre- and post-impoundment mercury concentration studies.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Ann G. Rappoport
Field Supervisor

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Enclosure

The following comments and recommendations are based on our review of the 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project provided at the January 24-26, 2012, work group meetings.

Synthesis of Existing Fish Population Data (F-S1)

Recommend including information on seasonal distribution and abundance of anadromous and resident fish species among riverine habitat types and river reaches. As part of the spawning and incubation period for resident and anadromous species, studies need to include fry emergence periods and time (of day) information to determine potential impacts from fluctuating winter/spring flows. Potential issues include stranding of fish (by life stage and species) and downstream displacement relative to potential ramp rates. This study needs to integrate with instream flow and geomorphic studies to look at effects of daily flow fluctuations, particularly in winter, in the middle and lower river reaches.

For clarity, we recommend referring to river "reaches" as defined in the PAD rather than river "segments."

Fish persistence should be evaluated relative to spatial and temporal availability of fish habitat under existing and proposed flows. The Service recommends fish habitat studies be developed concurrent with the water resource studies to interface and characterize fish habitat as it relates to physical (hydrologic, sedimentation, and geomorphic) processes. Fish habitat metrics should be developed and integrated with modeling efforts related to physical processes and fish presence.

Chinook Salmon Presence above Devil's Canyon Study (F-S4)

Chinook salmon presence above Devil's Canyon study should include an upstream and downstream fish passage component. This 2012 study should include fish passage relative to all life stages of Chinook salmon. There is the potential to include Dolly Varden and Humpback whitefish pending results of an otolith/anadromy analysis by the Service for these species.

The Service supports the genetic component of the study (F-S4) which is necessary to determine whether the Chinook salmon meta-population in the vicinity of the proposed dam is a distinct population.

Wetland Mapping Study (B-S3)

The draft wetland study states that the methods used will be consistent with guidance in the Alaska Regional Supplement (USACE 2007), the U.S. Army Corps of Engineers (USACE) Manual (Environmental Laboratory 1987), and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Therefore, the Service recommends the use of the Cook Inlet Classification (CIC) developed by Mike Gracz. The CIC is an HGM-based wetland ecosystem classification scheme analogous to Cowardin. The Service supports the use of CIC for wetland mapping in the Cook Inlet Basin over Cowardin because CIC is regionally

specific and indicative of function (e.g., a spring fen always receives groundwater discharge; whether a palustrine emergent wetland does is unknown). CIC can be cross-walked with Cowardin if necessary. CIC methodologies and Mike Gracz' mapping protocols are described on www.cookinletwetlands.info.

In terms of compensatory mitigation related to a site that will be monitored over time using site-specific, precise functional attribution, the best functional assessment method available is the use of the HGM Regional Guidebooks. The citation for slope/flat wetlands is as follows:

- Hall, J.V., J. Powell, S. Carrick, T. Rockwell, G.G. Hollands, T. Walter and J. White. 2003. Wetland Functional Assessment Guidebook, Operational draft guidebook for assessing the functions of slope/flat wetland complexes in the Cook Inlet Basin Ecoregion, Alaska, using the HGM approach. State of Alaska, Department of Environmental Conservation, Juneau, Alaska.

Eagles and Raptor Nest Study (W-S3)

The Service's Migratory Bird branch is evaluating the potential for an eagle study that would compare productivity/behavior of golden eagles in disturbed areas (such as the Golden Valley Wind project, Usibelli Coal Mine, and the Susitna-Watana dam) versus undisturbed areas (Denali Park). We would like to explore the option of partnering with Watana projects to complete eagle nesting surveys. The Service could potentially provide experienced biologists to conduct the surveys. The benefits to this partnership include: 1) assistance to the project sponsors to conduct an eagle nesting survey; 2) provide cost savings to project sponsors by eliminating the need to hire a consultant to complete the survey; and 3) allow the Service to collect information valuable for our study. These surveys would not be considered compensatory mitigation, but would help meet eagle nest survey requirements. The Service generally recommends a pre-project survey with a follow-up survey just prior to construction.

Since 2009, compensatory mitigation is required for "take" or disturbance of active and inactive bald eagle nests. For golden eagles, there is a "no net loss" policy. Identifying ways to offset compensatory mitigation requirements early in the project development process can help the resource and the project sponsors. For example, a 2-year pre-construction eagle tracking study could help minimize required compensatory mitigation if the study demonstrated a "disturbance" rather than a "loss of territory."

Riparian (B-S2)

In addition to comments provided previously, we recommend riparian studies be integrated with other 2012 studies and with future project-related studies.

Beluga Prey Species Study (F-S6)

This study should identify components that specifically interface with the water resource and fish habitat studies. Anadromous prey species such as eulachon, Pacific and Arctic lamprey have been documented as present in the lower reach of the Susitna River and may be impacted by the proposed regulated flows. Relationships between natural flows and existing habitats should be

developed to best predict changes during proposed regulated flows that may impact beluga whale prey species.

Instream Flow Planning Study (F-S5)

1) Selection of a model or series of models of 1D or 2D nature will drive the type of data needs for the field studies. This discussion and selection must be made prior to finalizing habitat studies.
2) The habitat suitability curve development is a useful product. Conduct the studies in such a manner as to ensure the development uses actual suitability data and is not dominated by best professional consensus.
3) Need a better understanding of how the instream flow study relates to the routing model or uses its own calibrated flow model. Concern is that the overall routing model may have significant variation in water level between cross-sections depending on their placement in relation to the habitat cross-sections. Location in pools or riffles and within these features or braided section will vary the water level of a certain flow and may not correctly interpret the water level of a habitat cross-section.
4) Anticipate that the habitat study will have its own cross-sections and flow analysis separate from the routing model. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new spots as needed for 2013 and 2014.
5) Desire to have a large map with the routing and habitat cross-sections on it over recent aerial imagery.
6) In review of 1980s studies, were there any groundwater/surface water exchange studies?
7) Need to confirm whether the 1980s studies included mapping of groundwater upwelling areas along the river for gaining and losing reaches. We recommend at least a large-scale thermal temperature study along the river to note locations and relate it to the habitat study areas and cross-section surveys.

Reservoir and Flow Routing Model Transect Data Collection (WR-S1)

1) We recommend that the cross-section re-surveys in 2012 go beyond the forest limit but stay within the floodprone area, as there may be key floodplain elements not captured in the LIDAR data.
2) Need to evaluate appropriate model to consider ice effects as ice is a significant factor, not only for habitat but also for recreational use. We highly recommend utilizing one model that is fully dynamic and can deal with both floods and ice dynamics during winter low flows for routing. A model was recommended in the January work group discussion, created in Canada that may be appropriate. Model selection will drive data needs so this needs to be selected soon and with a full idea of the types of available models out there to select the best one.
3) Given the discussion of ice dynamics, cross-sections are likely needed in the lower reach to adequately assess ice dynamics as ice forms and slowly freezes upstream. We recommend that these cross-sections be identified and obtained in 2012 to maximize utilization of the model and potentially correlated to lower river habitat studies to reduce redundancy of effort.

4) Instream flow and habitat study cross-sections are assumed to be different than the routing cross-sections. We recommend creating a map for distribution that overlays the original routing and habitat cross-sections to begin to understand their spatial location and orientation and begin discussing 2012 study locations. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new sampling locations as needed for 2013 and 2014.
5) Flows need to be measured to calibrate routing as much as possible. We recommend that water surface and flow be captured at key cross-sections while in the field to calibrate the routing model results and to verify Manning's n assumptions.

Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations (G-S1)

1) For locations obtaining bedload data need to also do a bed pebble count to compare to transported load to calibrate for shear stress and other calculations.
2) Recommend that gravel bar sampling be part of the study to compare to transport load data obtained. This methodology must be well documented.
3) Evaluate the Chulitna and Talkeetna as well as other key tributary deltas for sediment distribution and load into the system.
4) Recommend attempting to get high flow values near bankfull stage at both Gold Creek and Watana sites to add to data.
5) Recommend sediment sampling at the Susitna-Watana dam site to demonstrate correlation to Gold Creek and/or model changes in sediment loading between the sites.
6) Evaluate 3-inch versus 6-inch bedload sampler use for 2012 field season to try to capture large fractions of bedload movement as able.

Geomorphic Assessment of Middle River Reach using Aerial Photography (G-S2)

1) Include a listing and evaluation of flood and ice conditions during and between aerial photography events, especially during breakup periods to help correlate differences to significant events in the watershed.
2) Does not address winter flows and habitat use under winter conditions; needs to come up with a plan to address this beginning winter 2012/13.
3) For geomorphic analysis and comparison to habitat studies, cross-section locations for substrate classification, large woody debris counts in floodprone width, and categorization of fluvial process (Montgomery and Buffington, Rosgen) should be determined and fieldwork performed. If location agrees with an old cross-section, it will help verify any changes over time and with flow to help determine stability and shear stress equations.

Geomorphic Assessment of Project Effects on Lower River Channel (G-S4)

1) There is a need to evaluate the hydrology and habitat use of the lower river to evaluate change over time from dam operations:
    a. Winter operations are a major concern given the need to evaluate daily flow fluctuations of 3,000-10,000 cfs in the winter. This effect must be modeled into

the lower reach to see if the magnitude of fluctuating flows in the winter extends further downstream than spring and summer flow periods. Additionally, ice and open water effects will be extended into the downstream area so modeling will need to address this by extending it downstream.

b. In the January work group meetings it was pointed out that ice is generated upstream and flows down the river to the lower reaches, beginning to form in the lower reach and slowly ice up the river upstream. This also needs modeling from a thermal standpoint, hence again, the need for cross-sections in the lower reaches.
c. Recommend that the gage at Su Station be turned on by the U.S. Geological Survey (USGS) and maintained by USGS to help calibrate lower reach modeling efforts over the next 5 years, especially for ice effects and dynamics modeling.
d. Cross-sections need to be made in the lower reach to add to an ice dynamics model as well as habitat studies – recommend selecting locations and getting these cross-sections in 2012 to facilitate modeling efforts.

2) Re-do all cross-sections at existing and past gage sites in the middle and lower reaches (including Su Station) to evaluate hydraulics, assess stability by comparing to old cross-section data and give an initial assessment of stability or changes in rating curve information. Also, it would be beneficial to do an initial evaluation of these gage sites at winter flows and with ice dynamics to begin to understand the impact winter flows will have. This will help with evaluating changes over the last 30 years in the lower reaches to determine whether additional work in 2013-2014 is needed.

Documentation of Sustina River Ice Breakup and Formation (G-S3)

1) Key elements to identify are: where ice generation occurs (production zones) and where ice lodges and begins the process of ice formation in the river.
2) Recommend that flights include an ice scientist, fishery biologist, riparian specialist and fluvial geomorphologist so that multiple observations can be made at the same time and can be stitched together to understand the processes taking place.
3) Recommend video be taken during all river flights for later reference.
4) Documentation of frazil ice generation is very important – current thought is that 80% is generated upstream of Devil's Canyon in the middle reach.
5) Daily flights might be needed during the height of breakup or freeze-up.
6) Is CRREL involved with the ice research?
7) Highly recommend utilizing our Canadian neighbors and their research and models for ice issues.

Review of Existing Water Temperature Data and Models (WQ-S1)

1) Identify appropriate temperature models to use based on new technology and understanding.
2) Evaluate MET station locations and strongly consider an additional station around the Deshka or Yentna which could help with ice studies.

3) Discuss MET station locations with NOAA Weather Forecast Center to access experts as well as potentially help with storing data.
4) Perform large-scale thermal study of the river for groundwater exchange areas over different flows.
5) At old, existing, and new gage sites, include continuous temperature monitoring; consider a water quality study at gage sites for 2012, 2013, and 2014 seasons with parameters agreed to by all parties and performed by USGS.
6) Evaluate past assumptions for temperature modeling (at least our understanding of it), i.e., summer analysis of surface water temperatures only, as this dominates habitat use, versus winter analysis of intergravel temperature only. Provide quantification of the hypothesis and assumptions made and determine if they are still relevant.
7) 2012 fieldwork in the work group meeting was discussed to primarily show how mainstem temperatures influence side channel habitat. This should be expanded to do a thermal analysis up and down the river (#4).
8) Discussed in the work group meetings that 2013-2014 work will deal with upwelling water temperatures. A thermal analysis in 2012 can help determine these sites.
9) Fieldwork needs to be performed that can help calibrate heat transfer coefficients and other assumptions in selected temperature models between mainstem and other waters.
10) Analysis of temperature effects on ice formation was not discussed and needs to be part of the scope in coordination with ice and habitat studies.
11) Ensure that solar radiation information will be collected at all MET sites as it is crucial to modeling efforts (ice, etc.) and evaluate other metrics that are needed for calibrating models.

Susitna–Watana Hydroelectric Project

Agency Meeting Record

Subject:	Eagle take permits under the Bald and Golden Eagle Protection Act (BGEPA) and 2012 study plan for surveys of eagles and other raptors
Location:	U.S. Fish and Wildlife Service (USFWS) office, West 4th Ave, Anchorage
Date/Time:	11 April 2012, 10:00–14:16
Attendees:	Maureen deZeeuw (USFWS), Jordan Muir (USFWS), Betsy McGregor (AEA), John Shook (ABR, Inc.); Brian Lawhead (ABR, Inc., via telephone)

Eagle permitting discussion (Maureen & Jordan):

Eagle surveys should focus on obtaining information needed for the permitting process.

Two new permit types under the BGEPA (USFWS will provide web link for eagle permitting):

1) Nest take (intentional or unintentional) — No taking of active nest allowed except in emergency; uninhabited nest is defined as no adult, egg, or chick within 10 days; unoccupied nests are assumed to be usable unless in very poor shape.

2) Eagle take permit — Incidental take only; not limited to lethal take, so includes disturbance (anything that may affect productivity)

Standard and programmatic permits are issued, depending on whether specific numbers can be identified for take; Jordan envisions a standard permit for this project (no programmatic permits have been issued yet for Golden Eagle [GOEA])

- If disturbance is likely, permit will be needed.
- If avoidance measures are adequate, then no permit will be required.
- See web site for Bald Eagle (BAEA) disturbance-buffer zones; no comparable buffer zones have been established yet for GOEA.
- BAEA take allowance is robust in Alaska (555/yr).
- GOEA take threshold is 0/yr, but this does not preclude a take permit from being issued. Any take (including disturbance) will need to be mitigated for. GOEA take permit standards are still being worked out but will be stricter than for BAEA and will require no net loss for take of a nest or a territory—USFWS will want to know average territory size in affected area.
- Territory take will apply to inundation zone, access routes, transportation-line corridors.

- Permit is generally issued for 5 years and is renewable; should focus on specific activity types and can be amended, if necessary, to add new activities.
    - 2012–2017 Surveys: might need a permit depending on proximity, timing w/ breeding season and disturbance levels
    - 2017–2022/23 Construction: need a permit
    - 2023+ Operation: need a permit
- Any GOEA permit will be precedent-setting, so will require national review and should expect it to be a very high profile, controversial issue.
- BAEA permit will require 60–90 days at minimum, but likely will take longer (expect 120 days), but only if compensatory mitigation is figured out before permit application (compensatory mitigation is the difficult part).
- Mitigation requires that stable or increasing population be maintained.
- Only compensatory mitigation used thus far has been retrofitting of problem poles that kill Golden Eagles; this is a challenge in Alaska because no power poles have been identified as a mortality source (nothing has been identified as a mortality source in AK). Other options are being considered, such as: identifying and retrofitting high-risk poles in Alaska (based on proximity to GOEA habitat and pole configuration), blasting new cliff areas, and USFWS is open to any suggestions for new mitigation.
- Jordan and Maureen emphasized that we document everything that shows avoidance/minimization of disturbance (this includes 2011 surveys).
- Discussion of territory take and considerations of value of affected area—they really emphasize average territory size calculation.

Betsy briefly reviewed project description: construction to start in 2017, first on corridors, then dam; construction period would be 5 years; dam construction would be finished in 2022; dam would begin operating in 2023 (takes a year to fill). They are leaning away from the Gold corridor (southern) because of all the stream crossings w/ ravines). The project will likely have 2 transmission corridors, one of which will also have the road (2 separated transmission lines may be needed to attenuate the power as it is fed into the intertie powerlines)

- Project studies will be operating some fish wheels at Curry. Make sure they do not attract Bald Eagles or other wildlife (Common Raven, Bears etc).

John reviewed historical data on eagle nests from the 1980s Susitna Hydroelectric Project.

Jordan suggested that expanding the survey area away from the reservoir inundation zone may detect additional nests that could reduce the average territory size for mitigation calculations (which uses 1/2 of the mean inter nest distance as the territory radius).

- If up to 50% of territory overlaps with project footprint, then that territory is considered to be taken.
- Jordan recommended surveying suitable nesting habitats within 10 miles, then applying the average territory size calculation—but possibly could use other data from comparable nesting habitat (e.g., Alaska Range GOEA) if its applicability can be demonstrated.
- Should not need a disturbance permit this year (2012) for geotechnical borehole drilling program because of temporal avoidance (August–September timing), or for study activities because they will be on foot and by boat; but, plan to provide them with description of measures taken and activities conducted.
- Determine whether nest sites are visible from drilling locations.
- 2-mi buffer distance around access corridors is consistent with USFWS guidance for avoidance/minimization of disturbance for Golden Eagles for linear infrastructure ("2 to 3 miles from linear projects such as pipelines and roads etc.").
- Jordan would prefer that surveys be conducted within 10 miles of inundation zone, rather than simply applying an average territory radius based on other Alaska work nearby.
- USFWS will need to conduct an internal environmental assessment (EA) for the GOEA territory take permit, so Jordan wants to know if that can be incorporated into the FERC NEPA review—Betsy encouraged USFWS to get any such ideas incorporated into the 2013/2014 FERC study request, due May 31. The EA will focus on the impacts on local populations, defined as GOEA nesting within a 140-mile radius and BAEA nesting within a 43-mile radius (based on median juvenile dispersal distances), and on regional populations, defined as USFWS Region VII (Alaska) for BAEA and Bird Conservation Region (BCR) 4 for GOEA.
- 2012: We agreed that 2–3 mile buffer for corridors and inundation area is sufficient
- 2013–2014: We agreed that 2–3 mile buffer for corridors and 10 mi buffer for inundation area is sufficient.

Break at 12:50–12:58 (Betsy left for another meeting).

- Resume on BAEA nesting surveys; Jordan stated that the 10-mile radius for GOEA surveys around the inundation zone will give sufficient information on BAEA territory sizes. And the 2–3 miles for corridors is sufficient.
- More mitigation options are available for BAEA than for GOEA.
- No need to go out to 10 miles from access and transportation line corridors for BAEA territory mapping; plan to identify nests within the 2–3-mile corridors, including active and alternative nests.
- Maureen said to expect a study request on mercury levels in fish eaters (from the USFWS contaminants specialist).
- Discussion of downstream extent of surveys for BAEA—no particular concern about territory loss, but perhaps some about effects on food resources (fish); need to know how much of diet consists of fish vs. birds; and how far downstream to extend surveys (topic tabled for now)—Maureen will discuss with others at USFWS.
- Productivity aspect—Maureen suggests it should be added explicitly to the objectives of the study plan.
- Post-construction monitoring will be required.
- Maureen asked how study needs can be incorporated into the FERC process if additional impacts are identified in the future.

Jordan departed at 13:35.

- Maureen then discussed other raptors/species of concern, wanting more information on how they will be covered in the eagle/raptor surveys.
- John described the applicability of the survey methods to detect nests of Red-tailed Hawk, Northern Goshawk, Gyrfalcon, Peregrine Falcon, Great-horned Owl, Great Gray Owl, Common Raven.
- Also discussed nesting landbirds and shorebirds briefly: How many of these would be affected? What are the implications for the populations in BCR 4? Rare species? Are they at the edges or in the middle of their ranges? What are the implications of nesting habitat loss for local populations (Olive-sided Flycatcher and Rusty Blackbird were species Maureen mentioned

specifically). Is there stopover habitat for shorebirds or waterfowl? As the reservoir fills during the breeding season, will it inundate nests?

- Also discussed shorebirds, fish-eaters (loons, Belted Kingfisher), mercury issues, lighting of towers (FAA likes steady red glowing lights, which may be a problem for collisions), and possible collision risks for nocturnal migrants, swans and cranes.

Betsy McGregor

From: Lori_Verbrugge@fws.gov
Sent: Tuesday, June 12, 2012 8:41 AM
To: lawhead@abrinc.com
Cc: Betsy McGregor; Michael_Buntjer@fws.gov; Jennifer_Spegon@fws.gov
Subject: Fw: Meg's answers to chytrid questions

Hi Brian,

Meg has responded to our preliminary questions about wood frogs, chytrid fungus and project development - please see below.

Please don't hesitate to follow up with her (or her contacts) if you have more questions!

Lori Verbrugge, PhD
Contaminants Biologist
US Fish and Wildlife Service
605 W 4th Avenue, Room G-61
Anchorage, AK 99501
Phone: (907) 271-2785
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----- Forwarded by Lori Verbrugge/R7/FWS/DOI on 06/12/2012 08:36 AM -----

Margaret Perdue/R7/FWS/DOI — To Lori Verbrugge/R7/FWS/DOI@FWS

06/11/2012 09:10 PM — cc

Subject Re: Fw: Meg's contact info

Hey Lori ---

Yes chytrid has been found infecting frogs in Alaska. We have had positive results for a number of frogs down here in the Kenai - 17 sites last year had frogs that came back positive for *Batrachochytrium dendrobatidis* (Bd) the species of chytrid fungus that causes the disease chytridiomycosis. There is also a USGS person / doctoral student, Tara Chestnut who is doing here dissertation on its distribution and has found it elsewhere up here (not sure exactly where, Tara doesn't want to give out too much info until she completes here research) and I also believe another researcher found it in Denali NP.

As far as how it might be spread and whether a project like Su-Watana could be a potential means of spread is one of the big questions but it certainly seems possible that the associated traffic to an area that comes with development of any sort at least raises the possiblity for increased incidence.

Mari tested for it down here and in a couple of the other refuges where she did the amphibian survey work and she found it down here then (2006) but not in Innoko or Tetlin (the other places where she tested) leading to speculation that road proximity like with the malformations could be a factor.

Lori
Verbrugge/R7/FWS/DOI ToBrian Lawhead

06/07/2012 02:57 PM cc

SubjectMeg's contact info

Nice meeting you in person yesterday, Brian! Always nice to be able to put a face to a name.

As promised, here is the contact information for my co-worker, who is an expert in Alaskan wood frogs. She is doing field research on the Kenai all summer, but she keeps up on her email and is sometimes in the office on Fridays. She may be able to answer your questions about the chytrid fungus, and whether there are potential links to the Project.

Meg Perdue, Biologist
U. S. Fish & Wildlife Service
Environmental Contaminants Program
Anchorage Field Office
605 W. 4th Ave., Rm G-61
Anchorage, AK 99501
phone: 907-271-6647
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margaret_perdue@fws.gov

Talk to you soon -

Lori