Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Landbird and Shorebird Migration, Breeding, and Habitat Use
Study Plan Section 10.16

Initial Study Report
Part A: Sections 1-6, 8-10

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

ABR, Inc.—Environmental Research & Services

Anchorage, Alaska

June 2014

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
AEA	Alaska Energy Authority
AIC	Akaike Information Criterion
AOU	American Ornithologists' Union
APA	Alaska Power Authority
AVC	Alaska Vegetation Classification
CIRWG	Cook Inlet Region Working Group
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
GPS	global positioning system
ILP	Integrated Licensing Process
ISR	Initial Study Report
n	sample size
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project
RSP	Revised Study Plan
SD	standard deviation
SPD	study plan determination
USFWS	United States Fish and Wildlife Service
USR	Updated Study Report

1. INTRODUCTION

On December 14, 2012, Alaska Energy Authority (AEA) filed with the Federal Energy Regulatory Commission (FERC or Commission) its Revised Study Plan (RSP) for the Susitna-Watana Hydroelectric Project No. 14241 (Project), which included 58 individual study plans (AEA 2012). Section 10.16 of the RSP described the Landbird and Shorebird Migration, Breeding, and Habitat Use Study.

On February 1, 2013, FERC staff issued its study plan determination (February 1 SPD) for 44 of the 58 studies, approving 31 studies as filed and 13 with modifications. RSP Section 10.16 was one of the 31 studies approved with no modifications.

In the first year of this study (2013), data were collected on breeding landbirds and shorebirds that occurred in the Project vicinity. Three survey methods were employed: (1) ground-based point-count surveys for breeding birds (focusing on landbirds and shorebirds) in all available habitats; (2) ground-based point-count and transect surveys focused on riverine and lacustrine habitats; and (3) aerial surveys for colonially nesting swallows. The ground-based monitoring of bird migration using a combination of daytime visual observations and nocturnal radar sampling (which yielded data on the migration of landbirds and shorebirds) is reported in Initial Study Report (ISR) 10.15, Waterbird Migration, Breeding, and Habitat Use.

Following the first study season, FERC's regulations for the Integrated Licensing Process (ILP) require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). This ISR on the Landbird and Shorebird Migration, Breeding, and Habitat Use Study has been prepared in accordance with FERC's ILP regulations and details AEA's status in implementing the study, as set forth in the FERC-approved RSP (referred to herein as the "Study Plan").

The common names of bird species are capitalized throughout this report, in keeping with the formal nomenclature recognized by the American Ornithologist's Union in the Check-list of North American Birds (AOU 1998, 2012).

2. STUDY OBJECTIVES

As established in the RSP (Section 10.16.1), the goal of this study is to collect baseline data on the occurrence, distribution, abundance, 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 was designed to provide data on 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.

The study has four specific objectives:

- Collect data on the distribution and abundance of landbirds and shorebirds during the summer breeding season.
- Identify habitat associations for landbirds and shorebirds.
- Evaluate changes in distribution, abundance, and habitat use of landbirds and shorebirds through comparison with historical data.
- Characterize the timing, volume, direction, and altitude of landbirds and shorebirds migrating through the dam and camp facilities area (reported in ISR Study 10.15, Waterbird Migration, Breeding, and Habitat Use).

3. STUDY AREA

As established in the RSP (Section 10.16.3), the study area for the ground-based point-count surveys includes the areas of the proposed Watana Reservoir (at predicted maximum pool elevation), the Watana Dam Site, and Watana Camp, the three alternative Susitna-Watana Transmission Line/Access corridors, and a 2-mile buffer surrounding each of those areas (Figure 3-1).

As established in the RSP (Section 10.16.3), because lacustrine habitats were surveyed only when they occurred near point-count plots, the transect surveys for landbirds and shorebirds in lacustrine habitats were conducted in the same study area used for the point-count surveys, as described above (Figure 3-1).

As established in the RSP (Section 10.16.3), the transect and point-count surveys for landbirds and shorebirds in riverine habitats were conducted along the prominent rivers and streams in the area of the proposed Watana Reservoir (at predicted high water) and in areas surrounding the site of the proposed Watana Dam plus a 2-mile buffer around those areas (Figure 3-2).

As established in the RSP (Section 10.16.3), the survey area for colonially nesting swallows includes suitable riverine cliff and bluff nesting habitats within the area of the proposed Watana Reservoir (at predicted maximum-pool elevation) (Figure 3-3).

4. METHODS AND VARIANCES IN 2013

The landbird and shorebird study methods include the following components:

- Conduct ground-based point-count surveys to collect field data on the occurrence, distribution, and abundance of landbirds and shorebirds in the study area during the summer breeding season.
- Collect habitat-use data for landbirds and shorebirds during the point-count surveys to inform the Evaluation of Wildlife Habitat Use (Study 10.19), which will be the first step

in quantifying habitat change (i.e., gain/loss and alteration) for landbirds and shorebirds from the proposed Project.

- Conduct focused point-count and linear walking surveys in riverine and lacustrine habitats, targeting piscivorous species and other species typical of fluvial, riparian, and lacustrine habitats, which often are under-represented in standard point-count surveys.
- Conduct aerial surveys of colonially nesting swallows in riparian habitats within the inundation zone of the proposed Watana Reservoir.
- Review the literature on the foraging habits and diets of piscivorous and partly piscivorous landbird and shorebird species (e.g., Belted Kingfisher, American Dipper, Spotted Sandpiper), which will be used to inform the Mercury Assessment and Potential for Bioaccumulation Study (Study 5.7).
- Conduct visual migration-watch surveys and radar sampling in the immediate vicinity of the dam, powerhouse, and camp facilities (reported in ISR Study 10.15, Waterbird Migration, Breeding, and Habitat Use).
- Compare historical (Alaska Power Authority [APA] Susitna Hydroelectric Project) data from the 1980s for landbirds and shorebirds with the current data from this study, to evaluate any changes in distribution, abundance, and habitat use over the intervening 30 years. Many species of migratory birds have suffered population declines in recent decades, so these comparisons may also provide information on the population status of those species in the Project area.

4.1. Point-count Surveys

4.1.1. Plot-allocation Procedure

The study team implemented the plot-allocation procedures as described in the RSP (Section 10.16.4.1.1) with the exception of the variance explained below (Section 4.1.1.1). In this study, ground-based point-count surveys for breeding landbirds and shorebirds were used. Point-count surveys, in which all birds seen or heard are recorded, were designed originally as a survey method for singing male passerines, and are now the preferred method for inventory and monitoring efforts for landbirds in remote, roadless landscapes in Alaska (Handel and Cady 2004; ALMS 2010). These methods have also 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 (involving a few large plots with set area boundaries) would yield few observations, even with a relatively large survey effort.

Point-count surveys are appropriate for large development projects that can affect a large geographic area and can include many different types of habitats. The sample points can be distributed across the landscape and allocated among habitat types to ensure that all prominent habitat types are sampled. Because management agencies in Alaska are increasingly concerned with landbird and shorebird species of conservation concern (which generally are uncommon), and because it is important to sample many different occurrences of each habitat type to detect uncommon species (which are patchy in occurrence across the landscape), the point-count

locations surveyed in this study were allocated in as many different occurrences of each of the habitat types in the study area as possible. Because the wildlife habitat mapping for the Project (ISR Study 11.5) is not yet complete for the study area, the point-count plots surveyed were allocated using a two-stage, stratified systematic/random sampling design in which vegetation types from the APA Project vegetation map (Kreig and Associates1987) were used as one of two primary sampling strata. The vegetation types used from the APA Project vegetation map are roughly equivalent to the Alaska Vegetation Classification (AVC) Level-III vegetation classes of Viereck et al. (1992) [see Vegetation and Wildlife Habitat Mapping Study (Study 11.5)].

In 2013, the sampling frame used for the allocation of point-count transects and plots consisted of those state and federal lands within the area covered by the APA Project vegetation map (Kreig and Associates 1987) and within the 2-mile buffer study area surrounding the proposed Project components, as described below in Section 4.1.1.1. By using this sampling frame, researchers avoided any allocation of point-count transects or plots on Cook Inlet Region Working Group (CIRWG) lands (Figure 3-2), where access was not granted in 2013. The stratified systematic/random sampling design used to select the locations of transects and point-count plots on each transect involved the use of a two-stage, cluster sampling technique (Morrison et al. 2008). First, a grid of potential point-count plot locations was created across the entire study area using a Geographic Information System (*ArcGIS*). The systematic locations of potential point-count plots determined using the grid were not randomly assigned, but their locations were unbiased with respect to the distribution of breeding birds on the landscape. The grid of potential point-count plots was created to maintain minimum distances between point-count plots (see below), while maximizing efficiency of access to the point-count plots in the field. Using the vegetation types mapped by Kreig and Associates (1987) to define open and closed habitats, all potential point-count plots in closed habitat types were spaced 250 m (820 ft) apart, and all potential point-count plots in open habitat types were spaced 500 m (1,640 ft) apart, in accordance with the field sampling protocols developed for landbird point-count surveys in Alaska for the Alaska Landbird Monitoring System (ALMS 2010) protocol.

In the second stage of the point-count plot allocation process, the vegetation types mapped by Kreig and Associates (1987) were categorized as common or rare based on their relative areal coverage in the mapped area. This categorization was the first step in an attempt to allocate an adequate number of point-count plots in both common and rare habitat types. Because rare habitats are often under-sampled or even unsampled in random plot-allocation procedures, an effort was made to place additional point-count plots in rare habitats. Rare vegetation types (each less than 4 percent of the total area mapped by Kreig and Associates [1987]) were combined into one sampling stratum, and common vegetation types (each greater than 4 percent of the total area mapped) were aggregated into a second sampling stratum (Table 4.1-1). Using these two sampling strata, a random, spatially balanced sample of 100 transect-starting locations was selected using *ArcGIS*. In initial runs of the selection of transect-starting locations, the final set of point-count locations was still skewed heavily toward common habitats when an even split (50 transect-starting locations in rare habitats and 50 in common habitats) was used. Therefore, the selection of random transect-starting locations was set in favor of rare habitats (70 in rare habitats and 30 in common habitats).

The second stratum used in the stratified systematic/random sampling design to allocate point-count plot locations involved a split of the study area into two parts, one of which was the

proposed Watana Reservoir (plus a 2-mile buffer) and the other was the remaining portions of the study area (Watana Dam, Watana Camp, the three possible Susitna-Watana Roads, the three possible Susitna-Watana Transmission Lines, and a 2-mile buffer surrounding these areas). Half of the transect starting locations were located in the first stratum, the proposed Watana Reservoir plus 2-mile buffer (which would undergo more habitat alteration from development of the Project), and the other half of the transect-starting locations were located within the second stratum, which comprised the remaining portions of the study area.

In the last phase of the point-count plot allocation process, the 15 potential point-count plot locations (defined by the grid of points, described above) closest to each transect-starting location were selected for inclusion in that transect. Each point-count transect was designed to be surveyed in one day by each survey team of two, and included 15 spatially independent point-count plots arranged around the transect-starting location (roughly in the center of the grid of point-count plots). Finally, using aerial imagery and topographic maps, the point-count plot locations on each transect were modified visually, when necessary, by adding or removing plots on each transect so as to minimize landscape hazards in travelling in the field, maintain a close clustering of plots, and maximize efficiency of surveying in the field. A total of 100 potential point-count transects and 1,500 point-count plots were allocated in the study area (Figure 3-2).

4.1.1.1. Variances

As described in the RSP (Section 10.16.4.1.1), aerial image-signatures from current aerial imagery were planned to be used as the habitat sampling strata in a pseudo-stratified random sampling procedure to allocate point-count survey locations. However, because high-resolution aerial imagery was not available for the full study area at the time the point-count plots were allocated, it was not possible to use aerial image-signatures as the habitat strata to determine point-count plot locations. Instead, as described above in Section 4.1.1, the 1987 vegetation map polygons prepared by Kreig and Associates (1987) were used as the habitat sampling strata in a stratified systematic/random sampling procedure to allocate point-count transects and plots by vegetation type. Given that the 1987 vegetation map appears to be reasonably accurate at the Level-III vegetation classes of Viereck et al. (1992) when compared to current imagery (see Study 11.5), this alternative plot-allocation procedure served to adequately achieve the study objective of allocating point-count plots randomly by habitat type. Additionally, the stratified systematic/random sampling procedure used in 2013 is less prone to bias in the determination of point-count plot locations than the pseudo-stratified random sampling procedure originally proposed in the RSP (Section 10.16.4). For these reasons, and to maintain consistency with the plot-allocation procedure used in 2013, the same stratified systematic/random sampling procedure will be used again in the next study year, with the addition of new AVC Level-III vegetation mapping from Study 11.5 for those portions of the study area that were not surveyed in 2013.

Another variance occurred in 2013 in which the study area for the point-count surveys, as described in the RSP (Section 10.16.3) and in Section 3 above, was reduced for two reasons. First, the study area was restricted to those areas for which vegetation had been mapped by Kreig and Associates (1987) for the APA Project. Because the current wildlife habitat mapping for the Project was not complete for the study area at the time that point-count plots were allocated (see above), the best available and finest-scale vegetation map (prepared by Kreig and Associates

1987) was used to allocate point-count plots by vegetation types. The APA Project vegetation map, however, does not completely cover the entire study area described in the Study Plan; missing are portions of the northern Susitna-Watana Transmission Line/Road alternative near the Denali Highway (Figure 3-2). Because of this, the study area in 2013 was restricted to those areas where vegetation mapping had been completed for the APA Project. This variance reduced the size of the study area in 2013 by approximately 12 percent. Similar habitats to those occurring at the northern end of the Denali Corridor were sampled elsewhere in study area in 2013, as judged from the vegetation sampling done at the northern end of the Denali Corridor by the study team for the Vegetation and Wildlife Habitat Mapping Study (Study 11.5). In the next study year, field sampling in those portions of the Denali Corridor that were not sampled in 2013 will be accomplished by making use of the new wildlife habitat mapping being completed for the Project (see ISR Study 11.5) to allocate point-count locations by habitat type. Hence, across both study years, this variance will not hinder achievement of the study objectives, and no modifications to the Study Plan are needed for the next year of study.

Second, because land-access permits were not available for CIRWG lands, private lands, or Alaska Railroad Corporation land, the allocation of point-count transects and plots in 2013 was restricted to State and Federal lands within the study area. Because of this restriction, approximately 27 percent of the study area described in the Study Plan was excluded from field surveys during 2013; the vast majority of that 27 percent of the study area occurs on CIRWG lands. Some of the prominent habitats occurring on CIRWG lands in the Gold Creek Corridor (where the bulk of the restricted access occurred) and that do not occur elsewhere in the study area include lower elevation mixed and broadleaf riverine forests along the Susitna River, lower elevation wet scrub habitats on terraces above the Susitna River, and wetland complexes in the Fog Lakes area and at the northern end of Stephan Lake. In particular, none of the large stands of riverine balsam poplar (*Populus balsamifera*) along the Susitna River were sampled in 2013 because those stands essentially only occur downstream of Devils Canyon (where access was restricted).

Even with the lack of access to some portions of the study area in 2013, the study team was able to conduct 1,364 point-count surveys, which is more than 500 point counts above the goal of 800 point counts per year noted in the RSP (Section 10.16.8). If sampling on CIRWG lands is authorized for the next study season, the study objective of collecting data in all portions of the study area (e.g., so as to compare landbird and shorebird data for the three alternative Susitna-Watana Transmission Line/Road corridors), will be achieved. At that point, sufficient data will be available to calculate reasonable abundance estimates for all of the numerically dominant species and most of the common species. For those areas that were sampled in only one year and especially for some of the more uncommon species, the study team is likely to have less confidence in the abundance estimates because of low sample sizes of observations. However, this does not indicate that the study will fall short of meeting its objectives. Rather, it represents the common case of a data caveat that will have to be carefully taken into account when making comparisons of levels of abundance among the three alternative Susitna-Watana Transmission Line/Road corridors, and comparisons of the current data to historical data from the 1980s (see Section 4.5 below).

4.1.2. Field Surveys

The study team implemented the field survey methods as described in the RSP (Section 10.16.4.1.2) with no variances. Point-count field surveys were conducted following standard protocols for point-count surveys for breeding birds in Alaska (Handel and Cady 2004; ALMS 2010). These protocols are based on variable circular-plot point-count methods in which temporally stratified observation periods and distance estimates are recorded to allow the calculation of densities (Ralph et al. 1995; Buckland et al. 2001; Farnsworth et al. 2002; Rosenstock et al. 2002).

A staff of 8–10 biologists conducted the field surveys in 2013, working in 4–5 separate crews of 2 biologists, each consisting of primary and secondary observers. Because of the length of the survey period (29 continuous field days, see below), several staff changes were required, mostly during the middle of the sampling period. All primary observers who were responsible for recording the point-count observations were experienced point-count observers skilled in the identification of Alaska birds by both sight and sound. A minimum of 2 days of training in horizontal distance estimation and refresher training in bird identification (by sight, song, and call) for all observers was conducted either immediately prior to the field surveys (in Anchorage) or during the field surveys, as a new observer worked alongside a trained observer before being allowed to record point-count observations. The distance-estimation training included estimation to visual targets at known distances, auditory distance testing in a simulated point-count survey, accuracy retesting of distance estimates, and final distance testing in a simulated survey.

Point-count surveys are conducted during the bird breeding season and are scheduled to encompass the variable arrival dates of different species of migratory birds for a specific location (ALMS 2010). In 2013, the start date for the field surveys was delayed 8 days because abnormally cold spring weather and deep snowpack in the study area resulted in the late arrival of most migratory birds. Surveys began on May 23, 2013, and continued through June 20, 2013, for a total of 28 survey days. During this period, only one survey day was lost to inclement weather (rain). Because the lingering snowpack in the study area limited access to breeding-bird habitats, the point-count surveys were focused first at lower elevations in the eastern portion of the study area (which receives substantially less snowfall than areas to the west and north). As the season and snowmelt progressed, field surveys were conducted at higher elevations and in the western and northern portions of the study area.

In 2013, the point-count surveys were conducted during early morning hours (0230 to 1100) to coincide with the period of greatest vocal activity of breeding species, especially singing male passerines. All point-count transects were accessed by helicopter and then surveyed on foot using preselected Global Positioning System (GPS) locations on handheld GPS receivers to navigate to each point-count plot. Standard 10-minute observation periods were used. During each point-count, observers recorded the species, number of individuals, sex (if possible), time period (in 1-minute intervals), behavior (e.g., singing, calling, flying), approximate horizontal distance to each bird observed (see below), and, whenever possible, the specific habitat being used by each bird at the time of observation. In closed habitats, the horizontal distance to birds was estimated using 10-m (32.8ft) distance classes up to 100 m (328 ft), then larger classes of 100–125 m (328–410 ft), 125–150 m (410–492 ft), and >150 m (492 ft) were used. In open habitats, distances were binned in 10-m (32.8ft) classes to 100 m (328 ft), then larger classes of 100–150 m (328–

492ft), 150–400 m (492–1,312 ft), and >400 m (1,312 ft) were used. In the field, laser rangefinders were used to confirm and calibrate the distance estimates recorded by measuring distances to visible landmarks (e.g., tree trunks, large rocks, slope crests) before starting a point-count.

In addition to the bird observations, at each point-count plot observers recorded the Viereck et al. (1992) Level-III vegetation type (and Level-IV whenever possible) for the primary habitat surrounding the plot. The primary habitat surrounding each plot was considered the focal habitat for the point-count observations. Whenever possible, however, the habitat actually being used by each bird at the time of observation, whether the focal habitat or not, was also recorded. Data on the habitats (in this case vegetation type) being used by birds at the time of observation will be used as an additional source of ground-reference data to help in the mapping of wildlife habitats in the Upper and Middle Susitna River Basin (see ISR Study 11.5) and also will be used to inform the habitat-use evaluations for landbirds and shorebirds, to be conducted in the next year of study for the Evaluation of Wildlife Habitat Use (ISR Study 10.19). Additional data collected at each point-count plot included site photographs, atmospheric data (temperature, wind speed, cloud cover, precipitation), and ambient noise levels. In some cases, researchers relocated, removed, or added point-count plots in the field, as necessary, to ensure the safety of the field crew (when the allocated point-count plots could not be accessed) and/or to increase the detectability of birds (e.g., by avoiding stream noise). All new point-count plots were located at least 250 m (820 ft) from any nearby point-count plots in closed habitats, or 500 m (1,640 ft) in open habitats.

The landbird and shorebird study also provided data on incidental sightings of other birds, mammals, and frogs to inform the qualitative results and reporting efforts of other wildlife studies being conducted in 2013.

4.1.2.1. Variances

No variances from the field methods for the point-count surveys described in the RSP (Section 10.16.4.1.2) occurred in 2013.

4.1.3. Data Analysis

4.1.3.1. Occurrence, Abundance, and Habitat Use

Researchers implemented the data analysis methods described in the RSP (Section 10.16.4.1.3) with no variances. The point-count survey data (uncorrected for detectability; see Section 4.1.3.2, Distance Analysis and Density Calculations, below) were summarized to assess the observed occurrence, abundance, and habitat use of landbird and shorebird species within the study area. To assess occurrence and abundance, the total number of bird detections, percent occurrence, and average occurrence (number of bird detections/total number of point-count plots) in the study area were calculated for each species. To assess habitat use, average occurrence values were calculated for each sampled habitat. Average occurrence values (birds/point-count—in this case calculated individually for each sampled habitat) facilitate unbiased comparisons of bird detections among habitat types because the values are standardized to account for variation in field effort (i.e., the variable number of point-counts conducted in

each habitat), which will directly influence the number of bird detections. Observations of birds detected in adjacent habitats outside of the focal habitat type in which each point-count plot was centered were removed from this analysis because those habitats typically occurred at some distance from the observer and hence were unlikely to have been adequately sampled (i.e., less active and less vocal species in those adjacent habitats likely would have been missed). For these preliminary analyses, the habitats evaluated were the AVC Level-III categories (Viereck et al. 1992), which primarily represent vegetation structure. For the USR, which will be prepared with data from the field surveys in both study seasons, a more formal habitat-use assessment will be conducted using the mapped wildlife habitat types for the study area (see Study 11.5). The abundance and habitat-use results are presented separately for landbirds and shorebirds because of the large differences in abundance between the two bird groups; landbirds are far more abundant than shorebirds in the study area. For all of these analyses, only observations recorded during the point-count sampling periods were used (i.e., detections of birds recorded at previous plots and all detections recorded before and/or after the point-count periods were excluded). Detections of birds not identified to species (e.g., unknown warblers or sparrows) also were excluded because those observations provided no information on species occurrence, abundance, and habitat use.

To place the 2013 abundance information for landbirds and shorebirds in the study area within the context of other information on landbird and shorebird abundance in the region of the Project, the average occurrence values for landbirds and shorebirds across the full study area were compared with average occurrence values calculated for eight other relatively recent avian point-count studies in Interior Alaska (see Sections 6.1.1, Landbirds, and 6.1.2, Shorebirds, below). As with the comparisons among habitats sampled in the study area, the average occurrence values for each point-count study (calculated as the total number of detections of each species/total number of point-count plots sampled) facilitate unbiased comparisons of abundance among studies because the data have been standardized for varying levels of survey effort. For the USR, comparisons of the landbird and shorebird abundance and habitat-use data from each year of survey in the study area will be made with the data for these same species groups collected in the 1980s for the APA Project (see Section 4.5, Comparisons with Historical Data, below).

One species (Common Redpoll), which was frequently observed in the study area in 2013, deserves special comment because of the difficulty in identification. Redpolls were commonly detected (mostly in flight) and it is not possible to confidently identify redpolls to species by vocalizations or in-flight visual observations alone. Due to this uncertainty, field observers recorded redpolls as “unknown redpoll” if they did not observe them well enough to confirm the identification. However, because the field surveys were conducted during the breeding season and the study area is within the breeding range of Common Redpolls, and well outside the breeding range of Hoary Redpolls (Knox and Lowther 2000a, 2000b), it was assumed that the majority of the redpolls observed were Common Redpolls. Accordingly, all redpoll observations were treated as Common Redpolls in the data analyses.

4.1.3.2. Distance Analysis and Density Calculations

Knowing how well birds are detected during field surveys is critical for producing accurate estimates of density and abundance (Buckland et al. 2001; 2004). For point-count surveys,

detectability varies with both the radial distance of the target bird from the observer and environmental conditions, which may hinder detections of vocalizations or visual observations (e.g., wind and river noise, closed vs. open habitats).

Using the first year of data collected for this study, preliminary densities corrected for detectability (hereafter, corrected densities) of breeding birds were estimated using point-count sampling analyses available in the computer software package MRDS in program R (Miller 2012) and by following the analytical methods for distance analyses described by Buckland et al. (2001; 2004). This approach accounts for the decreased probability of detecting a bird with increased distance from the observer. A minimum of approximately 60 observations for each species or species group is necessary to fit detection functions accurately (Buckland et al. 2001). To meet this minimum sample-size criterion, each species was assigned to one of seven detection groups, based on shared vocalization quality and behaviors that affect visual detections: grouse, warblers, flycatchers, thrushes, chickadees, sparrows, or corvids (Gray Jay, Black-billed Magpie, and Common Raven). The detection groups were defined by the majority of the species in that group, but species outside those taxonomic groupings were included in a detection group if they exhibited similar vocalization quality and behavior. Species that did not fit into one of the seven detection groups were excluded from the preliminary density analyses conducted for this report. For the USR, sample sizes of observations will be larger with two years of data, so it should be possible to estimate densities for more species.

The inclusion of data for birds that are detected while flying over a point-count plot leads to an overestimation of densities of breeding birds (Buckland et al. 2001; 2004), so all observations of flying birds were excluded from the analysis. In particular, this restriction greatly reduced the estimated abundance level for Common Redpolls relative to the analyses based on the uncorrected data (see Section 4.1.3.1, Occupancy, Abundance, and Habitat Use, above). For many species, males have a much higher detection probability than females because males often engage in singing and displaying activities. For detection groups in which at least 85 percent of the observations consisted of singing males (warblers and flycatchers), the observations of females and individuals of unknown sex were excluded from analysis. The male-only analyses were conducted because the male-only detection models (see below) were the best fit for those two detection groups. Density estimates for the species within those censored detection groups are estimates of male density only, although males represented the vast majority (85 percent or more) of the observations in those detection groups.

Density estimation was conducted in two steps. First, a detection function was fitted for each detection group to estimate the probability of detection of the species in that group, based on the radial distance of the target from the observer and on other covariates. Next, the group-specific detection function was applied to each species within a group to estimate species-specific densities for the entire study area. For each detection group, nine detection models were fitted to the distribution of observation distances to find the model that best estimated the probability of detection. The models used employed a half-normal key function and included observer, habitat type (closed vs. open), and background noise as covariates. Models without covariates were evaluated with and without a cosine adjustment term.

Model fit was evaluated based on the lowest Akaike Information Criterion (AIC) and Pearson's chi-squared test. Once the best detection model was selected for a detection group, a filter was

used to apply the fitted detection function to each species within each detection group, and species-specific corrected densities for the study area then were calculated. Corrected density estimates were calculated with the formula:

$$\hat{D} = \frac{n \cdot \hat{E}(s)}{a \cdot \hat{P}_a}$$

where $\hat{D}$is the corrected density estimate, n is the total number of observations, $\hat{E}(s)$ is the average flock size, a is the area sampled at each point-count plot multiplied by the number of sampling occasions, and $\hat{P}$ is the probability of detection estimated by the detection model (Buckland et al. 2001). Confidence intervals for the density estimates were calculated using bootstrap procedures (Buckland et al. 2001), and the estimated numbers of breeding birds of each species in the study area was calculated by applying density estimates to the area encompassed by the 2-mi buffer study area (assuming uniform densities throughout the study area).

4.1.3.3. Variances

No variances from the analysis methods of the point-count data described in the RSP (Section 10.16.4.1.3) occurred in 2013.

4.2. Riparian- and Lacustrine-focused Surveys

The study team implemented the methods as described in the RSP (Section 10.16.4.2) for the riparian- and lacustrine-focused surveys (hereafter referred to as riverine- and lacustrine-focused surveys) with the exception of the variances explained below (Section 4.2.1). Several species of landbirds and shorebirds that are known to be closely associated with riverine and lacustrine habitats (Belted Kingfisher, American Dipper, Semipalmated Plover, Solitary Sandpiper, Spotted Sandpiper, Wandering Tattler) are not commonly recorded in standard point-count survey locations allocated randomly across all available habitats (as described above in Section 4.1.1, Plot-allocation Procedure). Therefore, additional surveys were conducted specifically in riverine and lacustrine habitats that may be affected by Project development. These additional surveys were requested by the U.S. Fish and Wildlife Service (USFWS). The riverine- and lacustrine-focused surveys were conducted between May 24 and June 20, 2013, the same period when point-count surveys were conducted, as described above in Section 4.1.2, Field Surveys.

On riverine-focused surveys, observers walked along transects that followed riverine corridors. Point-count plots were interspersed along the transects to increase the number of point-count plots in riverine habitats. The riverine corridors surveyed generally were the larger, named tributary streams to the Susitna River and the Susitna River itself. The riverine-focused transect locations were assigned using *ArcGIS Version 10.1* software and a random, spatially balanced selection of 13 starting locations (generally the center of each transect). The starting locations were allocated along riverine corridors in the Watana Reservoir and Watana Dam portions of the study area (plus a 2-mi buffer surrounding the maximum pool elevation of the reservoir). No transects were allocated on CIRWG lands. On each transect, between 10 and 15 point-count plots were allocated upstream and downstream from the starting location. The 13 riverine-focused point-count transects included 171 potential point-count plots, which resulted in a total set of 113

transects and 1,671 potential point-count plots being allocated in the full study area in 2013 (Figure 3-2).

The point-counts and transect surveys in riverine corridors generally were conducted later in the sampling period (after the second week of June), after shorefast ice had melted and high water from spring flooding had subsided. Each of the riverine-focused transects was accessed by helicopter and then surveyed on foot using preselected GPS locations on handheld GPS receivers to navigate between each point-count plot. Point-counts in riparian habitats were conducted as described above in Section 4.1.2, Field Surveys, except that no attempt was made to move the point-count locations away from the riverine corridors to reduce stream noise. Moving the point-count locations out of the riverine corridors would have negated the focus of the surveys, which was to document the use of riparian and riverine habitats by breeding birds. Stream noise hindered auditory detection of birds in some areas with fast water but was a negligible concern in areas of slower riffles and flat water and some sloughs along the Susitna River. Because of this potential hindrance, most records of birds in riparian and riverine habitats were obtained through visual detection, rather than auditory.

In addition to the point-counts conducted in riverine corridors, researchers walked slowly along each stream course as they moved between point-count locations and recorded all birds observed, as well as the habitat being used at the time of observation. Bird activity in riverine waters and along stream shorelines was recorded, as well as activity in riparian and upland habitats when those habitats occurred adjacent to the sampled streams. When traveling along stream courses, it was sometimes necessary for researchers to climb around cutbanks and bends in the streams (when streams could not be crossed safely); such diversions resulted in some sections of streams not being visible, so that a complete sampling of the riverine corridors on each transect was not always possible. For transects along the mainstem Susitna River, the sampling transects were located only along one side of the river. Birds were visible at least as far as the middle of the river, but it was not possible to survey across the entire width of the river and detect birds on the opposite river bank. Similarly, the opposite sides of islands in the Susitna River were not visible to observers. To provide a standardized relative measure of abundance for all species recorded during the riverine-focused surveys, the resulting data are presented as the number of observations of each species per unit time spent in transit (following methods used by Andres et al. 1999 and Boisvert and Schick 2007).

The lacustrine-focused surveys were transect surveys that were conducted concurrently with the transect-based point-counts described above in Section 4.1, Point-count Surveys. Lacustrine water bodies in the vicinity of established point-count transects were surveyed when a water body was located within approximately 250 m (820 ft) of any preselected point-count plot location. During the lacustrine-focused surveys, researchers walked the perimeter of each water body or, for small ponds, selected a vantage point from which the entire water body and shoreline were visible. All birds seen or heard using lacustrine habitats or adjacent vegetated habitats were recorded, as was the habitat being used at the time of observation.

An additional goal of the riverine- and lacustrine-focused surveys was to collect data on the distribution and abundance of piscivorous species (primarily Belted Kingfisher, but also American Dipper and Spotted Sandpiper, which occasionally consume fish) in the inundation zone of the proposed Watana Reservoir and immediately below the location of the proposed

Watana Dam. This information was collected to inform the mercury assessment study (see ISR Study 5.7).

4.2.1. Variances

The same variance in the study area sampled in 2013 for the point-count surveys (described above in Section 4.1.1.1) also applies to the riverine- and lacustrine-focused surveys. Because the lacustrine-focused transect surveys were geographically linked to the locations of the point counts, both the lack of fine-scale vegetation mapping for the APA Project and the lack of authorization to sample on CIRWG lands precluded sampling in two portions of the study area, as described above in Section 4.1.1.1. For the riverine-focused surveys, the lack of authorization to sample on CIRWG lands precluded sampling on some tributary rivers and streams in the study area. As described above in Section 4.1.1.1, neither of these variances will hinder the achievement of the study objectives because sampling in the areas not surveyed in 2013 will be possible during the next study season, assuming that CIRWG lands are accessible.

4.3. Survey of Colonially Nesting Swallows

The study team implemented the colonially nesting swallow survey methods as described in the RSP (Section 10.16.4.3) with the exception of variances explained below (Section 4.3.1). The focal species for the survey of colonially nesting swallows included Bank Swallow, Cliff Swallow, and Violet-green Swallow. These three species are gregarious, colonial nesters that prefer to nest in riverine cutbanks and cliffs near fluvial waters (Kessel et al. 1982; Brown et al. 1992; Brown and Brown 2002; Garrison 1999). Bank and Violet-green Swallows nest in burrows in relatively soft, sandy substrates and may form mixed-species colonies (Brown et al. 1992; Garrison 1999). Cliff Swallows build nest cavities of mud and clay on rocky cliffs, bridges, and other human-made structures (Brown and Brown 2002). All three species feed on flying insects and often forage over or near water bodies (Brown et al. 1992; Brown and Brown 2002; Garrison 1999).

In 2013, the swallow survey was conducted in two phases. In the first phase, an aerial survey was used to identify swallow nesting habitat and active swallow colonies in the study area on July 1–2. In the second phase, accessible colonies were observed from the ground to estimate activity levels, stage of breeding (nest building, incubation, or nestling [feeding of young]), and abundance. The second phase of the survey was completed in two periods: July 2–3, during the period of incubation for the majority of birds, and July 15–16, during the estimated peak in feeding of young.

The aerial survey used a piston-engine helicopter (Robinson R44) flying slowly (15–35 mph) at low altitude (15–150 ft above ground level) throughout all potential nesting habitat in the study area. Two observers positioned on the same side of the helicopter searched for suitable nesting habitat and recorded all active or potentially active colonies. One observer recorded the geographic coordinates of each colony on a hand-held GPS receiver while the other observer photographed the habitat and the extent of the colony to aid in accurate burrow counts and to quantify the total area of potential nesting habitat. Both observers assisted in species identification.

Colonies that were accessible (i.e., with no land-access restrictions and which could be accessed safely) were observed during the second phase. Researchers accessed each site by helicopter (landing only in areas approved for helicopter landings) and observed each colony for a minimum of 10 minutes to confirm species identification and obtain estimates of abundance and activity. Spotting scopes and digital video camcorders were used to monitor colony activity. Digital videos were preferred because they allowed researchers to estimate rates of entry into burrows (a measure of feeding frequency) in addition to obtaining counts of active burrows. At colonies that were accessible from the ground, a random sample of burrows was examined visually using a flashlight. Burrows containing eggs, young, or adults were considered to be occupied. The number of eggs or young in each nest was recorded. These data were used to estimate the total number of active burrows in each colony and in the overall survey area, thereby facilitating an estimate of population size.

4.3.1. Variances

In 2013, an aerial survey was used to locate swallow nesting colonies rather than the boat-based survey described in the RSP (Section 10.16.4.3). After a visual assessment of the study area, it was clear that a helicopter would be a more efficient survey platform and would allow greater coverage of available habitats than would a boat-based survey. Hence, the implementation of this variance improved the survey coverage and efficiency, improving the achievement of the study objectives. In the next survey year, the colonially nesting swallow survey will be conducted again using a helicopter survey platform for optimal survey efficiency and to maintain consistency with 2013 survey methods.

In 2013, the colonially nesting swallow surveys extended beyond the study area defined in the RSP (Section 10.16.3), as a 2-mi buffer surrounding the proposed Watana Reservoir, Watana Dam site, and Watana Camp was included in the survey. Surveying this additional buffer area was deemed advantageous because it allowed researchers to survey all potential swallow nesting habitat in areas that could be directly or indirectly affected by the proposed Project (i.e., with the inclusion of colonies very near to but not expected to be directly inundated by the proposed Watana Reservoir). Additionally, the expansion was feasible given the greater efficiency in locating swallow colonies from a helicopter, as opposed to a boat. This variance enhanced the study objectives by widening the search area for potential swallow colonies.

4.4. Migration Survey

The migration survey component of this study was conducted using a combination of daytime visual sampling and nocturnal radar and visual sampling (using night-vision devices) during both the spring (late April to June) and fall (late August to mid-October) migration periods. This study component was conducted in association with the waterbird study (Study 10.15) and is reported in ISR Study 10.15.

4.4.1. Variances

See ISR Study 10.15.

4.5. Integration of Existing Information with Current Study (hereafter referred to as Comparison with Historical Data)

The methods for comparing current and historical data on landbirds and shorebirds in the study area, as described in the RSP (Section 10.16.4.5), will be implemented in the next year of study; the single variance to the Study Plan methods is explained in below (Section 4.5.1). For the USR, the landbird and shorebird data collected in both study seasons will be compared with the data collected for the APA Project area in the early 1980s (Kessel et al. 1982, AEA 2011). The primary focus will be to compare occurrence, abundance, and habitat-use patterns in the historical data with the results from the current data set, and to highlight any changes that may have occurred over the intervening 30 years.

4.5.1. Variances

As described in the RSP (Section 10.16.4.5), comparisons of the current and historical (1980s APA Project) data on landbirds and shorebirds were planned to be made in both the ISR and the USR. However, it is well known that annual fluctuations in the abundance of landbirds and shorebirds can be quite large; therefore, it could be misleading to make comparisons of the historical data with only one year (2013) of current data. For these reasons, comparisons with the historical data will be presented in the USR, after data from both years of this study are available. The implementation of this variance will enhance the achievement of the study objectives by avoiding potentially contradictory and misleading information being presented in the ISR and the USR. When conducting the comparisons of current and historical data, the study team will correct for the lack of access to CIRWG lands in 2013 (see the variance described above in Section 4.1.1.1) by using only the data for areas sampled in both study years to compare to the historical data. Additionally, the comparison of current to historical data will be done correcting, as well as possible, for differences in the habitats sampled; this is likely to further restrict the current point-count data that can be used in these comparisons.

4.6. Mercury Assessment (hereafter referred to as Mercury Assessment Support)

The study team implemented the mercury assessment support methods as described in the RSP (Section 10.16.4.6) with no variances. Scientific literature on the foraging habits and diets of piscivorous landbirds and shorebirds (primarily Belted Kingfisher, but also American Dipper and Spotted Sandpiper) was reviewed to inform the mercury risk-assessment study (Study5.7) and to complement the field data gathered on the distribution and abundance of these species in the study area. The literature review focused on studies conducted in Alaska to the extent possible, but few such studies were available, so literature from elsewhere was included. In addition to the literature review, in the RSP (Section 10.16.4.6) the opportunistic collection of feathers from any Belted Kingfisher nests located during the landbird and shorebird field surveys was proposed, for transfer to the mercury study lead for laboratory analysis of methyl-mercury levels. No Belted Kingfisher feathers were collected in 2013, however, because no nests of that species were found during the field surveys.

4.6.1. Variances

No variances from the methods described in the RSP (Section 10.16.4.6) for literature review of diets and foraging habits of piscivorous landbirds and shorebirds occurred in 2013.

5. RESULTS

The results of each of the 2013 breeding landbird and shorebird survey efforts (point-counts, riverine- and lacustrine-focused surveys, and swallow surveys) are presented separately below. The focus of the results is on the observations of landbirds and shorebirds, although observations of other bird species groups are reported for the riverine- and lacustrine-focused surveys because those surveys were designed specifically to assess the use of those habitats by species that are typically under-sampled in point-count surveys. Observations of waterbirds and raptors that were made during the landbird and shorebird surveys are reported in the ISRs for waterbirds and raptors (ISR Studies 10.15 and 10.14). A complete list of the 107 bird species recorded during all four survey tasks of the breeding landbird and shorebird study is appended to this ISR (Appendix A); organized phylogenetically (AOU 2012), it includes common and scientific names, breeding status, and relative abundance.

This report summarizes the work conducted to date, including the landbird and shorebird species observed, an initial assessment of their abundance and population density, and a preliminary analysis of habitat associations. The final habitat-association information will be critical for predicting the direct impacts of the proposed Project on breeding landbirds and shorebirds (through habitat loss and disturbance) in the license application. The final habitat-association analysis will be conducted for the USR after the wildlife habitat mapping for the study area is completed (see ISR Study 11.5).

5.1. Point-count Surveys

The point-count data developed in support of this study are available for download at http://gis.suhydro.org/reports/isr. The data are in the file: ISR_10_16_LSBRD_Data_ABR.accdb.

In 2013, the study team conducted 1,364 point-count surveys along113 transects in the study area (Figure 3-2) between May 23 and June 20, 2013. Point-count plots were spread throughout the study area as much as possible (see Section 4.1.1, Plot-allocation Procedure, above). Across all species groups (landbirds, shorebirds, waterfowl, and raptors), 14,880 individual birds of at least 97 different species were recorded during the point-count surveys, including 53 landbirds, 11 shorebirds, 25 waterbirds, and 8 raptors. Averages of 7.0 ± 4.9 (mean ± SD) species (range 0–15) and 10.9 ± 5.5individual birds (range 0–61) were recorded among all point-count plots. No birds were detected on 15 plots (0.01 percent of all plots surveyed).

Because the wildlife habitat map for the study area is not yet complete (see ISR Study 11.5), only a preliminary assessment of habitat use by breeding birds was conducted for this report. For this analysis, all records of AVC Level-IV vegetation types (Viereck et al. 1992) recorded in the field were aggregated to the broader Level-III vegetation types, resulting in a total of 24 focal

habitat types (Table 5.1-1). The number of observations of each bird species recorded in each focal habitat type was tallied and the average occurrence was calculated to provide an estimate of habitat use for each species.

5.1.1. Landbirds

5.1.1.1. Abundance

During the point-count surveys in 2013, researchers recorded 53 landbird species (Table 5.1-2) and calculated averages of 6.0 ± 2.7 landbird species (range 0–15) and 9.6 ± 4.7 individual landbirds (range 0–52) per plot. Most of the birds observed were assumed to be nesting in the study area, based on observations of nests or repeated observations of display activities, territorial behavior (e.g., singing), or alarm and mobbing reactions typical of nesting birds.

Using the raw point-count data (uncorrected for detectability), the most frequently observed landbird species (each accounting for 5 percent or more of the total landbird point-count observations) were Fox Sparrow, White-crowned Sparrow, Common Redpoll, Yellow-rumped Warbler, Varied Thrush, Savannah Sparrow, Ruby-crowned Kinglet, and American Tree Sparrow; combined, they accounted for 59 percent of the total landbird point-count observations (Table 5.1-2). Six landbird species (Dark-eyed Junco, Wilson's Warbler, Blackpoll Warbler, Gray-cheeked Thrush, Swainson's Thrush, and American Robin) each accounted for 3.0 to 4.9 percent of the total landbird point-count observations; combined, these species accounted for 23 percent of all landbird point-count observations. Another 27 species (each accounting for 0.1 to 2.9 percent of the total landbird point-count observations) together accounted for 17 percent of all landbird observations. Lastly, 12 species each accounted for less than 0.1 percent of the total landbird point-count observations); combined, those 12 species accounted for less than 1 percent of all landbird point-count observations.

5.1.1.2. Habitat Associations

Landbirds were observed in each of the 24 habitat types sampled in the study area in 2013, including forests and woodlands; scrub (tall, low, and dwarf types); herbaceous meadows; riverine habitats; and partially vegetated and barren areas at higher elevations (Table 5.1-2). Landbird abundance was highest in Closed Mixed Forests, in which a total average occurrence of 13.2 landbirds (of all species) per point count was recorded (n = 14 plots; Appendices B and C). Mixed Woodlands, Open Needleleaf Forests, and Needleleaf Woodlands also had relatively high landbird abundance, with total average occurrence values for landbirds of all species of 11.4, 9.5, and 9.4 (n = 14, 349, and 195 plots), respectively. Landbird species richness was highest in Open Needleleaf Forest and Needleleaf Woodland, in which 37 and 34 landbird species were observed, respectively. The lowest landbird abundance levels were recorded in Riverine habitats and Barrens, where the total average occurrence values for all landbird species were 0.3 (n = 52 plots) and 1.7 (n = 7 plots), respectively. The lowest landbird species richness was found in Dry Graminoid Meadows and Barrens, where 5 and 6 landbird species, respectively, were recorded during the point-count surveys. Of the individual species, White-crowned Sparrows were observed in the greatest number of habitat types (n = 20; Appendices B and C).Other common species of landbirds occurred in 13–18 different habitat types, whereas the species observed least frequently occurred in only 1–3 habitats each (Table 5.1-2).

5.1.1.3. Density

In the distance analyses used to estimate breeding bird densities, the best detection model for most bird detection groups was the model with the lowest AIC score. Several detection groups had more than one model within two integer AIC scores of the best model. When more than one model was supported by the data, the associated chi-square statistic was evaluated and the model that produced the smallest confidence interval around the density estimate was selected. For each detection group, all models within two AIC scores of the best model are presented (Table 5.1-3).

Although the chickadee detection group contained enough observations (n = 122) to meet the minimum sample-size criterion for detection function analysis, no detection model was a good fit (the confidence intervals were unacceptably large for both of the best models; Table 5.1-3), thus no density estimates for species within this detection group (Boreal Chickadee, Black-capped Chickadee, Bohemian Waxwing) were produced. Re-evaluation of the existing dataset in conjunction with the additional data to be collected during the next study season may yield better models and more precise density estimates.

For the grouse, flycatcher, and corvid detection groups, several models were within 2 integer AIC scores of the best model, indicating that those models were strongly supported by the data, and produced similar density estimates. The models containing no covariates or only the habitat type covariate, however, produced the smallest confidence intervals around the density estimate. The simpler model without covariates was selected for estimating total density for species within these detection groups.

For the warbler and thrush detection groups, the models with the lowest integer AIC values were used to estimate densities. Both of these models included observer and habitat type covariates in the detection functions and the model for warblers also included background noise as a covariate.

After correcting for detectability, Fox Sparrow was the most abundant species in the study area, followed by White-crowned Sparrow, Yellow-rumped Warbler, Ruby-crowned Kinglet, and Wilson's Warbler. In contrast, Ruffed Grouse, Spruce Grouse, Alder Flycatcher, Black-billed Magpie, and Rusty Blackbird were all considered rare (Table 5.1-4). Within the study area, Willow Ptarmigan were the most abundant game bird species, outnumbering other ptarmigan and grouse species. Varied Thrush was the most common thrush species, and Fox and White-crowned Sparrows were the most common sparrows in the study area. Ruby-crowned Kinglet (in the Old World warbler family) and Yellow-rumped Warbler were the most common warbler species. Of the two flycatchers analyzed, Olive-sided Flycatchers were more common than Alder Flycatchers.

5.1.2. Shorebirds

5.1.2.1. Abundance

The study team recorded 11 shorebird species in the study area in 2013 (Table 5.1-5) and calculated an average of 0.4 ± 0.6 shorebird species (range 0–4) and 0.6 ± 1.0 individual shorebirds (range 0–12) per plot during the point-count surveys. Most shorebirds were assumed

to be nesting in the area, based on observations of nests or repeated observations of aerial display activities and territorial behavior, or alarm and mobbing reactions typical of nesting birds.

Based on the raw point-count data (uncorrected for detectability), Wilson's Snipe was the most common shorebird species in the study area, accounting for 61 percent of all shorebird observations. Seven shorebird species (American Golden-Plover, Lesser Yellowlegs, Spotted Sandpiper, Least Sandpiper, Red-necked Phalarope, Semipalmated Plover, and Solitary Sandpiper) were much less common, together accounting for less than 10 percent of all shorebird point-count observations in the study area. Three other species (Wandering Tattler, Whimbrel, and Greater Yellowlegs) were rarely encountered, together accounting for less than 1 percent of all shorebird point-count observations in the study area (Table 5.1-5).

5.1.2.2. Habitat Associations

Shorebirds were observed in 22 of the 24 focal habitat types sampled in the study area in 2013 (Table 5.1-5), but they were most common in the open habitats. Shorebird abundance was highest in Wet Graminoid Meadows, where a total average occurrence of 0.90 shorebirds (of all species) per point count was recorded (n = 20 plots) (Appendices D and E). Riverine habitats, Closed Mixed Forest, and Moist Graminoid Meadows also had relatively high shorebird abundance (total average-occurrence values for shorebirds of all species of 0.87, 0.57, and 0.54; n = 52, 14, and 42 plots, respectively). Species richness of shorebirds was highest in Open Needleleaf Forest and Ericaceous Dwarf Shrub, where 7 and 6 shorebird species were recorded, respectively. No shorebirds were detected in two habitats (Barrens and Broadleaf Woodland). Of the individual species, Wilson's Snipe was observed in the greatest number of habitat types (n = 18; Appendices D and E). All other shorebird species were found in nine or fewer habitats; Wandering Tattler, Greater Yellowlegs, and Red-necked Phalarope, which were found in only one habitat type each.

5.1.2.3. Density

For the USR, more detailed habitat-use analyses will be conducted for each species of shorebird and landbird (using abundance data corrected for detectability whenever possible); in those analyses, the use of each of the mapped wildlife habitat types (see ISR Study 11.5) sampled in the study area will be assessed.

No shorebird species were detected frequently enough in 2013 to support calculation of density estimates. Although a high number of detections (464) was recorded for Wilson's Snipe, most of those birds were observed in flight (aerial displays). Calculation of density estimates using birds in flight will overestimate their true breeding density. After more field data are collected in the next study season, it may be possible to calculate breeding densities for the most common species of shorebirds.

5.2. Riverine- and Lacustrine-focused Surveys

The riverine- and lacustrine-focused survey data developed in support of this study are available for download at http://gis.suhydro.org/reports/isr. The data are in two files:

- ISR_10_16_LSBRD_Data_ABR.accdb
- ISR_10_16_LSBRD_Data_ABR.gdb

The study team conducted 13 riverine- and 59 lacustrine-focused transects in 22 days of surveys in the study area in May and June 2013 (Figure 5.2-1). Lacustrine-focused surveys were completed during the point-count surveys and consequently were spread throughout the entire study area for the landbird and shorebird study (see Section 4.2, Riverine- and Lacustrine-focused Surveys, above) whereas the riverine-focused surveys were located within the area of the proposed Watana Dam and Watana Reservoir and a 2-mile buffer surrounding those areas. Similar to the methods used for the point-count surveys, the habitat being used by each bird observed was recorded, whenever possible, during the riverine- and lacustrine-focused surveys. Habitats were recorded in the field as AVC Level-III or, whenever possible, Level-IV vegetation types (Viereck et al. 1992). For the preliminary analyses conducted for this report, vegetation types were aggregated to the broader Level-III categories, which primarily represent vegetation structure.

5.2.1. Lacustrine-focused Surveys

The 59 lacustrine-focused surveys were completed within the same study area used for the point-count surveys over a period of 22 days between May 24 and June 20, 2013. Twenty-six of the surveys were located within or near the area of the proposed Watana Reservoir, seven in the area of the Watana Dam and Camp, 15 in the Denali Corridor, 10 in the Chulitna Corridor, and one in the Gold Creek Corridor (Figure 5.2-1). The surveys ranged from 1 to 109 minutes in length and varied in distance from a single point location to approximately 5.2 km (3.2 mi) along the shorelines of lacustrine water bodies.

Overall, 435 individual birds of 50 different species were recorded during the lacustrine-focused surveys, including 21 waterbird, 11 shorebird, and 18 landbird species. Averages of 2.9 ± 2.8 species (range 0–13) and 7.5 ± 10.0individual birds (range 0–46) were recorded per survey, although 10 locations (17 percent) had zero detections. Waterbirds were the most abundant species group observed, and composed 55 percent (n = 235) of all observations. Shorebirds and landbirds were less abundant, accounting for 31 percent (n = 132) and 15 percent (n = 63) of all observations, respectively.

The most abundant landbirds found near lacustrine water bodies were American Robin, Rusty Blackbird, Bohemian Waxwing, and Savannah Sparrow, which together comprised almost half of all landbird detections on the lacustrine-focused surveys. Tree Swallows, Violet-Green Swallows, and Bank Swallows comprised 11 percent of all landbirds observed. Landbirds were generally found in Open Low Shrub, Closed Low Shrub, and in Open Needleleaf Forests near the shorelines of lacustrine water bodies, but were also found foraging directly along the shorelines of ponds and lakes; swallows were often found foraging in the air directly above water bodies (Table 5.2-1).

The most abundant waterbird species recorded during the lacustrine-focused surveys were Green-Winged Teal, Northern Pintail, and American Wigeon, which together accounted for

almost 40 percent of all waterbird observations. Waterbirds were observed almost exclusively in lacustrine waters (97 percent of waterbird observations) (Table 5.2-1).

Red-Necked Phalarope was the most abundant shorebird species observed on the lacustrine-focused surveys, composing 25 percent of all shorebird observations (Table 5.2-1). Other common shorebird species included Wilson's Snipe, Lesser Yellowlegs, and Least Sandpiper, which together accounted for 55 percent of all shorebird detections. Shorebirds were found in lacustrine habitats 70 percent of the time and in adjacent Moist Graminoid Meadow habitats 24 percent of the time.

5.2.2. Riverine-focused Surveys

The 13 riverine-focused transects were sampled during the five-day period of June 15–19, 2013, except for one transect that was sampled along the Susitna River on May 23. The latter transect was a pilot transect along the Susitna River to test the methodology; at that time, substantial shorefast ice remained along the riverbanks, limiting the availability of riverine habitats to birds, especially along the narrow tributary streams of the Susitna River. The other 12 transects were sampled in late June after the subsidence of high, turbid flows and the melting of shorefast ice. The riverine-focused transects were located along portions of the Susitna River mainstem and the major tributary streams in the proposed Watana Reservoir, plus a 2-mi buffer surrounding the proposed Watana Dam and reservoir. Seven transects were located along tributary streams (Tsusena, Deadman, Watana, Kosina, Jay, and 2 unnamed creeks), four transects were located along the mainstem of the Susitna River, and two were located along portions of tributary streams (Goose and an unnamed creek) and the Susitna River (Figure 5.2-1; Appendix F).

In all, 692 individual birds of 44 different species were recorded during the riverine-focused surveys, including 28 landbird, 11 waterbird, 3 shorebird, and 2 raptor species. Averages of 12.7 ± 4.5 species (range 7–21) and 53.2 ± 36.6 individual birds (range 7–137) were recorded per transect. Landbirds were the most abundant species group (62 percent of all observations); waterbirds (19 percent) and shorebirds (18 percent) were less abundant. Across all transects and species, an average of 12.72 birds were recorded per hour of survey time. The average number of individuals observed per hour across all 13 transects ranged from a minimum of 0.02 birds per hour for the least common species (American Robin, Yellow Warbler, and Common Merganser) to a maximum of 2.24 birds per hour for the most abundant species (Spotted Sandpiper) (Appendix F).

Across all 13 transects, an average of 7.9 landbirds was recorded per hour during the riverine-focused surveys. The most common species observed were Blackpoll Warbler, Wilson's Warbler, Fox Sparrow, and Northern Waterthrush. These four species combined accounted for nearly 43 percent of all observations during the riverine-focused surveys, and each species individually accounted for at least five percent of all landbird observations. Landbirds were most frequently observed in Open Needleleaf Forest and a variety of riparian shrub habitats adjacent to riverine water bodies (Table 5.2-2).

For waterbirds, an average of 2.4 birds per hour was recorded across all 13 transects. Harlequin Duck was the most commonly recorded species during the riverine-focused surveys, followed by Green-winged Teal, American Wigeon, and Mallard. These four species combined accounted for

80 percent of all observations of waterbirds. All waterbirds observed were found either in riverine waters or were observed flying low over the sampled streams (Table 5.2-2).

Lastly, for shorebirds, across all 13 transects an average of 2.3 birds per hour was recorded during the riverine-focused surveys. Spotted Sandpiper was by far the most abundant shorebird species and accounted for 98 percent of the shorebird observations and 17 percent of all bird observations made. Spotted Sandpipers were observed most frequently using riverine shoreline habitats, but they were also found in low riparian shrub habitats located along tributary streams and the Susitna River (Table 5.2-2).

5.3. Survey of Colonially Nesting Swallows

The colonially nesting swallow survey data developed in support of this study are available for download at http://gis.suhydro.org/reports/isr. The data are in the file ISR_10_16_LSBRD_Data_ABR.accdb.

A total of 25 swallow colonies (both active and inactive) were identified in the study area during the survey in 2013 (Figure 5.3-1, Table 5.3-1). Twelve (48%) of the colonies were classified as active, two were inactive, and the status of the 11 other colonies could not be determined. All of the active colonies were inhabited by Bank Swallows and colonies S10 and S12 also were inhabited by Violet-green Swallows. The number of swallow burrows (potential nest sites) per colony ranged from one to 354 across all 25 colonies, totaling 935 burrows and averaging 37.4 burrows per colony (Table 5.3-1).

Although the study team did not locate any Cliff Swallow colonies during the swallow survey, Cliff Swallows were observed in the study area during the landbird and shorebird point-count surveys (see Section 5.1, Point-count Surveys, above) and Cliff Swallow nests were found on human structures during searches for bat roosts in several locations near, but outside of the swallow colony survey area (Study10.13).

The study team was able to conduct ground-based observations of swallow activity at 772 burrows in nine colonies (Table 5.3-1); the other 16 colonies were located in areas that were either unavailable for sampling in 2013 or were otherwise inaccessible (e.g., at the top of cliffs). Five of the 16 colonies that were not observed from the ground were active, and the status of the other 11 is unknown (Table 5.3-1). Two of the nine colonies observed from the ground appeared to be inactive. A total of 361 (47%) of the 772 burrows observed were being used by nesting swallows, and 9 to 196 active burrows were recorded per colony. Within the proposed reservoir area, a total of 319 active burrows were located below the maximum-pool elevation of 2,050 ft.

During colony monitoring, which was conducted in mid-July to coincide with the period of peak feeding of young, burrow entry-rate data were recorded at six colonies as an index of feeding frequency. During this period, the burrow entry rate averaged 2.5 entries per 10 minute sampling period (range1.0 to 3.2; Table 5.3-1). Colony S10 was located on a 6- to 10-foot-tall cut bank along the Susitna River, which allowed Project researchers to visually inspect burrows to estimate the number of young in each nest. For 12 nests inspected visually, the average number of nestlings was 2.1.

Fifteen of the colonies were located below the maximum-pool elevation (2,050 feet) of the proposed Watana Reservoir and three were located within the proposed Watana Camp area. Seventeen colonies were located along the Susitna River, six in the Watana Creek drainage, and two in the Deadman Creek drainage (Figure 5.3-1). The majority of the colonies (n = 15) were located in firm soils high up on heavily eroded hillsides (see examples in Appendix G). Five colonies were located in soft substrates on cut banks of the Susitna River, which were freshly formed by ice scour during the break-up of river ice in spring 2013 (Appendix G).

6. DISCUSSION

The field surveys for landbirds and shorebirds in 2013 were executed as planned with the necessary variances described above in Section 4, Methods and Variances in 2013. Although it was a cold, late spring in the study area, the weather during the survey period was generally excellent and the study team conducted 1,364 point counts, which is more than 500 point counts above the goal of 800 point counts per year noted in the RSP (Section 10.16.8). The preliminary data analyses presented in this report (see discussion below) indicate that the data are of sufficient quantity and quality to meet the study objectives, when coupled with the inclusion of a second year of data.

The landbird and shorebird study is related to several other on-going Project studies, the most important being the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna River Basin (Study 11.5). First, the vegetation mapping from Study 11.5 will be used in the next study season for point-count plot allocation in those areas for which there is no APA Project vegetation mapping, as described above in Section 4.1.1.1. Second, the completed wildlife habitat mapping for Study 11.5 will be used for analyses of landbird and shorebird habitat use and also as a covariate in the distance analyses to determine densities for landbirds and shorebirds. In turn, the abundance and habitat-use data from the landbird and shorebird study will be used by another related study (Evaluation of Wildlife Habitat Use, Study10.19). The landbird and shorebird study is on schedule to achieve its study objectives and provide the necessary data for Study 10.19. Lastly, the landbird and shorebird study team will be providing a literature review of the diets and foraging habits of piscivorous landbirds and shorebirds for use in the mercury risk-assessment study (Study 5.7). This literature review has been completed (see Section 4.6, Mercury Assessment, above) and it will be provided to the mercury risk-assessment study team in 2014.

6.1. Point-count Surveys

6.1.1. Landbirds

During the point-count surveys in 2013, landbirds were by far the most abundant bird group recorded, accounting for 87 percent of all observations. Within landbirds, sparrows were the most abundant species group observed in the study area, composing over 40 percent of all landbird observations. Warblers and thrushes were also common in the study area, accounting for about 20 percent and 18 percent, respectively, of all landbird observations. In contrast, grouse and ptarmigan, chickadees, and woodpeckers were recorded infrequently, accounting for only1.3, 0.8, and 0.2 percent, respectively, of all landbird observations. These ratios are typical

of other studies of landbirds in Alaska, in which migrants (e.g., sparrows, warblers, thrushes) greatly outnumber resident species such as grouse and ptarmigan, chickadees, and woodpeckers.

Several other landbird species (American Dipper, Belted Kingfisher, and swallows) are often detected in low numbers during point-counts because they are often or exclusively associated with riverine habitats, which typically are under-sampled in point-count surveys. In this study, the inclusion of additional point-count plots in riverine areas helped to increase the number of detections of most of these species, although Belted Kingfishers were not recorded on any point-count plots. Belted Kingfishers, however, were observed in small numbers during aerial surveys for migrant waterbirds and breeding Harlequin Ducks along streams in the Project area (see Study 10.15 and Section 6.2, Riverine- and Lacustrine-focused Surveys, below).

During the first week of point-count surveys in late May, resident species had already started nesting while migratory species were still arriving and establishing territories. It is likely that other migrants also were moving through the study area en route to their breeding grounds. Hence, it is important to interpret the first week of observations carefully to exclude, whenever possible, migrants from other populations from the breeding population estimates for the study area. Before calculating final abundance estimates for landbirds after the next year of study, all point-count data in the full data set will be reviewed to include only birds that were breeding in the study area.

Abundance estimates from the point-count survey data for a subset of species were corrected for detectability, and density estimates were calculated using distance-analysis techniques. In general, the eight most abundant species from the uncorrected data were estimated to be abundant species after correcting for detectability, with the prominent exception of Common Redpoll. Because most Common Redpolls were observed in flight, the majority of observations could not be included in the distance analyses. Several other species also were considered less common or more common after correcting for detectability, though dramatic differences in the rankings of species by commonness after correcting for detectability did not occur. The density estimates and the estimated number of breeding birds shown in Table 5.1-4 represent values calculated for the study area as a whole. In the next study season, using the full two-year data set, densities and estimated numbers of breeding birds will be calculated for the various project components, including the three alternative Susitna-Watana Transmission Line/Access corridors. Those data will then be used, in the License Application, to determine the estimated numbers of breeding landbirds that would be affected by development of the proposed Project.

To place the results of this study in the context of other studies of breeding landbirds in Alaska, the species and levels of abundance (uncorrected for detectability) recorded in this study in 2013 were compared with results from eight other relatively recent point-count studies conducted in Interior Alaska (Table 6.1-1). The eight studies evaluated were conducted in Gates of the Arctic National Park and Preserve (DiFolco 1996). Fort Wainwright (Benson 1999), Yukon-Charley National Preserve (Swanson and Nigro 2003), State of Alaska forest lands near Fairbanks and Tok (Hannah et al. 2003; Benson 2004), Denali National Park and Preserve (McIntyre 2005), Bureau of Land Management lands in the Black River and White Mountains areas (Sharbaugh et al. 2009; and Shaw and Schmidt 2011). Although geography and habitats varied greatly among these studies and the Project area, the comparisons are useful for assessing general similarities and differences in species richness and abundance among the studies.

In general, the species and abundance levels recorded in the Project study area were comparable to those other point-count studies in Interior Alaska; however, several notable differences were found. Three species (Hammond's Flycatcher, Say's Phoebe, and Western Wood-Pewee) that were detected in several of the other studies were notably absent in the point-count surveys for this study. Hammond's Flycatcher, which was recorded in six of the eight other studies from Interior Alaska, does not occur on a regular basis south of the Alaska Range and it is likely that the Project study area is located just south of the species' normal range. Say's Phoebe was recorded in four of the eight other studies. Say's Phoebes breed in rocky areas at high elevations and, though they are uncommon, were expected to occur in the Project study area. The lack of observations of this species in 2013 is curious, although suitable nesting habitats may have been under-sampled (7 and 39 point-count plots were conducted in Barrens and Partially Vegetated habitats, respectively); additional sampling in the next study season may produce detections of this species. Western Wood-Pewee was recorded in three of the eight other point-count studies. This species is generally uncommon in Interior Alaska and was recorded in relatively low densities in the other studies. Although it was not in the study area, one Western Wood-Pewee was observed by researchers near the Stephan Lake Lodge, which is located at a lower elevation than the majority of the point-count plots surveyed. Hence, although Western Wood-Pewees were not detected during the point-count surveys, they are known to occur near the study area.

Three species (Cliff Swallow, American Dipper, and Snow Bunting) were detected in the Project study area, but not in any of the other eight studies. As discussed above in Section 5.1, Point-count Surveys, Cliff Swallows were found breeding in the study area, although they appeared to be uncommon. The addition of point-count plots in riverine areas in this study increased the potential to detect American Dipper, which appeared to be uncommon in the study area. Snow Buntings were uncommon in the study area and were found almost exclusively in barrens or partially vegetated habitats above tree line.

The abundance of several species recorded in the other eight studies was notably different than in this study. Five species were substantially more abundant in the Project study area than in the eight other studies. Willow Ptarmigan were over eight times more abundant (average occurrence of 0.082 in this study vs. mean average occurrence of 0.010 for the other studies); Northern Waterthrushes were three times more abundant (average occurrence = 0.274 vs. 0.082); Ruby-crowned Kinglets and Varied Thrushes were more than twice as abundant (average occurrence = 0.478 vs. 0.216, and 0.587 vs. 0.203, respectively); and Wilson's Warblers were almost twice as abundant (average occurrence = 0.444 vs. 0.262).

Three species were substantially less abundant in the Project study area than in the eight other studies. Hairy Woodpeckers were more than an order of magnitude less abundant (average occurrence of <0.001 in this study vs. mean average occurrence of 0.012 for the eight other studies); Orange-crowned Warblers were an order of magnitude less abundant (average occurrence = 0.067 vs. 0.327); and Swainson's Thrushes were less than half as abundant (average occurrence = 0.299 vs.0.771). The differences in landbird abundance between the Project study and the eight other studies examined may be due to differences in the habitats sampled (e.g., differences in sampling effort in mixed vs. needleleaf forests and/or elevational differences in study areas). These differences will be evaluated further in the USR after the next year of data collection.

This study represents one of the most extensive point-count surveys yet conducted in Interior Alaska, in terms of both the large area surveyed and the intensity of sampling. This study will benefit, however, from access to those portions of the study area in the Gold Creek Corridor where lower-elevation vegetation types (e.g., various types of mixed and broadleaf-dominated forests) are located primarily on CIRWG lands. Currently, these habitat types are noticeably under-sampled relative to the needleleaf forests that dominate much of the rest of the study area (Table 5.1-1). Increased sampling of these vegetation types and others that are currently under-sampled will increase the number of detections for less common species and will improve the estimates of density and breeding population numbers for more landbird species. Assuming access to the full study area described in the RSP (Section 10.16.3) is authorized for the next study year, the combination of two seasons of point-count data on landbird abundance and habitat use will be sufficient to meet the study objectives.

6.1.2. Shorebirds

During the point-count surveys in 2013, shorebirds accounted for only 5.2 percent of all observations recorded. This low frequency is not surprising, however, given that most breeding shorebirds depend on open habitats for nesting and brood-rearing, whereas the study area is strongly dominated by forests. Wilson's Snipe was the most common shorebird observed, including many observations of birds involved in aerial flight displays (winnowing) that occurred above a diversity of different habitat types. Spotted Sandpipers were uncommon overall but were regularly recorded along streams during the riverine-focused point-count surveys. American Golden-Plovers also were uncommon and were found most often in open, higher elevation montane habitats. Other boreal forest-breeding shorebirds (e.g., Solitary Sandpiper, Least Sandpiper, Lesser Yellowlegs) were detected infrequently during the point-count surveys, likely due to the relatively low breeding densities of these species (Cooper 1994; Moskoff 1995; Tibbitts and Moskoff 1999) and the relatively small amount of suitable habitat available for these species in the study area, rather than to low detectability.

As noted above in Section 5.1.2.3, Shorebird Densities, too few shorebirds of any species were detected during the point-count surveys in 2013 to allow calculation of density estimates. With additional field data collection in the next study season, it may be possible to calculate breeding densities for some of the more common shorebird species.

Shorebirds were recorded infrequently in the eight other point-count studies in Interior Alaska that were assessed for species richness and abundance levels to compare with the data collected in this study; thus, few comparisons can be made (Table 6.1-1). One species (Upland Sandpiper) has been recorded in Denali National Park and Preserve, but was not detected in the Project study area in 2013. This little-studied species has a restricted and patchy breeding range in the Alaska Range (Kessel and Gibson 1978). Similarly, the Surfbird has been recorded in the White Mountains north of Fairbanks but not in this study, although suitable habitat is available at higher elevations in the Project study area.

In terms of abundance, Wilson's Snipe was recorded three times more commonly in the Project study area (average occurrence = 0.340) than in the other eight studies (mean average occurrence = 0.111) conducted in Interior Alaska. The average occurrence value for Wilson's Snipe in the Project study area was similar to that reported for Fort Wainwright (0.323) by Benson (1999).

American Golden-Plover also was recorded three times more commonly in the Project study area (average occurrence = 0.048) vs. the mean average occurrence of 0.014 for eight other studies.

For shorebirds in particular, the riverine- and lacustrine-focused surveys provided useful complementary data to those obtained during the point-count surveys. Increased information on shorebird occurrence and abundance will be derived in the next study season once access can be achieved in the Gold Creek Corridor and sampling can be conducted there in lower elevation habitats that are primarily located on CIRWG lands. In particular, it will be beneficial to sample open wetland habitat types (e.g., Open Dwarf Forest and Wet Graminoid Meadow) at lower elevations. Those types are known to be used by breeding shorebirds but were under-sampled in 2013 due to access restrictions on CIRWG lands. Assuming full access to the study area described in the RSP (Section 10.16.3) is authorized, the combination of two seasons of data on shorebird abundance and habitat use will be sufficient to meet the study objectives.

6.2. Riverine-and Lacustrine-focused Surveys

The riverine- and lacustrine-focused surveys proved to be effective methods to record the occurrence of some landbird and shorebird species that are not commonly recorded in standard point-count surveys. The riverine-focused transect surveys in particular allowed for the detection of several species that occur in riverine environments where audible detection using point counts can be difficult. The data from the lacustrine-focused surveys provided information on the use of lacustrine water bodies by landbirds and shorebirds, and also provided additional information on the use of smaller lakes and ponds by waterbirds, to complement the data collected during the aerial waterbird surveys (see ISR Study 10.15).

Using the riverine- and lacustrine-focused surveys, researchers were able to increase the total number of observations of several uncommon habitat specialists, such as Spotted Sandpipers, American Dippers, and Rusty Blackbirds. Spotted Sandpipers were found to be fairly common in riverine habitats throughout the study area. American Dippers were rarely observed during point-counts in riverine habitats, but the additional riverine-transect surveys allowed researchers to record additional occurrences of this species. During the lacustrine-focused surveys, researchers were able to document Rusty Blackbirds using open needleleaf forests and adjacent lacustrine habitats. Continuation of the riverine- and lacustrine-focused surveys in the next study season will be valuable for increasing the information on the occurrence of these and other species that are often under-recorded during standard point-count surveys.

In general, the number of avian observations recorded during the riverine-focused surveys was relatively few along the clear-water tributary streams when compared to the Susitna River, indicating that many birds are more attracted to the shoreline habitat of the Susitna River than riverine habitats along the tributary streams. In particular, the abundance of waterbirds and shorebirds (strongly dominated by Spotted Sandpipers) was notably higher on those riverine surveys along the Susitna River (Appendix F). In contrast, some species (e.g., Belted Kingfisher and American Dippers, see below) were never observed along the Susitna River, likely because the turbid waters would severely hinder visual foraging activities in the water column. During the riverine-focused surveys, many waterbirds were observed flying low over stream courses, indicating that the streams act as corridors for travel during the breeding season.

Belted Kingfishers were not observed and American Dippers were observed rarely on the ground-based riverine-focused surveys. These two species, however, were observed regularly in small numbers on some of the clear-water tributaries of the Susitna River during the aerial (helicopter-based) surveys for migrating waterbirds and breeding Harlequin Ducks (see ISR Study 10.15). An important difference between the two survey efforts is that, during the aerial surveys, each stream was sampled continuously from its mouth upstream until the habitat was no longer suitable for Harlequin Ducks, whereas during the ground-based surveys observers sampled only portions of each stream corridor. During the aerial waterbird surveys, Belted Kingfishers were observed on Wells, Tsusena, Watana, Deadman, and Seattle creeks, and on the Black, Oshetna, and Indian rivers. The greatest number of individuals detected during a single survey effort was five during the mid-August surveys (August14–18, 2013). Single individuals were observed on Indian River and Seattle and Tsusena creeks, and two individuals were seen on Deadman Creek. American Dippers were seen regularly during the aerial surveys of waterbirds, with a peak number of 11 individuals recorded during the survey on May 23–24, 2013. American Dippers were observed on nine tributary streams in the Project area: Indian River and Portage, Fog, Devil, Tsusena, Kosina, Goose, Cheechako, and Gilbert creeks.

6.3. Survey of Colonially Nesting Swallows

The results of the swallow surveys in 2013 indicated a minimum of 361 nesting pairs of Bank Swallows in the survey area during the 2013 nesting season; 319 (88%) of those nesting pairs were located below the elevation of the maximum pool for the proposed Watana Reservoir (2,050 ft). Although the proportion of active burrows in the colonies surveyed was highly variable, applying the overall observed proportion of active burrows (0.47) from the monitored colonies to the unmonitored colonies (n = 163 burrows) produced an estimate of another 77 nesting pairs of Bank Swallows in the study area (including 34 located below the reservoir maximum pool elevation). Although Violet-green Swallows were observed at two of the nesting colonies, no Violet-green Swallows were recorded during the monitoring of burrows for nesting activity.

The burrow entry-rate results reported here are the maximum activity counts recorded during either the first or second visits. Activity counts can vary greatly within a short period of time depending on the nesting stage of each individual breeding pair, prey availability, hatching success or failure, and nest depredation. For instance, burrow entry rates for most colonies were substantially lower during the first visit (July1–3) because most pairs were incubating, whereas during the second visit (July 14–15) most pairs were feeding young. Additionally, although 18 of 23 burrows at colony S8 were active during the first visit, none were active during the second visit, evidently due to predation by a bear (see Appendix G). Some of the colonies monitored in this study were in unusual and potentially vulnerable locations (only 6 to 10 feet above ground level); reproductive success in swallows is greater for higher and deeper burrows (Hoogland and Sherman 1976; Cramp et al. 1988; Sieber 1980).

The vast majority of individuals observed at the nesting colonies were Bank Swallows. All three colonially nesting species (Bank Swallow, Violet-green Swallow, and Cliff Swallow) were relatively uncommon during the point-count surveys but Bank Swallows were recorded most often (Table 5.1-2). Cliff Swallow abundance was likely underestimated due to their inaccessible nesting locations. Cliff Swallows nest most commonly on human structures, but are also known

to nest deep in caves or vertical chimneys where their nest structures are out of sight. Nesting Cliff Swallows have been observed on human-built structures at Clarence, Deadman, and Big lakes and under bridges along the Denali Highway (N. Schwab and B. Lawhead, ABR, Inc., personal communication, August 16, 2013). It is likely that Cliff Swallows breed in the survey area for colonially nesting swallows, but suitable nesting habitat for Cliff Swallows appears to be fairly uncommon there.

Colonially nesting swallow habitat in the study area is limited to steep slopes and cut banks along the Susitna River and the lower stretches of its major tributaries. The majority of the colonies were located in firmer soils higher up on heavily eroded slopes. Many of these features are highly unstable and actively eroding. Several other colonies were located in the loose, sandy substrates of riverine cut banks that were freshly formed from ice scour during spring break-up in early June. The location of colonies in such unstable habitats suggests that substantial annual turnover in colony habitation may occur (Garrison 1999). For this reason, some authors have suggested that Bank Swallows exhibit low levels of site fidelity (Freer 1979; Hjertaas 1984; Jones 1987). Due to their proximity to the Susitna River, at least seven colonies (S2, S8, S9, S10, S15, S16, and S17) are susceptible to potential damage or destruction in future years as a result of ice scour, flooding, and erosion.

The average burrow entry rate of 2.5 entries per 10 minutes was less than the 3.7 to 4.7 entries per 10 minutes that Hickman (1979) observed at other colonies in Interior Alaska. This difference could indicate that the observations in the Project study area were not made during the peak feeding period, that food availability was lower at the colonies monitored, or that fewer feeding events were needed to support a smaller number of young per nest. The average count of 2.1 young per nest (recorded at colony S10) was low in comparison to the average clutch size of 4.1 ± 0.8 eggs reported for other Bank Swallow colonies in Interior Alaska (Hickman 1979). The lower nestling numbers could indicate low hatching success or low nestling survivorship.

Avian surveys for the APA Project in the early 1980s (Kessel et al.1982) did not include surveys of colonially nesting swallows, so a direct comparison of the results of this study and that one is not possible. Kessel et al. (1982) reported Bank Swallows to be uncommon, which is consistent with the point-count surveys in this study (Table 5.1-2). However, in the swallow nesting surveys in 2013, Bank Swallows appeared to be relatively common in suitable habitat. Violet-green Swallows appeared to be more abundant in the study area in 2013 than in the early 1980s. Cliff Swallows were considered uncommon in the early 1980s and nesting colonies were observed opportunistically in some of the same locations as in 2013 (Kessel et al. 1982). Overall, all three species of colonially nesting swallows were relatively uncommon at the scale of the full landbird and shorebird study area (Appendix A).

Colonially nesting swallow surveys in the next study season will provide another year of data to improve the abundance estimates reported in this ISR. As with other landbird species, swallow abundance is likely to fluctuate substantially between years as a result of variability in reproductive success and survivorship. For this reason, a second year of surveys will be helpful in understanding the abundance of breeding swallows in the study area. Additional surveys also will result in a better understanding of swallow nesting activity, habitat use, and colony location changes throughout the study area. The 2013 results in combination with another study year will provide sufficient data to meet the study objectives.

7. COMPLETING THE STUDY

[Section 7 appears in the Part C section of this ISR.]

8. LITERATURE CITED

AEA (Alaska Energy Authority). 2011. Pre-Application Document: Susitna–Watana Hydroelectric Project FERC Project No. 14241. December 2011. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, AK.

AEA. 2012. Revised Study Plan: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2012. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska. Available on-line at http://www.susitna-watanahydro.org/study-plan.Accessed October 2013.

ALMS (Alaska Landbird Monitoring Survey). 2010. Boreal Partners in Flight: Alaska Landbird Monitoring Survey. Available on-line at http://alaska.usgs.gov/science/biology/bpif/monitor/alms.php#information.Accessed October 2013.

Andres, B. A., D. L. Brann, and B. T. Browne. 1999. Legacy Resource Management Program: Inventory of breeding birds on local training areas of the Alaska Army National Guard. Final report prepared for Alaska Army National Guard, Fort Richardson, Alaska, by U.S. Fish and Wildlife Service, Anchorage, Alaska.

AOU (American Ornithologists' Union). 1998. *Check-list of North American birds*. 7th ed. American Ornithologists' Union, Washington, DC.

AOU. 2012. 53rd Supplement to the AOU Check-list of North American Birds. *Auk*: 573–588.

ASG (Alaska Shorebird Group). 2008. Alaska Shorebird Conservation Plan. Version II. Alaska Shorebird Group, Anchorage, Alaska.

Benson, A. M. 1999. Distribution of Landbirds among Habitats on the Yukon Maneuver Area Fort Wainwright, Alaska. Report prepared for the United States Fish and Wildlife Service, Region 7 by the Alaska Bird Observatory.

Benson, A. M. 2004. Habitat Selection and Densities of Passerines Breeding in Interior Alaska. Final Report prepared for the United States Fish and Wildlife Service, Northern Alaska Ecological Services by the Alaska Bird Observatory, Fairbanks, AK.

Boisvert, J. H., and C. T. Schick. 2007. Breeding Bird Surveys, Stewart River Training Area, Alaska, 2006. Final report prepared for Alaska Army National Guard, Fort Richardson, AK, by ABR, Inc.—Environmental Research & Services, Anchorage, AK.

Brown, C. R., A. M. Knott, and E. J. Damrose. 1992. Violet-green Swallow (*Tachycineta thalassina*). *In* A. F. Poole, P. Stettenheim, and F. B. Gill (eds.), *The birds of North America*, No. 14. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Brown, C. R., and M. B. Brown. 2002. Cliff Swallow (*Petrochelidon pyrrhonota*). *In* A. F. Poole, P. Stettenheim, and F. B. Gill (eds.), *The birds of North America*, No. 149. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Buckland, S. T., D. R. Anderson, K. T. Burnham, J. L. Laake, D. L. Borchers, and J. Thomas. 2001. *Introduction to distance sampling: Estimating abundance of biological populations*. Oxford University Press, Oxford, United Kingdom.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2004. *Advanced distance sampling: Estimating abundance of biological populations*. Oxford University Press, Oxford, United Kingdom.

Cooper, J. M. 1994. Least Sandpiper (*Calidris minutilla*). *In* A. Poole and F. Gill, (eds.), *The birds of North America*, No. 115. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Cramp, S., D. J. Brooks, E. Dunn, R. Gillmor, J. Hall-Craggs et al. 1988. *The birds of the Western Palearctic. Vol. 5: tyrant flycatchers to thrushes*. Oxford University Press, Oxford, United Kingdom.

DiFolco, D. L. 1996. 1996 Neotropical Migratory Bird Surveys, Gates of the Arctic National Park and Preserve. National Park Service, Report GAAR 96-01. Fairbanks, Alaska.

Farnsworth, G. L., K. H. Pollock, J. D. Nichols, T. R. Simons, J. E. Hines, and J. R. Sauer. 2002. A removal model for estimating detection probabilities from point-count surveys. *Auk* 119: 414–425.

Freer, V. M. 1979. Factors affecting site tenacity in New York Bank Swallows. *Bird-Banding 50*: 349-357.

Garrison, B. A. 1999. Bank Swallow (*Riparia riparia*). *In* A. F. Poole and F. B. Gill (eds.), *The Birds of North America*, No. 414. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Handel, C. M., and M. N. Cady. 2004. Alaska Landbird Monitoring Survey: protocol for setting up and conducting point count surveys. U.S. Geological Survey, Alaska Science Center, Anchorage. Available on-line athttp://alaska.usgs.gov/science/biology/bpif/monitor/alms/ALMSprotocol_2004.pdf.Accessed October 2013.

Hannah, K. C., A. R. Ajmi and T. R. Walker. 2003. Distribution and Abundance of Landbirds in the Tanana Valley State Forest 2002-2003. Alaska Bird Observatory Report.

Hickman, G. R. 1979. Nesting ecology of Bank Swallows in interior Alaska. Master's thesis, University of Alaska, Fairbanks.

Hjertaas, D. G. 1984. Colony site selection in Bank Swallows. Master's thesis, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

Hoogland, J. L., and P. W. Sherman. 1976. Advantages and disadvantages of Bank Swallow (*Riparia riparia*) coloniality. *Ecological Monographs* 46: 33–58.

Jones, G. 1987. Colonization patterns in Sand Martins *Riparia riparia*. *Bird Study* 34: 20–25.

Kessel, B. K. and D.D. Gibson 1978. Status and distribution of Alaska birds. *Studies in Avian Biology*. 1:1–100.

Kessel, B., S. O. MacDonald, D. D. Gibson, B. A. Cooper, and B. A. Anderson. 1982. Susitna Hydroelectric Project environmental studies, Phase I final report—Subtask 7.11: Birds and non-game mammals. Report prepared by University of Alaska Museum, Fairbanks, and Terrestrial Environmental Specialists, Inc., Phoenix, New York, for Alaska Power Authority, Anchorage, Alaska. 149 pp.

Knox, A. G., and P E. Lowther. 2000a. Common Redpoll (*Acanthis flammea*). *In* A. Poole and F Gill, (eds.), *The birds of North America,* No. 543. The Birds of North America, Inc. Philadelphia, Pennsylvania.

Knox, A. G., and P. E. Lowther. 2000b. Hoary Redpoll (*Acanthis hornemanni)*. *In* A. Poole and F Gill, (eds.), *The birds of North America,* No. 544. The Birds of North America, Inc. Philadelphia, Pennsylvania.

Kreig and Associates. 1987. Susitna Hydroelectric Project, vegetation mapping final report and user guide. Report prepared by Ray A. Kreig and Associates, Inc., Anchorage, for Harza–Ebasco Susitna Joint Venture, Anchorage. [APA Doc. No. 3509].

McIntyre, C. 2005. Monitoring Trends of Passerine Birds in Denali National Park and Preserve, Alaska: 2005 Progress Report. Report to the Central Alaska Network, Vital Signs Monitoring Program.

Miller, D. L. 2012. Distance: a simple way to fit detection functions to distance sampling data and calculate abundance/density for biological populations. R package version 0.7.1. Available on-line at http://CRAN.R-project.org/package=Distance.Accessed October 2013.

Moskoff, W. 1995. Solitary Sandpiper (*Tringa solitaria*). *In* A. Poole and F. Gill, (eds.), The birds of North America, No. 156. The Birds of North America Inc., Philadelphia, Pennsylvania

Morrison, M. L., W. M Block, M. D. Strickland, B. A. Collier, and M. J. Peterson. 2008. *Wildlife study design*, 2nd ed. Chapter 3, *Experimental designs*, pp. 77–135. Springer Science and Business Media, New York.

Ralph, C. J., S. Droege, and J. R. Sauer. 1995. Managing and monitoring birds using point-counts: standards and applications. *In* C. J. Ralph, S. Droege, and J. R. Sauer (eds.), *Monitoring bird populations by point-counts*, pp. 161–168. U.S. Department of Agriculture, Forest Service General Technical Report PSW-GTR-149.

Rosenstock, S. S., D. R. Anderson, K. M. Giesen, T. Leukering, and M. F. Carter. 2002. Landbird counting techniques: current practices and an alternative. *Auk* 119: 246–253.

Sharbaugh, S., J. Schmidt, C. A. Abercrombie, J. P. Houghton. 2009. Landbird Surveys in the Black River Region of the Bureau of Land Management Eastern Interior Field Office, Alaska. Final Report to the Bureau of Land Management, Fairbanks Field Office by Hart Crowser, Inc.

Shaw, D., and J. H. Schmidt. 2011. The Breeding Landbird Communities of the Mount Prindle and Pinnell Mountain Trail Area in Alaska during 2010 and 2011: An Assessment Based on Repeated Counts and Hierarchical Occupancy Modeling. Report prepared for the Bureau of Land Management, Fairbanks Field Office, by the Alaska Bird Observatory, Fairbanks, Alaska.

Sieber, O. 1980. Causal and functional aspects of brood distribution in Sand Martins (*Riparia riparia*). *Journal of Comparative Ethology* 52: 19–56.

Swanson, S. A., and D. A. Nigro. 2003. A Breeding Landbird Inventory of Yukon-Charley Rivers National Preserve, Alaska, June 1999 and 2000. Yukon-Charley Rivers National Preserve Alaska Report YUCH-03-001.

Tibbitts, T. L. and W. Moskoff. 1999. Lesser Yellowlegs (*Tringa flavipes*). *In* A. Poole and F. Gill, (eds.), *The birds of North America*, No. 427. The Birds of North America Inc., Philadelphia, Pennsylvania.

Viereck, L. A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska Vegetation Classification. General Technical Report PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

9. TABLES

Table 4.1-1. Vegetation Types Mapped in the 1980s (Kreig and Associates 1987), Classified as Rare or Common for Allocation of Landbird/Shorebird Point-count Plots in 2013.

Vegetation Type	Percent of Mapped Area
Rare Vegetation Types[1]	<4% of Mapped Area
Dry Forb Meadow	<0.01
Dry Graminoid Meadow	0.01
Moist Graminoid Meadow	0.16
Broadleaf Woodland	0.17
Moist Dwarf Shrub (ericaceous)	0.24
Dwarf Forest Woodland	0.50
Open Broadleaf Forest	0.62
Closed Dwarf Forest	0.63
Mixed Woodland	0.96
Closed Broadleaf Forest	1.02
Wet Graminoid Meadow	1.09
Barrens	1.91
Unknown	2.04
Open Dwarf Forest	2.07
Water	2.45
Closed Needleleaf Forest	2.57
Open Tall Shrub	3.03
Closed Tall Shrub	3.72
Common Vegetation Types[1]	>4% of Mapped Area
Needleleaf Woodland	5.33
Open Mixed Forest	6.24
Closed Mixed Forest	6.89
Dry Dwarf Shrub	9.28
Open Needleleaf Forest	12.29
Closed Low Shrub	12.54
Open Low Shrub	24.26

Notes:

1. Vegetation types were considered common if they accounted for 4% or more of the mapped area, and they were considered rare if they accounted for less than 4% of the mapped area.

Table 5.1-1. Habitats Surveyed and the Number of Landbird/Shorebird Point-counts Conducted in Each Focal Habitat Type, 2013.

Focal Habitat Type[1]	Number of Point-Count Plots
Barrens	7
Partially Vegetated	39
Closed Broadleaf Forest	2
Open Broadleaf Forest	13
Broadleaf Woodland	3
Closed Mixed Forest	14
Open Mixed Forest	103
Mixed Woodland	14
Closed Needleleaf Forest	12
Open Needleleaf Forest	349
Needleleaf Woodland	195
Dry Graminoid Meadow	4
Moist Graminoid Meadow	42
Wet Graminoid Meadow	20
Riverine Waters (including shorelines)	52
Dry Dwarf Shrub	8
Shrub Dwarf Ericaceous	103
Wet Dwarf Shrub	7
Open Dwarf Forest	13
Dwarf Forest Woodland	14
Closed Low Shrub	92
Open Low Shrub	169
Closed Tall Shrub	45
Open Tall Shrub	44
Total	1,364

Notes:

1. Level-III vegetation types of the Alaska Vegetation Classification (Viereck et al. 1992), with the addition of barren and partially vegetated habitats and riverine waters; the primary habitat surrounding each point-count plot was considered the focal habitat (see text).

Table 5.1-2. Abundance and Average Occurrence of Landbird Species Observed During Point-count Surveys, 2013.

Species	Total Number Detected	% of Landbird Observations	Average Occurrence[1]
Fox Sparrow	1,590	12.3	1.166
White-crowned Sparrow	1,261	9.7	0.925
Common Redpoll	1,169	8.8	0.857
Yellow-rumped Warbler	837	6.5	0.614
Varied Thrush	801	6.2	0.587
Savannah Sparrow	675	5.2	0.495
Ruby-crowned Kinglet	652	5.0	0.478
American Tree Sparrow	649	5.0	0.476
Dark-eyed Junco	624	4.8	0.458
Wilson's Warbler	606	4.7	0.444
Blackpoll Warbler	522	4.0	0.383
Gray-cheeked Thrush	517	4.0	0.379
Swainson's Thrush	408	3.1	0.299
American Robin	390	3.0	0.286
Northern Waterthrush	374	2.9	0.274
Hermit Thrush	229	1.8	0.168
Gray Jay	168	1.3	0.123
American Pipit	160	1.2	0.117
Golden-crowned Sparrow	155	1.2	0.114
Willow Ptarmigan	112	0.9	0.082
Horned Lark	111	0.9	0.081
Arctic Warbler	104	0.8	0.076
Orange-crowned Warbler	91	0.7	0.067
Boreal Chickadee	88	0.7	0.065
White-winged Crossbill	81	0.6	0.059
Lincoln's Sparrow	77	0.6	0.057
Olive-sided Flycatcher	75	0.6	0.055
Bohemian Waxwing	74	0.6	0.054
Rock Ptarmigan	51	0.4	0.037
Snow Bunting	43	0.3	0.032
Common Raven	39	0.3	0.029
Lapland Longspur	35	0.3	0.026
Alder Flycatcher	30	0.2	0.022
Rusty Blackbird	23	0.2	0.017
Northern Flicker	22	0.2	0.016
Black-capped Chickadee	18	0.1	0.013
Pine Siskin	14	0.1	0.010
Bank Swallow	11	0.1	0.008
Northern Wheatear	10	0.1	0.007
Cliff Swallow	8	0.1	0.006

Species	Total Number Detected	% of Landbird Observations	Average Occurrence[1]
Violet-green Swallow	8	0.1	0.006
Black-billed Magpie	6	0.05	0.004
Tree Swallow	6	0.05	0.004
Spruce Grouse	5	0.04	0.004
Yellow Warbler	5	0.04	0.004
American Three-toed Woodpecker	4	0.00	0.003
Downy Woodpecker	3	0.03	0.002
Townsend's Warbler	3	0.02	0.002
American Dipper	2	0.02	0.002
Pine Grosbeak	2	0.02	0.002
Gray-crowned Rosy-Finch	1	0.01	<0.001
Hairy Woodpecker	1	0.01	<0.001
Ruffed Grouse	1	0.01	<0.001
Total	12,951	100	9.495

Notes:

1. Average occurrence = total number of birds detected/total number of point counts conducted for the full study area.

Table 5.1-3. DISTANCE Detection Groups, Model Covariates, Estimated Densities, Akaike Information Criterion (AIC) Scores, and Associated Results from Detection-function Modeling of Point-count Survey Data, 2013.

Detection Group	Model[1]	Density: Birds/km^2 (95% Confidence Limits)	AIC[1]	ΔAIC	Model Weight	Chi[2]	Chi P[2]
All Individuals							
Grouse	Habitat Type	2.7 (2.0–3.6)	324.75	0	0.26	0.88	0.83
	No covariates	2.7 (2.0–3.5)	325.63	0.88	0.17	0.66	0.72
	Habitat Type + Observer	4.1 (0.0–532.7)	325.8	1.04	0.15	42.99	0.01
	Observer	3.4 (0.0–54,754.2)	325.83	1.08	0.15	17.85	0.40
	Habitat Type + Noise	2.7 (2.0–3.6)	326.75	2.00	0.09	1.74	0.99
Chickadees	Habitat Type + Observer	22.3 (0.0–85,269.6)	185.07	0	0.58	94.34	0.08
	Habitat Type + Observer + Noise	23.5 (0.0–96,017.8)	186.83	1.76	0.24	183.65	0
Corvids	Habitat Type	6.2 (0.0–1,396.4)	358.39	0	0.50	4.94	0.96
	Habitat Type + Noise	6.2 (0.0–1,374.0)	360.24	1.85	0.20	12.17	0.99
	No covariates	4.9 (3.8–6.2)	360.34	1.95	0.19	2.29	0.51
Thrushes	Habitat Type + Observer	53.7 (13.8–209.9)	4,338.64	0	1.00	140.72	0.02
	Habitat Type + Observer + Noise	53.6 (18.1–158.9)	4,339.65	1.01	0.60	206.06	0.51
Sparrows	Habitat Type + Observer + Noise	160.5 (153.0–168.3)	49,790.85	0	0.81	739.66	1.00
Males Only[3]							
Warblers	Habitat Type + Observer + Noise	129.2 (121.0–137.9)	26,659.01	0	0.80	354.97	1.00
Flycatchers	No covariates	1.4 (1.0–2.0)	296.62	0	0.29	212.14	0.94
	Observer	1.9 (0.0–229.0)	296.64	0.01	0.28	0.29	0.87
	Habitat Type + Observer	1.9 (0.0–218.9)	298.43	1.81	0.12	10.79	0.70
	Habitat Type	1.4 (1.0–2.0)	298.46	1.83	0.11	10.79	0.97
	Observer + Noise	1.9 (0.0–233.4)	298.54	1.92	0.11	0.52	0.97

Notes:

1. All models within two integer AIC values of the lowest AIC value are presented.
2. Pearson's chi-squared value and chi-squared probability.
3. Models for warblers and flycatchers were based on observations of males only.

Table 5.1-4. Estimated Density and Estimated Total Breeding Birds in the Landbird and Shorebird Study Area, Based on Point-count Survey Data, 2013.

Common Name	n	Average Flock Size	Density: Birds/km^2 (95% Confidence Limits)	Total Estimated Birds (95% Confidence Limits)[1]
Ruffed Grouse	1	1.00	0.01 (0–0.06)	17 (3–89)
Spruce Grouse	4	1.00	0.06 (0.02–0.16)	89 (34–232)
Willow Ptarmigan	84	1.01	1.83 (1.34–2.51)	2,692 (1,963–3,691)
Rock Ptarmigan	41	1.00	0.72 (0.49–1.07)	1,057 (713–1,569)
Unidentified ptarmigan	2	1.00	0.04 (0.01–0.14)	56 (16–199)
Olive-sided Flycatcher[2]	100	1.01	1.13 (0.81–1.59)	1,667 (1,189–2,337)
Alder Flycatcher[2]	18	1.00	0.30 (0.16–0.57)	438 (230–837)
Gray Jay	148	1.18	4.56 (3.56–5.84)	6,700 (5,229–8,584)
Black-billed Magpie	1	1.00	0.03 (0.01–0.14)	40 (8–207)
Common Raven	9	1.00	0.28 (0.14–0.54)	405 (206–795)
Horned Lark	96	1.02	3.69 (2.83–4.81)	5,420 (4,155–7,071)
Tree Swallow	4	1.00	0.11 (0.04–0.33)	162 (54–491)
Ruby-crowned Kinglet	587	1.00	25.08 (22.87–27.51)	36,850 (33,602–40,413)
Arctic Warbler	88	1.01	5.15 (3.86–6.87)	7,571 (5,677–10,096)
Northern Wheatear	8	1.15	0.24 (0.11–0.52)	352 (163–757)
Gray-cheeked Thrush	451	1.01	12.02 (10.56–13.69)	17,664 (15,514–20,111)
Swainson's Thrush	354	1.01	10.25 (8.73–12.04)	15,059 (12,821–17,688)
Hermit Thrush	177	1.01	4.46 (0.21–95.69)	6,549 (305–140,584)
Unidentified (*Catharus*) thrush	9	1.11	0.11 (0.05–0.23)	155 (71–340)
American Robin	357	1.01	7.48 (0.29–195.86)	10,982 (419–287,744)
Varied Thrush	710	1.01	16.19 (14.37–18.25)	23,792 (21,111–26,813)
Unidentified thrush	2	1.00	0.04 (0.01–0.14)	58 (17–203)
American Pipit	115	1.03	2.89 (2.25–3.72)	4,250 (3,306–5,464)
Lapland Longspur	32	1.00	1.46 (0.85–2.50)	2,145 (1,252–3,674)
Snow Bunting	36	1.02	1.53 (0.98–2.40)	2,248 (1,435–3,522)
Northern Waterthrush[2]	318	1.00	17.29 (15.17–19.71)	25,405 (22,286–28,961)
Orange-crowned Warbler[2]	68	1.00	3.45 (2.57–4.65)	5,074 (3,771–6,827)
Yellow Warbler[2]	7	1.39	0.34 (0.14–0.84)	497 (199–1,241)
Blackpoll Warbler[2]	420	1.00	20.88 (18.73–23.28)	30,674 (27,511–34,200)
Yellow-rumped Warbler[2]	669	1.00	31.94 (29.02–35.16)	46,928 (42,629–51,661)
Townsend's Warbler[2]	1	1.00	0.04 (0.01–0.20)	58 (11–300)
Wilson's Warbler[2]	500	1.00	24.88 (22.47–27.56)	36,556 (33,010–40,483)
Unidentified warbler[2]	4	1.00	0.14 (0.05–0.35)	203 (80–514)
American Tree Sparrow	543	1.01	22.21 (19.64–25.11)	32,625 (28,852–36,892)
Savannah Sparrow	617	1.04	23.10 (20.76–25.69)	33,929 (30,498–37,747)
Fox Sparrow	1,425	1.00	41.20 (38.65–43.92)	60,528 (56,786–64,516)
Lincoln's Sparrow	75	1.00	1.99 (1.50–2.65)	2,928 (2,202–3,893)
White-crowned Sparrow	1,123	1.02	34.46 (31.96–37.15)	50,626 (46,956–54,582)
Golden-crowned Sparrow	118	1.02	4.29 (3.36–5.47)	6,295 (4,930–8,038)
Unidentified sparrow	37	1.30	1.05 (0.68–1.63)	1,547 (999–2,395)

Common Name	n	Average Flock Size	Density: Birds/km^2 (95% Confidence Limits)	Total Estimated Birds (95% Confidence Limits)[1]
Dark-eyed Junco	549	1.06	16.84 (15.14–18.74)	24,743 (22,243–27,525)
Rusty Blackbird	16	1.31	0.28 (0.15–0.51)	414 (227–753)
Common Redpoll	34	1.16	1.19 (0.75–1.87)	1,742 (1,105–2,747)

Notes:

1. Estimated number of breeding birds in the 2-mi buffer study area used for the point-count surveys.
2. Results shown for these species are based on male-only detection-function models (see text).

Table 5.1-5. Abundance and Average Occurrence of Shorebird Species Observed During Point-count Surveys, 2013.

Species	Total Detected	% of Shorebird Observations	Average Occurrence[1]
Wilson's Snipe	464	61.2	0.340
American Golden-Plover	66	8.7	0.048
Lesser Yellowlegs	64	8.4	0.047
Spotted Sandpiper	59	7.8	0.043
Least Sandpiper	39	5.1	0.029
Red-necked Phalarope	19	2.5	0.014
Semipalmated Plover	18	2.4	0.013
Solitary Sandpiper	15	2.0	0.011
Wandering Tattler	7	0.9	0.005
Whimbrel	5	0.7	0.004
Greater Yellowlegs	2	0.3	0.001
Total	758	100	0.556

Notes:

1. Average occurrence = total number of birds detected/total number of point counts conducted for the full study area.

Table. 5.2-1. Number of Birds Observed (*n*) and Percent Occurrence by Habitat Type during Lacustrine-focused Surveys, 2013.

		Percent Occurrence[1] by Habitat Type[2]						
Species	n	Open Needleleaf Forest	Mixed Woodland	Moist Graminoid Meadow	Lacustrine	Ericaceous Dwarf Shrub	Closed Low Shrub	Open Low Shrub
Snow Goose	4				100			
Trumpeter Swan	9				100			
American Wigeon	27							100
Mallard	4				100			
Northern Shoveler	5				100			
Northern Pintail	28				100			
Green-winged Teal	38			10.53	89.47			
Ring-necked Duck	10				100			
Greater Scaup	17				100			
Lesser Scaup	15		46.67		53.33			
Unidentified scaup	9				100			
Surf Scoter	2				100			
White-winged Scoter	2				100			
Long-tailed Duck	7				100			
Bufflehead	11				100			
Barrow's Goldeneye	16							
Unidentified waterfowl	10							
Red-throated Loon	2				100			
Common Loon	2				100			
Horned Grebe	6				100			
Red-necked Grebe	2				100			
Mew Gull	9				100			
Waterbirds Total	226			2.71	97.29			

		Percent Occurrence[1] by Habitat Type[2]						
Species	n	Open Needleleaf Forest	Mixed Woodland	Moist Graminoid Meadow	Lacustrine	Ericaceous Dwarf Shrub	Closed Low Shrub	Open Low Shrub
American Golden-Plover	3			66.67	33.33			
Semipalmated Plover	1					100		
Solitary Sandpiper	5	40.00		60.00				
Wandering Tattler	1							
Greater Yellowlegs	1		100					
Lesser Yellowlegs	21	5.88		23.53	64.71		5.88	
Least Sandpiper	17			7.14	92.86			
Pectoral Sandpiper	1			100				
Unidentified sandpiper—medium	3			100				
Long-billed Dowitcher	3			33.33	66.67			
Wilson's Snipe	20			17.65	82.35			
Red-necked Phalarope	34			8.82	91.18			
Unidentified shorebird—small	19			100				
Unidentified shorebird—large	1			100				
Unidentified shorebird	2			100				
Shorebirds Total	141	2.91	0.97	24.27	69.9	0.97	0.97	
Gray Jay	1		100					
Tree Swallow	2							
Violet-green Swallow	1							
Bank Swallow	4			12.50	87.50			
Arctic Warbler	1							100
Northern Wheatear	1					100		
Hermit Thrush	5							100
American Robin	8		25.00	12.50				62.50
Bohemian Waxwing	7		100					
Blackpoll Warbler	3			100				

		Percent Occurrence[1] by Habitat Type[2]						
Species	n	Open Needleleaf Forest	Mixed Woodland	Moist Graminoid Meadow	Lacustrine	Ericaceous Dwarf Shrub	Closed Low Shrub	Open Low Shrub
Yellow-rumped Warbler	4							100
American Tree Sparrow	3				100			
Savannah Sparrow	7			42.86	14.28			42.86
Fox Sparrow	3				33.33			66.67
Lincoln's Sparrow	2			100				
White-crowned Sparrow	1				100			
Dark-eyed Junco	2							100
Rusty Blackbird	8	50.00		12.50	37.50			
Landbirds Total	63	7.84	19.61	13.73	11.76	1.96		45.1
Grand Total	430	1.87	2.93	10.13	78.13	0.53	0.27	6.13

Notes:

1. Percent-occurrence values exclude birds in flight; hence, those species observed only in flight lack percent-occurrence information for habitats.
2. Level-III vegetation types of the Alaska Vegetation Classification (Viereck et al. 1992).

Table. 5.2-2. Number of Birds Observed (*n*) and Percent Occurrence by Habitat Type during Riverine-focused Surveys, 2013.

		Percent Occurrence[1] by Habitat Type[2]									
Species	n	Open Mixed Forest	Open Needleleaf Forest	Needleleaf Woodland	Moist Graminoid Meadow	Riverine	Wet Dwarf Shrub	Closed Low Shrub	Open Low Shrub	Closed Tall Shrub	Open Tall Shrub
American Wigeon	18					100					
Mallard	14					100					
Northern Shoveler	2					100					
Northern Pintail	5					100					
Green-winged Teal	21					100					
Harlequin Duck	50					100					
Common Goldeneye	2										
Barrow's Goldeneye	2					100					
Common Merganser	1					100					
Red-breasted Merganser	6					100					
Unidentified duck	3										
Mew Gull	6					100					
Waterbird Total	130					100					
Spotted Sandpiper	122				0.85	88.03		4.27	2.56	3.42	0.85
Solitary Sandpiper	1										
Wilson's Snipe	1									100	
Unidentified shorebird—medium	1			100							
Shorebird Total	124			0.85	0.85	87.29		4.24	2.54	3.39	0.85
Bald Eagle	3					100					
Great Horned Owl	1				100						
Unidentified raptor	4		100								
Raptor Total	8		25.00		25.00	50.00					
Olive-sided Flycatcher	1		100								
Alder Flycatcher	19	68.42	31.58								

		Percent Occurrence[1] by Habitat Type[2]									
Species	n	Open Mixed Forest	Open Needleleaf Forest	Needleleaf Woodland	Moist Graminoid Meadow	Riverine	Wet Dwarf Shrub	Closed Low Shrub	Open Low Shrub	Closed Tall Shrub	Open Tall Shrub
Gray Jay	4		100								
Tree Swallow	3										
Violet-green Swallow	10	100									
Bank Swallow	15					100					
Unidentified swallow	1										
Boreal Chickadee	4	75.00	25.00								
American Dipper	2					100					
Ruby-crowned Kinglet	21	33.33	66.67								
Gray-cheeked Thrush	9		88.89	11.11							
Swainson's Thrush	15	23.08	46.15					7.69		23.08	
Hermit Thrush	16	57.14	21.43	7.14				14.29			
American Robin	1										
Varied Thrush	7	28.57	57.14								14.29
Northern Waterthrush	39	17.95	38.46	5.13		12.82		10.26		15.38	
Orange-crowned Warbler	5		100								
Yellow Warbler	1									100	
Blackpoll Warbler	56	7.27	45.45	10.91		5.45		9.09	1.82	20.00	
Yellow-rumped Warbler	22	36.36	54.55							9.09	
Wilson's Warbler	50	18.75	14.58	4.17		4.17		2.08		56.25	
American Tree Sparrow	3	33.33						66.67			
Savannah Sparrow	17		5.88				35.29	29.41	29.41		
Fox Sparrow	39	33.33	58.97							7.69	
Lincoln's Sparrow	3							100			
White-crowned Sparrow	32	36.00	44.00	4.00			4.00	12.00			
Unidentified sparrow	9										

		Percent Occurrence[1] by Habitat Type[2]									
Species	n	Open Mixed Forest	Open Needleleaf Forest	Needleleaf Woodland	Moist Graminoid Meadow	Riverine	Wet Dwarf Shrub	Closed Low Shrub	Open Low Shrub	Closed Tall Shrub	Open Tall Shrub
Dark-eyed Junco	10	25.00	62.50						12.50		
Unidentified redpoll	12	14.29	85.71								
Pine Siskin	2		100								
Unidentified passerine	1		100								
Landbird Total	430	23.7	41.67	3.39		6.51	1.82	6.77	1.82	14.06	0.26
Grand Total	692	14.97	26.64	2.30	0.33	37.99	1.15	5.1	1.64	9.54	0.33

Notes:

1. Percent-occurrence values exclude birds in flight; hence, those species only observed in flight lack percent-occurrence information for habitats.
2. Level-III vegetation types of the Alaska Vegetation Classification (Viereck et al. 1992).

Table 5.3-1. Colonies Identified During Swallow Nesting Survey, 2013.

Colony ID	Species	General Location	Structure	Elevation (feet)[1]	Number of Burrows	Status	Number of Active Nests	Average Burrow Entry Rate
D1	Unknown	Deadman Creek	Erosional Slope	2,238	2	Unknown	Unknown	—
D2	Bank Swallow	Deadman Creek	Erosional Slope	2,172	17	Active	Unknown	—
S1	Unknown	Susitna River	Erosional Slope	1,503	10	Unknown	Unknown	—
S2	Unknown	Susitna River	Erosional Slope	1,543	3	Unknown	Unknown	—
S3	Unknown	Susitna River	Cliff Face	1,575	3	Unknown	Unknown	—
S4[2]	Bank Swallow	Susitna River	Cliff Face	1,550	354	Active	196	2.5
S5	Bank Swallow	Susitna River	Erosional Slope	1,904	9	Active	Unknown	—
S6	Unknown	Susitna River	Rock Outcrop	1,708	1	Unknown	Unknown	—
S7[2]	Bank Swallow	Susitna River	Cliff Face	1,751	60	Active	15	3
S8[2]	Bank Swallow	Susitna River	Cut Bank	1,691	23	Active[3]	18	—
S9	Unknown	Susitna River	Cut Bank	1,689	4	Unknown	Unknown	—
S10[2]	Bank and Violet-green swallows	Susitna River	Cut Bank	1,775	48	Active	30	2.2
S11[2]	Unknown	Susitna River	Erosional Slope	1,952	53	Inactive	0	—
S12[2]	Bank and Violet-green swallows	Susitna River	Erosional Slope	1,927	119	Active	51	1.7
S13[2]	Unknown	Susitna River	Erosional Slope	1,915	24	Inactive	0	—
S14	Bank Swallow	Susitna River	Erosional Slope	2,643	33	Active	Unknown	—
S15	Bank Swallow	Susitna River	Cut Bank	2,075	6	Active	Unknown	—
S16	Bank Swallow	Susitna River	Cut Bank	2,085	3	Active	Unknown	—
S17[2]	Bank Swallow	Susitna River	Erosional Slope	2,106	64	Active	42	3.2
W1	Unknown	Watana Creek	Erosional Slope	1,823	2	Unknown	Unknown	—
W2[2]	Bank Swallow	Watana Creek	Cut Bank	1,689	27	Active	9	1.0
W3	Unknown	Watana Creek	Erosional Slope	2,243	27	Unknown	Unknown	—
W4	Unknown	Watana Creek	Erosional Slope	2,263	25	Unknown	Unknown	—
W5	Unknown	Watana Creek	Erosional Slope	2,255	7	Unknown	Unknown	—
W6	Unknown	Watana Creek	Erosional Slope	2,246	11	Unknown	Unknown	—

Notes:

1. Elevation above mean sea level; surface elevation of proposed Watana Reservoir at maximum pool would be 2,050 feet.
2. Colonies observed from the ground to estimate abundance and quantify average burrow entry rate per 10-minute sampling period (as an index of feeding activity).
3. Colony S8 was active during the first visit but was inactive during the second visit, when sign of bear predation was found at most burrows.

Table. 6.1-1. Average Occurrence[1] of Landbirds and Shorebirds Calculated from Point-count Data for the Susitna-Watana Hydroelectric Project in 2013 and for Eight Other Comparable Point-count Studies in Interior Alaska.

Species	Gates of the Arctic[2]	Fort Wainwright[3]	Yukon Charley[4]	Tanana Valley[5]	Fairbanks/ Tok[6]	Denali[7]	Black River[8]	White Mountains[9]	Average of 8 Other Studies	This Study
Landbirds										
Ruffed Grouse										<0.001
Spruce Grouse		0.004				0.004			0.004	0.004
Sharp-tailed Grouse		0.012							0.012	
Willow Ptarmigan			0.010			0.019		0.002	0.010	0.082
Rock Ptarmigan			0.010					0.017	0.014	0.037
Downy Woodpecker		0.002							0.002	0.002
Hairy Woodpecker		0.012		0.006	0.017				0.012	<0.001
American Three-toed Woodpecker		0.002	0.010	0.006	0.023	0.023	0.103		0.028	0.003
Black-backed Woodpecker										
Northern Flicker		0.014		0.023	0.025				0.021	0.016
Olive-sided Flycatcher	0.028	0.064	0.100			0.096	0.333	0.002	0.104	0.055
Western Wood Pewee		0.050		0.006			0.009		0.021	
Alder Flycatcher	0.028	0.633	0.140	0.271	0.134	0.130	0.197	0.004	0.192	0.022
Hammond's Flycatcher		0.072	0.070	0.372	0.044	0.011	0.017		0.098	
Say's Phoebe	0.028						0.094	0.037	0.053	

Species	Gates of the Arctic[2]	Fort Wainwright[3]	Yukon Charley[4]	Tanana Valley[5]	Fairbanks/ Tok[6]	Denali[7]	Black River[8]	White Mountains[9]	Average of 8 Other Studies	This Study
Northern Shrike						0.008		0.004	0.006	
Gray Jay		0.361	0.220	0.141	0.292	0.211	0.291	0.002	0.217	0.123
Black-billed Magpie						0.027			0.027	0.004
Common Raven		0.054	0.030	0.023	0.025	0.015		0.009	0.026	0.029
Horned Lark			0.060			0.080	0.051	0.114	0.077	0.081
Tree Swallow		0.006		0.006		0.004	0.009		0.006	0.004
Violet-green Swallow	0.111					0.011			0.061	0.006
Bank Swallow	0.222			0.006					0.114	0.008
Cliff Swallow										0.006
Black-capped Chickadee		0.082		0.127	0.037				0.082	0.013
Boreal Chickadee		0.132	0.070	0.049	0.183	0.015	0.077		0.088	0.065
Red-breasted Nuthatch							0.009		0.009	
American Dipper										0.002
Ruby-crowned Kinglet	0.250	0.459	0.260	0.029	0.273	0.230	0.222	0.002	0.216	0.478
Townsend's Solitaire							0.188	0.030	0.109	
Arctic Warbler						0.410		0.006	0.208	0.076
Northern Wheatear			0.020					0.071	0.046	0.007
Gray-cheeked Thrush	0.472	0.008	0.280			0.548	0.590	0.028	0.321	0.379

Species	Gates of the Arctic[2]	Fort Wainwright[3]	Yukon Charley[4]	Tanana Valley[5]	Fairbanks/ Tok[6]	Denali[7]	Black River[8]	White Mountains[9]	Average of 8 Other Studies	This Study
Swainson's Thrush	0.639	1.273	0.630	0.438	1.117	0.981	1.085	0.004	0.771	0.299
Hermit Thrush		0.068	0.050	0.274	0.048	0.257	0.068		0.127	0.168
American Robin	0.250	0.152	0.380	0.179	0.121	0.391	0.368	0.156	0.249	0.286
Varied Thrush	0.056	0.259	0.440		0.242	0.310	0.085	0.030	0.203	0.587
American Pipit			0.170			0.100	0.060	0.488	0.204	0.117
Bohemian Waxwing		0.058	0.020	0.014	0.022	0.031	0.043	0.002	0.027	0.054
Lapland Longspur	0.139		0.040					0.244	0.141	0.026
Smith's Longspur	0.028								0.028	
Snow Bunting										0.032
Northern Waterthrush	0.083	0.078	0.040			0.165	0.043		0.082	0.274
Orange-crowned Warbler	0.611	0.495	0.200	0.173	0.130	0.724	0.274	0.006	0.327	0.067
Yellow Warbler		0.066	0.010			0.011	0.103	0.006	0.039	0.004
Blackpoll Warbler		0.100		0.003		0.011			0.038	0.383
Yellow-rumped Warbler	0.167	0.802	0.710	1.037	0.762	0.284	1.179		0.706	0.614
Townsend's Warbler		0.110	0.080	0.055	0.499				0.186	0.002
Wilson's Warbler	0.194	0.010	0.210	0.003		0.969	0.299	0.151	0.262	0.444
American Tree Sparrow	1.528	0.020	0.400			1.157		0.462	0.713	0.476
Savannah Sparrow	0.778	0.178	0.270	0.009		0.912		0.596	0.457	0.495

Species	Gates of the Arctic[2]	Fort Wainwright[3]	Yukon Charley[4]	Tanana Valley[5]	Fairbanks/ Tok[6]	Denali[7]	Black River[8]	White Mountains[9]	Average of 8 Other Studies	This Study
Fox Sparrow		0.076	0.330			0.973	1.162	0.341	0.577	1.166
Lincoln's Sparrow		0.667	0.120	0.012	0.087	0.192	0.094	0.004	0.168	0.057
White-crowned Sparrow	1.306	0.381	0.820	0.133	0.037	2.992	1.197	0.713	0.947	0.925
Golden-crowned Sparrow						0.034		0.006	0.020	0.114
Dark-eyed Junco	0.139	1.255	0.040	1.274	1.268	0.831	1.145		0.850	0.458
Red-winged Blackbird		0.004							0.004	
Rusty Blackbird		0.044				0.027			0.035	0.017
Gray-crowned Rosy-Finch						0.004			0.004	<0.001
Pine Grosbeak			0.050			0.004	0.017		0.024	0.002
White-winged Crossbill	0.278	0.319	0.490	0.098	0.050	1.180	0.368		0.397	0.059
Common Redpoll	0.944	1.517	0.500	0.455	0.033	0.785	0.444	0.095	0.597	0.857
Pine Siskin				0.040	0.019				0.030	0.010
Shorebirds										
American Golden-Plover						0.015		0.013	0.014	0.048
Semipalmated Plover										0.013
Spotted Sandpiper	0.083				0.025	0.019		0.000	0.032	0.043
Upland Sandpiper	0.056					0.050			0.053	
Solitary Sandpiper		0.002		0.012					0.007	0.011

Species	Gates of the Arctic[2]	Fort Wainwright[3]	Yukon Charley[4]	Tanana Valley[5]	Fairbanks/ Tok[6]	Denali[7]	Black River[8]	White Mountains[9]	Average of 8 Other Studies	This Study
Wandering Tattler										0.005
Greater Yellowlegs						0.011			0.011	0.001
Lesser Yellowlegs	0.111	0.138		0.003	0.038	0.138			0.086	0.047
Whimbrel								0.011	0.011	0.004
Least Sandpiper										0.029
Wilson's Snipe	0.056	0.323	0.150	0.006	0.020	0.169	0.017	0.151	0.111	0.340
Red-necked Phalarope										0.014
Surfbird								0.037	0.037	

Notes:

1. Average occurrence = total number of birds detected/total number of point counts conducted in each study.
2. Gates of the Arctic National Park and Preserve (DiFolco 1996).
3. Tanana Flats and Yukon Maneuver Area, Fort Wainwright (Benson 1999).
4. Yukon Charley National Preserve (Swanson and Nigro 2003).
5. Tanana Valley State Forest (Hannah et al. 2003).
6. Tok and Fairbanks areas (Benson 2004).
7. Denali National Park and Preserve (McIntyre 2005).
8. Bureau of Land Management, Black River area (Sharbaugh et al. 2009).
9. Bureau of Land Management, White Mountains area (Shaw and Schmidt 2011).

10. FIGURES

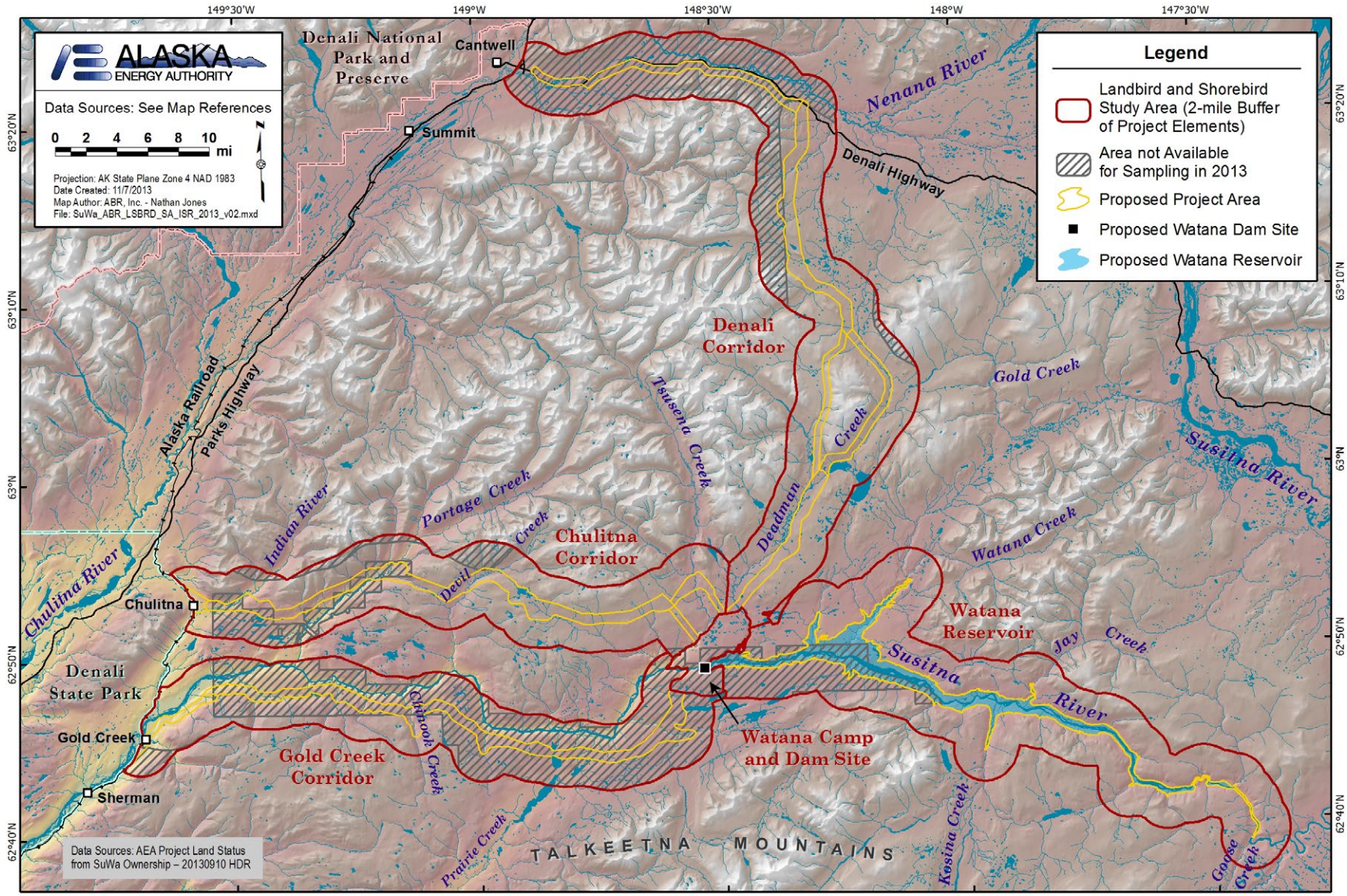

Figure 3-1. Study Area for Landbird and Shorebird Surveys, 2013.

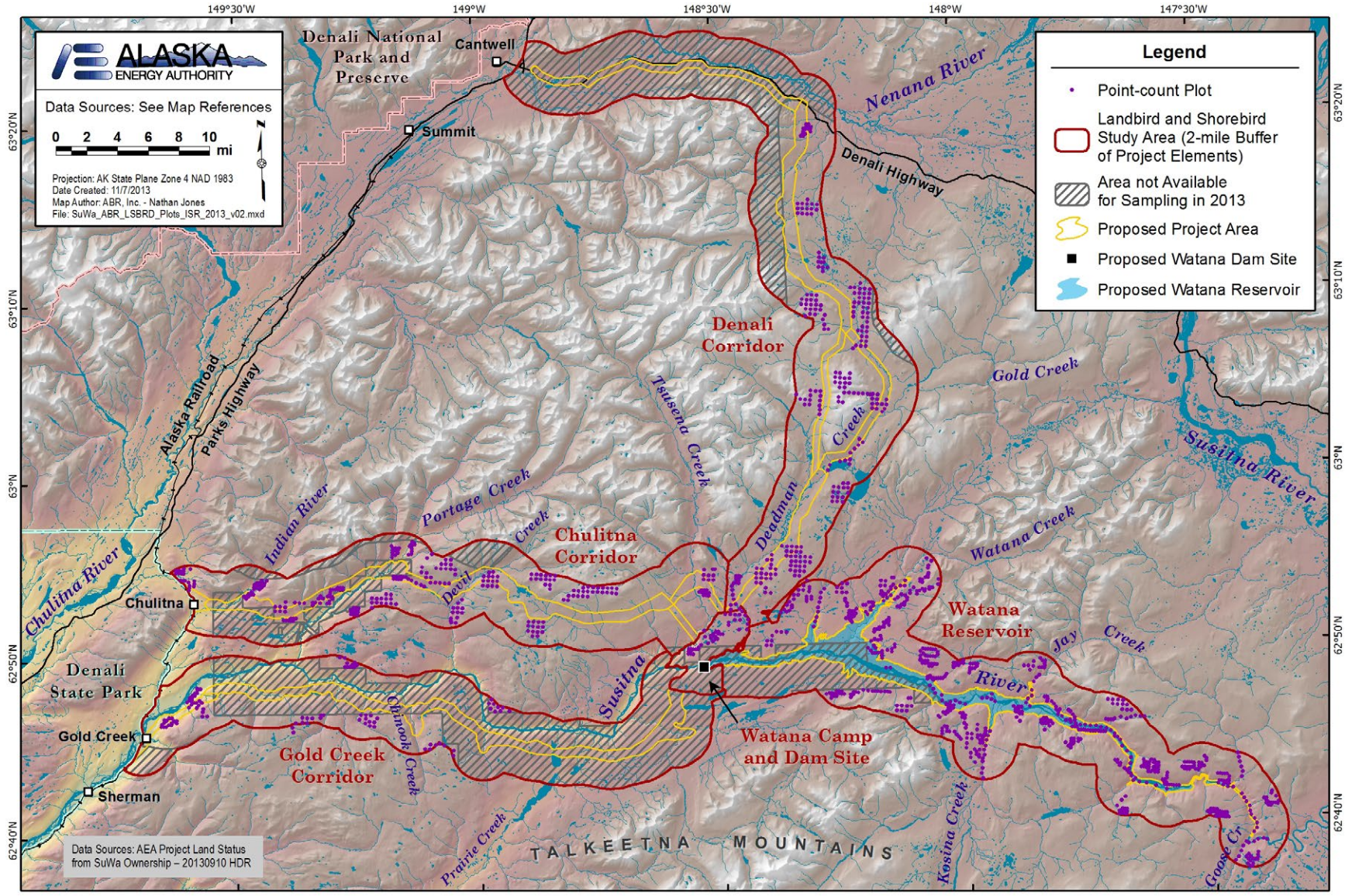

Figure 3-2. Sampling Area and Point-count Plot Locations for Landbird and Shorebird Surveys, 2013.

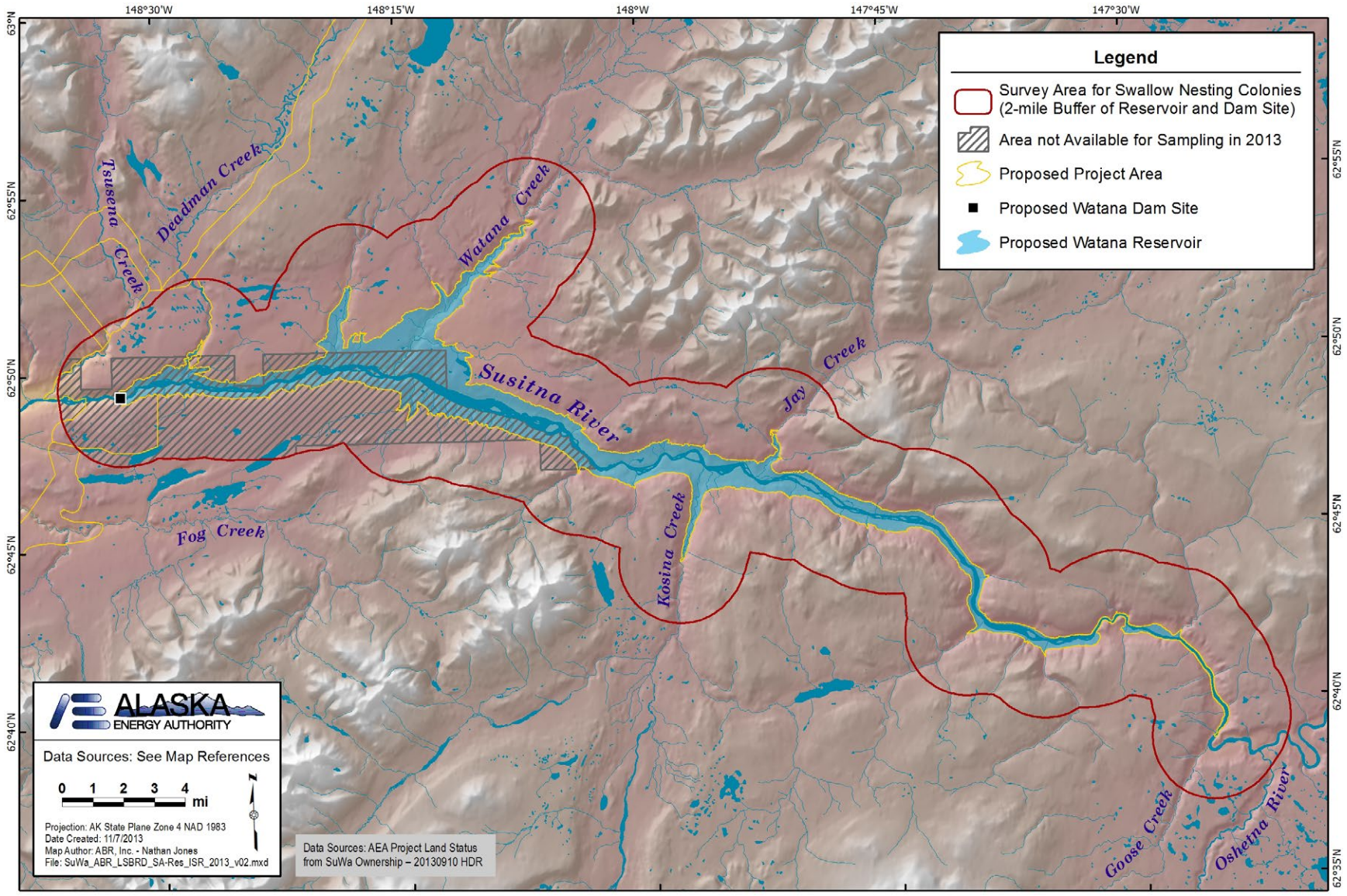

Figure 3-3. Survey Area for Colonially Nesting Swallows, 2013.

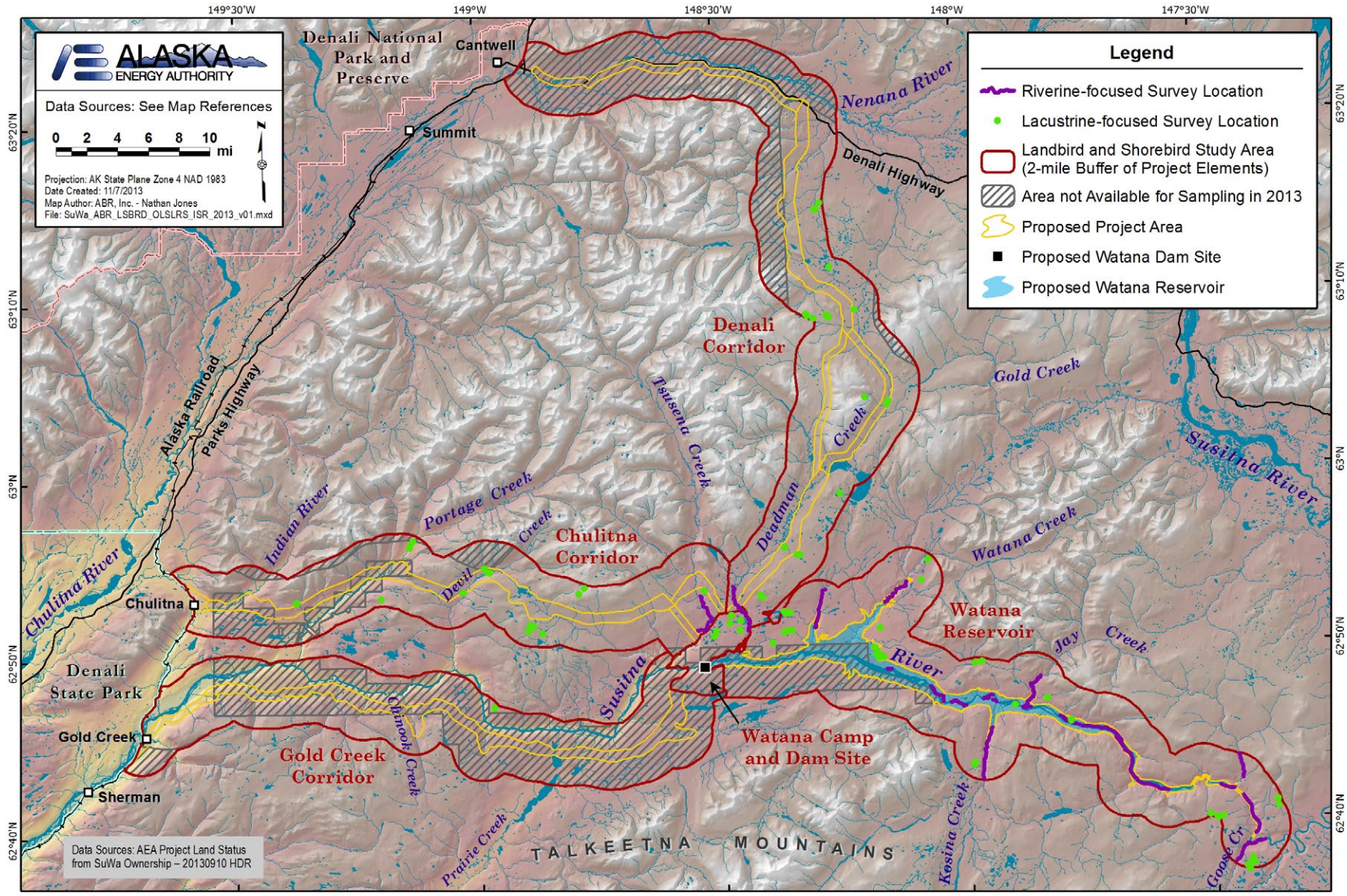

Figure 5.2-1. Riverine- and Lacustrine-focused Survey Locations, 2013.

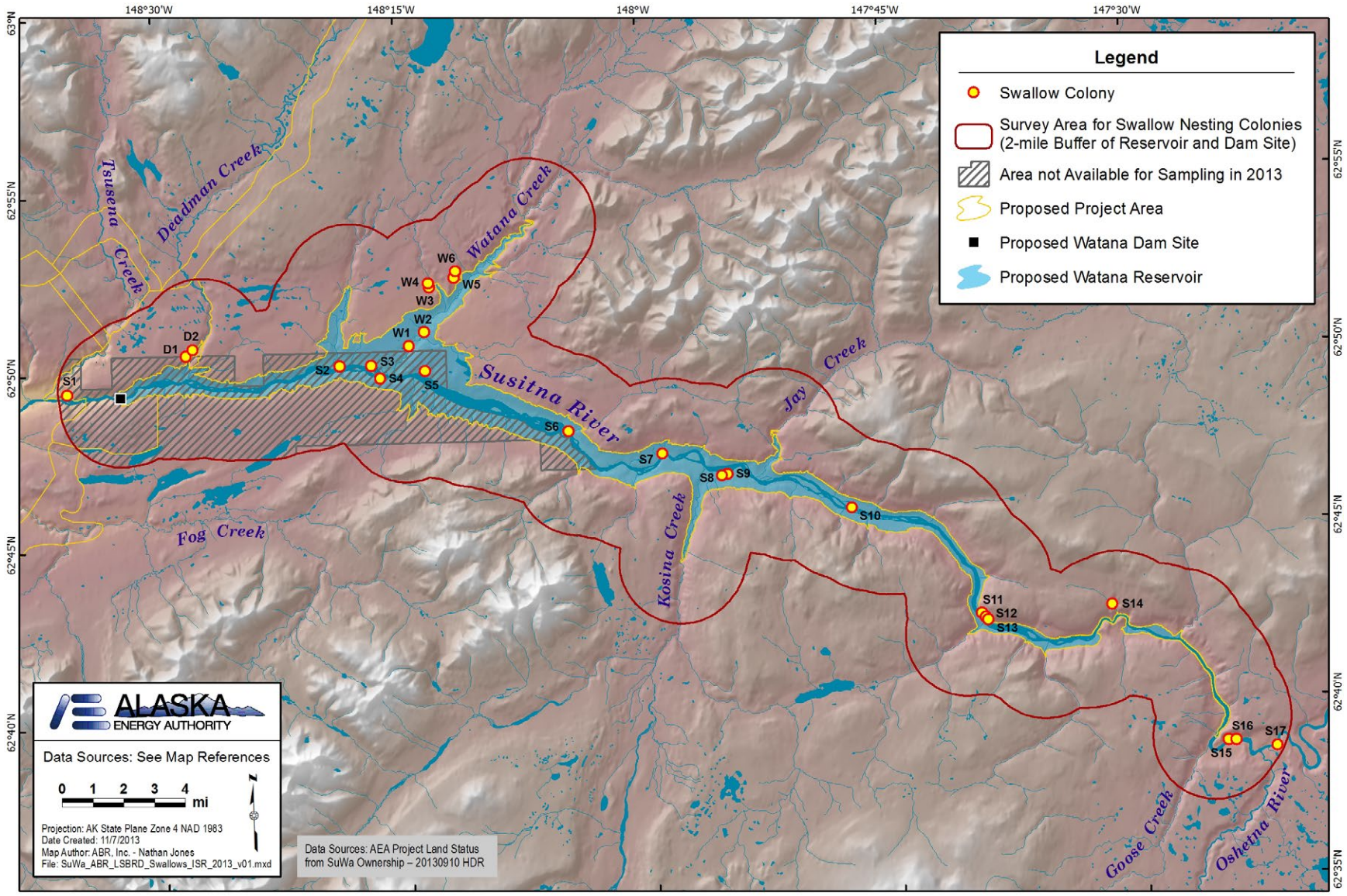

Figure 5.3-1. Colonies Identified During the Swallow Nesting Survey, 2013.

PART A - APPENDIX A: COMMON AND SCIENTIFIC NAMES, BREEDING STATUS, AND RELATIVE ABUNDANCE OF AVIAN SPECIES RECORDED DURING THE LANDBIRD AND SHOREBIRD STUDY, 2013.

Common Name	Scientific Name	Breeding Status[1]	Abundance[2]
Snow Goose[3]	*Chen caerulescens*	Unlikely[4]	Rare
Canada Goose[3]	*Branta canadensis*	Unlikely[4]	Rare
Trumpeter Swan[3]	*Cygnus buccinator*	Confirmed[4]	Common
American Wigeon[3]	*Anas americana*	Probable[4]	Uncommon
Mallard[3]	*Anas platyrhynchos*	Probable[4]	Uncommon
Northern Shoveler[3]	*Anas clypeata*	Confirmed[4]	Rare
Northern Pintail[3]	*Anas acuta*	Confirmed[4]	Uncommon
Green-winged Teal[3]	*Anas crecca*	Probable[4]	Common
Ring-necked Duck[3]	*Aythya collaris*	Probable[4]	Uncommon
Greater Scaup[3]	*Aythya marila*	Confirmed[4]	Common
Lesser Scaup[3]	*Aythya affinis*	Confirmed[4]	Common
Harlequin Duck[3]	*Histrionicus histrionicus*	Confirmed[4]	Uncommon
Surf Scoter[3]	*Melanitta perspicillata*	Confirmed[4]	Rare
White-winged Scoter[3]	*Melanitta fusca*	Confirmed[4]	Rare
Long-tailed Duck[3]	*Clangula hyemalis*	Probable[4]	Uncommon
Bufflehead	*Bucephala albeola*	Confirmed[4]	Uncommon
Common Goldeneye[3]	*Bucephala clangula*	Probable[4]	Rare
Barrow's Goldeneye	*Bucephala islandica*	Confirmed[4]	Uncommon
Common Merganser	*Mergus merganser*	Confirmed[4]	Uncommon
Red-breasted Merganser	*Mergus serrator*	Confirmed[4]	Common
Ruffed Grouse	*Bonasa umbellus*	Probable	Rare
Spruce Grouse	*Falcipennis canadensis*	Possible	Rare
Willow Ptarmigan	*Lagopus lagopus*	Confirmed	Common
Rock Ptarmigan	*Lagopus muta*	Confirmed	Uncommon
Red-throated Loon[3]	*Gavia stellata*	Confirmed[4]	Rare
Common Loon	*Gavia immer*	Confirmed[4]	Rare
Horned Grebe[3]	*Podiceps auritus*	Confirmed[4]	Uncommon
Red-necked Grebe	*Podiceps grisegena*	Confirmed[4]	Rare
Bald Eagle	*Haliaeetus leucocephalus*	Confirmed[5]	[see ISR 10.14]
Northern Harrier	*Circus cyaneus*	Possible[5]	[see ISR 10.14]

Common Name	Scientific Name	Breeding Status[1]	Abundance[2]
Northern Goshawk	*Accipiter gentilis*	Probable[5]	[see ISR 10.14]
Red-tailed Hawk	*Buteo jamaicensis*	Confirmed[5]	[see ISR 10.14]
Golden Eagle[3]	*Aquila chrysaetos*	Confirmed[5]	[see ISR 10.14]
Sandhill Crane	*Grus canadensis*	Unlikely[4]	Rare
American Golden-Plover[3]	*Pluvialis dominica*	Confirmed	Uncommon
Semipalmated Plover	*Charadrius semipalmatus*	Confirmed	Uncommon
Spotted Sandpiper	*Actitis macularius*	Confirmed	Common
Solitary Sandpiper[3]	*Tringa solitaria*	Probable	Uncommon
Wandering Tattler	*Tringa incana*	Probable	Rare
Greater Yellowlegs	*Tringa melanoleuca*	Unlikely	Rare
Lesser Yellowlegs[3]	*Tringa flavipes*	Confirmed	Uncommon
Whimbrel[3]	*Numenius phaeopus*	Possible	Rare
Least Sandpiper	*Calidris minutilla*	Probable	Uncommon
Pectoral Sandpiper	*Calidris melanotos*	Unlikely	Rare
Long-billed Dowitcher	*Limnodromus scolopaceus*	Unlikely	Rare
Wilson's Snipe[3]	*Gallinago delicata*	Confirmed	Common
Red-necked Phalarope	*Phalaropus lobatus*	Probable	Uncommon
Bonaparte's Gull	*Chroicocephalus philadelphia*	Confirmed[4]	Rare
Mew Gull	*Larus canus*	Confirmed[4]	Uncommon
Herring Gull	*Larus argentatus*	Probable[4]	Common
Arctic Tern	*Sterna paradisaea*	Confirmed[4]	Uncommon
Long-tailed Jaeger	*Stercorarius longicaudus*	Possible	Rare
Great Horned Owl	*Bubo virginianus*	Possible[5]	[see ISR 10.14]
Short-eared Owl[3]	*Asio flammeus*	Unlikely[5]	[see ISR 10.14]
Belted Kingfisher	*Megaceryle alcyon*	Probable	Rare
Downy Woodpecker	*Picoides pubescens*	Possible	Rare
Hairy Woodpecker	*Picoides villosus*	Possible	Rare
American Three-toed Woodpecker	*Picoides dorsalis*	Possible	Rare
Northern Flicker	*Colaptes auratus*	Possible	Uncommon
Merlin	*Falco columbarius*	Probable[5]	[see ISR 10.14]

Common Name	Scientific Name	Breeding Status[1]	Abundance[2]
Peregrine Falcon[3]	*Falco peregrinus*	Confirmed[5]	[see ISR 10.14]
Olive-sided Flycatcher[3]	*Contopus cooperi*	Confirmed	Uncommon
Alder Flycatcher	*Empidonax alnorum*	Probable	Uncommon
Gray Jay	*Perisoreus canadensis*	Confirmed	Common
Black-billed Magpie	*Pica hudsonia*	Possible	Rare
Common Raven	*Corvus corax*	Probable	Uncommon
Horned Lark	*Eremophila alpestris*	Confirmed	Uncommon
Tree Swallow	*Tachycineta bicolor*	Probable	Uncommon
Violet-green Swallow	*Tachycineta thalassina*	Confirmed	Uncommon
Bank Swallow	*Riparia riparia*	Confirmed	Uncommon
Cliff Swallow	*Petrochelidon pyrrhonota*	Confirmed	Rare
Black-capped Chickadee	*Poecile atricapillus*	Probable	Uncommon
Boreal Chickadee	*Poecile hudsonicus*	Confirmed	Uncommon
American Dipper	*Cinclus mexicanus*	Confirmed	Uncommon
Ruby-crowned Kinglet	*Regulus calendula*	Confirmed	Abundant
Arctic Warbler	*Phylloscopus borealis*	Confirmed	Uncommon
Northern Wheatear	*Oenanthe oenanthe*	Probable	Uncommon
Gray-cheeked Thrush[3]	*Catharus minimus*	Probable	Common
Swainson's Thrush	*Catharus ustulatus*	Probable	Common
Hermit Thrush	*Catharus guttatus*	Probable	Uncommon
American Robin	*Turdus migratorius*	Confirmed	Common
Varied Thrush[3]	*Ixoreus naevius*	Confirmed	Abundant
American Pipit	*Anthus rubescens*	Probable	Uncommon
Bohemian Waxwing[3]	*Bombycilla garrulus*	Probable	Uncommon
Lapland Longspur	*Calcarius lapponicus*	Probable	Uncommon
Snow Bunting	*Plectrophenax nivalis*	Probable	Uncommon
Northern Waterthrush	*Parkesia noveboracensis*	Confirmed	Uncommon
Orange-crowned Warbler	*Oreothlypis celata*	Confirmed	Uncommon
Yellow Warbler	*Setophaga petechia*	Probable	Rare
Blackpoll Warbler[3]	*Setophaga striata*	Confirmed	Common

Common Name	Scientific Name	Breeding Status[1]	Abundance[2]
Yellow-rumped Warbler	*Setophaga coronata*	Probable	Abundant
Townsend's Warbler[3]	*Setophaga townsendi*	Possible	Rare
Wilson's Warbler	*Cardellina pusilla*	Probable	Common
American Tree Sparrow	*Spizella arborea*	Confirmed	Abundant
Savannah Sparrow	*Passerculus sandwichensis*	Confirmed	Abundant
Fox Sparrow	*Passerella iliaca*	Confirmed	Abundant
Lincoln's Sparrow	*Melospiza lincolnii*	Confirmed	Uncommon
White-crowned Sparrow	*Zonotrichia leucophrys*	Confirmed	Abundant
Golden-crowned Sparrow[3]	*Zonotrichia atricapilla*	Probable	Uncommon
Dark-eyed Junco	*Junco hyemalis*	Confirmed	Common
Rusty Blackbird[3]	*Euphagus carolinus*	Probable	Uncommon
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	Unlikely	Rare
Pine Grosbeak	*Pinicola enucleator*	Probable	Rare
White-winged Crossbill[3]	*Loxial eucoptera*	Possible	Uncommon
Common Redpoll	*Acanthis flammea*	Probable	Abundant
Pine Siskin	*Spinus pinus*	Probable	Uncommon

Notes:

1. Breeding status follows Andres et al. (1999): ***Confirmed***: definitive observation of nesting, including nest found, adults carrying nesting material and/or food, flightless young. ***Probable***: breeding behavior observations, including pair observed in suitable habitat, territorial or courtship behavior. ***Possible***: individual (male or female) heard or seen in suitable nesting habitat, but no further evidence was noted. ***Unlikely***: male or female observed but did not show evidence of breeding, was not in suitable nesting habitat, or was an obvious migrant (based on range or behavior).
2. Abundance categories adapted from Kessel et al.(1982): ***Abundant***: species occurs in all or nearly all suitable habitats in large numbers. ***Common***: species occurs in nearly all suitable habitats. ***Uncommon***: species occurs regularly, but uses little suitable habitat or not regularly observed in suitable habitat. ***Rare***: species occurs no more than a few times, irregularly, throughout the study area.
3. Species of conservation or management concern (following Table 2 in ABR 2011), consistent with the *Memorandum of Understanding between the Federal Energy Regulatory Commission and the U.S. Department of the Interior United States Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"* (dated March 30, 2011).
4. Breeding status noted in waterbird study (ISR 10.15).
5. Breeding status noted in raptor study (ISR 10.14).

PART A - APPENDIX B: NUMBER OF LANDBIRDS RECORDED IN FOCAL HABITAT TYPES DURING POINT-COUNT SURVEYS, 2013.

	Focal Habitat Type[1]																								
Common Name	**Barrens**	**Partially Vegetated**	**Closed Broadleaf Forest**	**Open Broadleaf Forest**	**Broadleaf Woodland**	**Closed Mixed Forest**	**Open Mixed Forest**	**Mixed Woodland**	**Closed Needleleaf Forest**	**Open Needleleaf Forest**	**Needleleaf Woodland**	**Dry Graminoid Meadow**	**Moist Graminoid Meadow**	**Wet Graminoid Meadow**	**Riverine Waters**	**Dry Dwarf Shrub**	**Ericaceous Dwarf Shrub**	**Wet Dwarf Shrub**	**Open Dwarf Forest**	**Dwarf Forest Woodland**	**Closed Low Shrub**	**Open Low Shrub**	**Closed Tall Shrub**	**Open Tall Shrub**	**Total**
Ruffed Grouse										1															1
Spruce Grouse							2			3															5
Willow Ptarmigan	1			1						3	1		2	5			4				21	50	1	2	91
Rock Ptarmigan	2	9											12			2	14	4				2			45
Downy										2															2
Hairy							1																		1
American Three-										3	1														4
Northern Flicker				2			2			9	6														19
Olive-sided							1	2		47	22						1			1			3		77
Alder Flycatcher							14	2		1											1	1	1		20
Gray Jay							12	3		97	29								4			2			14
Black-billed										1											1				2
Common Raven		1																			2	1			4
Horned Lark	2	19										3	28	1		6	45	1				3			10
Tree Swallow										2	1								1						4
Violet-green															3										3
Bank Swallow															6										6
Black-capped				1			10				3												1	1	16
Boreal Chickadee						4	11		1	51	24												1		92
American Dipper							1																		1
Ruby-crowned				3		7	46	10	16	32	13								7	4	6	5	1	2	56
Arctic Warbler										4	1						3				18	45	6	5	82
Northern		1											3				5								9
Gray-cheeked		1		2	2	2	18	2	4	10	93			1			13	1	3	3	19	53	27	28	38

	Focal Habitat Type[1]																							
Common Name	**Barrens**	**Partially Vegetated**	**Closed Broadleaf Forest**	**Open Broadleaf Forest**	**Broadleaf Woodland**	**Closed Mixed Forest**	**Open Mixed Forest**	**Mixed Woodland**	**Closed Needleleaf Forest**	**Open Needleleaf Forest**	**Needleleaf Woodland**	**Dry Graminoid Meadow**	**Moist Graminoid Meadow**	**Wet Graminoid Meadow**	**Riverine Waters**	**Dry Dwarf Shrub**	**Ericaceous Dwarf Shrub**	**Wet Dwarf Shrub**	**Open Dwarf Forest**	**Dwarf Forest Woodland**	**Closed Low Shrub**	**Open Low Shrub**	**Closed Tall Shrub**	**Open Tall Shrub**	**Total**
Swainson's				8	2	36	10	10	4	13	35									1			13	7	35
Hermit Thrush		1		7	1	3	32	13		44	22		1		1		1				2	7	21	14	17
American Robin		1	1			5	8	3	2	12	90			1			7	1	4		3	21	5	15	29
Varied Thrush			1	10	1	28	86	18	12	33	13								3	6	3	8	17	15	67
American Pipit	5	21									1	1	29	1		2	54	1				4			11
Bohemian										26	40								2	2		7		2	79
Lapland													9			1	18					2			30
Snow Bunting		20														2	11								33
Northern			2	10	3	14	66	9	6	92	59										6	5	22	5	29
Orange-crowned				1	1	3	15	4		18	13											10	8	3	76
Yellow Warbler											3											1		1	5
Blackpoll Warbler			2	9	1	6	73	13	4	14	82				2		2		5	2	19	37	26	22	44
Yellow-rumped			1	16	5	26	14	22	8	32	13				1		3		3	5	11	13	18	10	74
Townsend's										2															2
Wilson's Warbler	1			9	2	8	33	6	1	11	71				3		10			2	47	89	55	29	47
American Tree		1		4					1	20	20		7	7	1		25			2	11	30	17	23	54
Savannah	1	10						1	2	32	28	5	39	17		2	10	3	2	7	94	21	9	17	58
Fox Sparrow			2	12	1	6	56	15	18	52	29					2	13	7	14	18	62	10	54	67	12
Lincoln's Sparrow							1			12	33								4		6	8			64
White-crowned		4			1	1	12	2	7	24	22	1	5	4		2	47	7	23	24	13	23	11	44	10
Golden-crowned		6		1	1		14	4		1	6	2					35	2			6	18	9	15	12
Dark-eyed Junco			1	5	2	8	71	11	6	26	12					1	3		8	4	11	11	7	8	54
Rusty Blackbird							2		1	7	6			4					4						24
Gray-crowned		1																							1

	Focal Habitat Type[1]																							
Common Name	**Barrens**	**Partially Vegetated**	**Closed Broadleaf Forest**	**Open Broadleaf Forest**	**Broadleaf Woodland**	**Closed Mixed Forest**	**Open Mixed Forest**	**Mixed Woodland**	**Closed Needleleaf Forest**	**Open Needleleaf Forest**	**Needleleaf Woodland**	**Dry Graminoid Meadow**	**Moist Graminoid Meadow**	**Wet Graminoid Meadow**	**Riverine Waters**	**Dry Dwarf Shrub**	**Ericaceous Dwarf Shrub**	**Wet Dwarf Shrub**	**Open Dwarf Forest**	**Dwarf Forest Woodland**	**Closed Low Shrub**	**Open Low Shrub**	**Closed Tall Shrub**	**Open Tall Shrub**	**Total**
Pine Grosbeak										1	1												20		22
White-winged							8			40	6								2						56
Common Redpoll			2	11	1	28	72	9	3	15	91						8	4	5	4	21	39	20	18	49
Pine Siskin							12																		12
Total	**12**	**96**	**12**	**11**	**24**	**18**	**92**	**15**	**96**	**3,3**	**1,8**	**12**	**13**	**41**	**17**	**20**	**42**	**31**	**94**	**85**	**60**	**13**	**37**	**35**	**10,**

Notes:

1. Level-III classes of the Alaska Vegetation Classification (Viereck et al. 1992); focal habitats are the primary habitats surveyed at each point-count plot (see text).

PART A - APPENDIX C: AVERAGE OCCURRENCE OF LANDBIRD SPECIES IN FOCAL HABITAT TYPES, CALCULATED FROM POINT-COUNT SURVEY DATA, 2013.

	Focal Habitat Type[1]																								
Common Name	***n***	**Barrens**	**Partially Vegetated**	**Closed Broadleaf Forest**	**Open Broadleaf Forest**	**Broadleaf Woodland**	**Closed Mixed Forest**	**Open Mixed Forest**	**Mixed Woodland**	**Closed Needleleaf Forest**	**Open Needleleaf Forest**	**Needleleaf Woodland**	**Dry Graminoid Meadow**	**Moist Graminoid Meadow**	**Wet Graminoid Meadow**	**Rivverine Waters**	**Dry Dwarf Shrub**	**Ericaceous Dwarf Shrub**	**Wet Dwarf Shrub**	**Open Dwarf Forest**	**Dwarf Forest Woodland**	**Closed Low Shrub**	**Open Low Shrub**	**Closed Tall Shrub**	**Open Tall Shrub**	**Total**
Ruffed Grouse	1										0.003														<0.001
Spruce Grouse	5							0.019			0.009														0.004
Willow Ptarmigan	91	0.143			0.077						0.009	0.005		0.048	0.250			0.039				0.228	0.296	0.022	0.045	0.067
Rock Ptarmigan	45	0.286	0.231											0.286			0.250	0.136	0.571				0.012			0.033
Downy Woodpecker	2										0.006															0.001
Hairy Woodpecker	1							0.010																		<0.001
American Three-toed Woodpecker	4										0.009	0.005														0.003
Northern Flicker	19				0.154			0.019			0.026	0.031														0.014
Olive-sided Flycatcher	77							0.010	0.143		0.135	0.113						0.010			0.071			0.067		0.056
Alder Flycatcher	20							0.136	0.143		0.003											0.011	0.006	0.022		0.015
Gray Jay	147							0.117	0.214		0.278	0.149								0.308			0.012			0.108
Black-billed Magpie	2										0.003											0.011				0.001
Common Raven	4		0.026																			0.022	0.006			0.003
Horned Lark	108	0.286	0.487										0.750	0.667	0.050		0.750	0.437	0.143				0.018			0.079
Tree Swallow	4										0.006	0.005								0.077						0.003
Violet-green Swallow	3															0.058										0.002
Bank Swallow	6															0.115										0.004
Black-capped Chickadee	16				0.077			0.097				0.015												0.022	0.023	0.012
Boreal Chickadee	92						0.286	0.107		0.083	0.146	0.123												0.022		0.067
American Dipper	1							0.010																		<0.001
Ruby-crowned Kinglet	560				0.231		0.500	0.447	0.714	1.333	0.920	0.677								0.538	0.286	0.065	0.030	0.022	0.045	0.411
Arctic Warbler	82										0.011	0.005						0.029				0.196	0.266	0.133	0.114	0.060
Northern Wheatear	9		0.026											0.071				0.049								0.007
Gray-cheeked Thrush	381		0.026		0.154	0.667	0.143	0.175	0.143	0.333	0.312	0.477			0.050			0.126	0.143	0.231	0.214	0.207	0.314	0.600	0.636	0.279
Swainson's Thrush	356				0.615	0.667	2.571	0.990	0.714	0.333	0.395	0.179									0.071			0.289	0.159	0.261
Hermit Thrush	170		0.026		0.538	0.333	0.214	0.311	0.929		0.126	0.113		0.024		0.019		0.010				0.022	0.041	0.467	0.318	0.125
American Robin	292		0.026	0.500			0.357	0.078	0.214	0.167	0.358	0.462			0.050			0.068	0.143	0.308		0.033	0.124	0.111	0.341	0.214
Varied Thrush	673			0.500	0.769	0.333	2.000	0.835	1.286	1.000	0.960	0.667								0.231	0.429	0.033	0.047	0.378	0.341	0.493
American Pipit	119	0.714	0.538									0.005	0.250	0.690	0.050		0.250	0.524	0.143				0.024			0.087
Bohemian Waxwing	79										0.074	0.205								0.154	0.143		0.041		0.045	0.058
Lapland Longspur	30													0.214			0.125	0.175					0.012			0.022
Snow Bunting	33		0.513														0.250	0.107								0.024
Northern Waterthrush	299			1.000	0.769	1.000	1.000	0.641	0.643	0.500	0.264	0.303										0.065	0.030	0.489	0.114	0.219
Orange-crowned Warbler	76				0.077	0.333	0.214	0.146	0.286		0.052	0.067											0.059	0.178	0.068	0.056
Yellow Warbler	5											0.015											0.006		0.023	0.004
Blackpoll Warbler	447			1.000	0.692	0.333	0.429	0.709	0.929	0.333	0.407	0.421				0.038		0.019		0.385	0.143	0.207	0.219	0.578	0.500	0.328

	Focal Habitat Type[1]																								
Common Name	***n***	**Barrens**	**Partially Vegetated**	**Closed Broadleaf Forest**	**Open Broadleaf Forest**	**Broadleaf Woodland**	**Closed Mixed Forest**	**Open Mixed Forest**	**Mixed Woodland**	**Closed Needleleaf Forest**	**Open Needleleaf Forest**	**Needleleaf Woodland**	**Dry Graminoid Meadow**	**Moist Graminoid Meadow**	**Wet Graminoid Meadow**	**Rivverine Waters**	**Dry Dwarf Shrub**	**Ericaceous Dwarf Shrub**	**Wet Dwarf Shrub**	**Open Dwarf Forest**	**Dwarf Forest Woodland**	**Closed Low Shrub**	**Open Low Shrub**	**Closed Tall Shrub**	**Open Tall Shrub**	**Total**
Yellow-rumped Warbler	747			0.500	1.231	1.667	1.857	1.417	1.571	0.667	0.937	0.677				0.019		0.029		0.231	0.357	0.120	0.077	0.400	0.227	0.548
Townsend's Warbler	2										0.006															0.001
Wilson's Warbler	477	0.143			0.692	0.667	0.571	0.320	0.429	0.083	0.318	0.364				0.058		0.097			0.143	0.511	0.527	1.222	0.659	0.350
American Tree Sparrow	549		0.026		0.308					0.083	0.057	0.103		0.167	0.350	0.019		0.243			0.143	1.239	1.817	0.378	0.523	0.402
Savannah Sparrow	587	0.143	0.256						0.071	0.167	0.092	0.144	1.250	0.929	0.850		0.250	0.971	0.429	0.154	0.500	1.022	1.290	0.200	0.386	0.430
Fox Sparrow	1,277			1.000	0.923	0.333	0.429	0.544	1.071	1.500	1.499	1.533					0.250	0.126	1.000	1.077	1.286	0.674	0.639	1.200	1.523	0.936
Lincoln's Sparrow	64							0.010			0.034	0.169								0.308		0.065	0.047			0.047
White-crowned Sparrow	1,025		0.103			0.333	0.071	0.117	0.143	0.583	0.699	1.128	0.250	0.119	0.200		0.250	0.456	1.000	1.769	1.714	1.467	1.367	0.244	1.000	0.751
Golden-crowned Sparrow	120		0.154		0.077	0.333		0.136	0.286		0.003	0.031	0.500					0.340	0.286			0.065	0.107	0.200	0.341	0.088
Dark-eyed Junco	544			0.500	0.385	0.667	0.571	0.689	0.786	0.500	0.756	0.631					0.125	0.029		0.615	0.286	0.120	0.065	0.156	0.182	0.399
Rusty Blackbird	24							0.019		0.083	0.020	0.031			0.200					0.308						0.018
Gray-crowned Rosy-Finch	1		0.026																							<0.001
Pine Grosbeak	22										0.003	0.005												0.444		0.016
White-winged Crossbill	56							0.078			0.115	0.031								0.154						0.041
Common Redpoll	492			1.000	0.846	0.333	2.000	0.699	0.643	0.250	0.447	0.467						0.078	0.571	0.385	0.286	0.228	0.231	0.444	0.409	0.361
Pine Siskin	12							0.117																		0.009
Total Average Occurrence		**1.714**	**2.462**	**6.000**	**8.615**	**8.000**	**13.214**	**9.000**	**11.357**	**8.000**	**9.496**	**9.354**	**3.000**	**3.214**	**2.050**	**0.327**	**2.500**	**4.097**	**4.429**	**7.231**	**6.071**	**6.609**	**7.728**	**8.289**	**8.023**	**7.521**
No. Point-count Plots		**7**	**39**	**2**	**13**	**3**	**14**	**103**	**14**	**12**	**349**	**195**	**4**	**42**	**20**	**52**	**8**	**103**	**7**	**13**	**14**	**92**	**169**	**45**	**44**	**1364**

Notes:

1. Average occurrence = total number of detections in each habitat/total number of point-count plots surveyed in each habitat.
2. Level-III classes of the Alaska Vegetation Classification (Viereck et al. 1992); focal habitats are the primary habitats surveyed at each point-count plot (see text).

PART A - APPENDIX D: NUMBER OF SHOREBIRDS RECORDED IN FOCAL HABITAT TYPES DURING POINT-COUNT SURVEYS, 2013.

	Focal Habitat Types[1]																							
Common Name	**Barrens**	**Partially Vegetated**	**Closed Broadleaf Forest**	**Open Broadleaf Forest**	**Broadleaf Woodland**	**Closed Mixed Forest**	**Open Mixed Forest**	**Mixed Woodland**	**Closed Needleleaf Forest**	**Open Needleleaf Forest**	**Needleleaf Woodland**	**Dry Graminoid Meadow**	**Moist Graminoid Meadow**	**Wet Graminoid Meadow**	**Riverine Waters**	**Dry Dwarf Shrub**	**Ericaceous Dwarf Shrub**	**Wet Dwarf Shrub**	**Open Dwarf Forest**	**Dwarf Forest Woodland**	**Closed Low Shrub**	**Open Low Shrub**	**Closed Tall Shrub**	**Open Tall Shrub**	**Total**
American Golden-Plover		6										2	16			3	25								52
Semipalmated Plover		9											1				2								12
Spotted Sandpiper										1					45										46
Solitary Sandpiper									1	1	4														6
Wandering Tattler																	2								2
Greater Yellowlegs										2															2
Lesser Yellowlegs							1		1	13	10			2			1					4			32
Whimbrel										2			2												4
Least Sandpiper									1	1	1		1	5			2		1		3	3			18
Wilson's Snipe			1	4		8	15	1	1	65	53		3	9			8	3	2	2	27	64	3	4	273
Red-necked Phalarope														2											2
Total	**0**	**15**	**1**	**4**	**0**	**8**	**16**	**1**	**4**	**85**	**68**	**2**	**23**	**18**	**45**	**3**	**40**	**3**	**3**	**2**	**30**	**71**	**3**	**4**	**449**

Notes:

1. Level-III classes of the Alaska Vegetation Classification (Viereck et al. 1992); focal habitats are the primary habitats surveyed at each point-count plot (see text).

PART A - APPENDIX E: AVERAGE OCCURRENCE OF SHOREBIRD SPECIES IN FOCAL HABITAT TYPES, CALCULATED FROM POINT-COUNT SURVEY DATA, 2013.

		Focal Habitat Type[2]																							
Common Name	***n***	**Barrens**	**Partially Vegetated**	**Closed Broadleaf Forest**	**Open Broadleaf Forest**	**Broadleaf Woodland**	**Closed Mixed Forest**	**Open Mixed Forest**	**Mixed Woodland**	**Closed Needleleaf Forest**	**Open Needleleaf Forest**	**Needleleaf Woodland**	**Dry Graminoid Meadow**	**Moist Graminoid Meadow**	**Wet Graminoid Meadow**	**Riverine Waters**	**Dry Dwarf Shrub**	**Ericaceous Dwarf Shrub**	**Wet Dwarf Shrub**	**Open Dwarf Forest**	**Dwarf Forest Woodland**	**Closed Low Shrub**	**Open Low Shrub**	**Closed Tall Shrub**	**Open Tall Shrub**	**Total**
American Golden-Plover	52		0.154										0.500	0.381			0.375	0.243							0.038
Semipalmated Plover	12		0.231											0.024				0.019							0.009
Spotted Sandpiper	46										0.003					0.865									0.034
Solitary Sandpiper	6									0.083	0.003	0.021													0.004
Wandering Tattler	2																	0.019							0.001
Greater Yellowlegs	2										0.006														0.001
Lesser Yellowlegs	32							0.010		0.083	0.037	0.051			0.100			0.010					0.024			0.023
Whimbrel	4										0.006			0.048											0.003
Least Sandpiper	18									0.083	0.003	0.005		0.024	0.250			0.019		0.077		0.033	0.018			0.013
Wilson's Snipe	273			0.500	0.308		0.571	0.146	0.071	0.083	0.186	0.272		0.071	0.450			0.078	0.429	0.154	0.143	0.293	0.379	0.067	0.091	0.200
Red-necked Phalarope	2														0.100											0.001
Total Average Occurrence		**0**	**0.385**	**0.500**	**0.308**	**0**	**0.571**	**0.155**	**0.071**	**0.333**	**0.244**	**0.349**	**0.500**	**0.548**	**0.900**	**0.865**	**0.375**	**0.388**	**0.429**	**0.231**	**0.143**	**0.326**	**0.420**	**0.067**	**0.091**	**0.329**
No. Point-count Plots		**7**	**39**	**2**	**13**	**3**	**14**	**103**	**14**	**12**	**349**	**195**	**4**	**42**	**20**	**52**	**8**	**103**	**7**	**13**	**14**	**92**	**169**	**45**	**44**	**1364**

Notes:

1. Average occurrence = total number of detections in each habitat/total number of point-count plots surveyed in each habitat.
2. Level-III classes of the Alaska Vegetation Classification (Viereck et al. 1992); focal habitats are the primary habitats surveyed at each point-count plot (see text).

PART A - APPENDIX F: NUMBER OF BIRDS DETECTED PER HOUR ON RIVERINE-FOCUSED SURVEY TRANSECTS ALONG TRIBUTARY STREAMS AND THE SUSITNA RIVER, 2013.

	Tributary Transects[1]									Susitna River Transects[2]						Combined Tributary/Susitna River Transects			
Common Name	**Tsusena Creek**	**Deadman Creek**	**PRM 194.8**	**Watana Creek**	**Kosina Creek**	**Jay Creek**	**PRM 218–224**	**Tributary Average**		**PRM 229–232**	**PRM 200–205**	**PRM 205–209**	**PRM 214–219**	**Susitna Average**		**PRM 227–228**	**Goose Creek/ PRM 233–235**	**Tributary/Susitna Average**	**Total**
American Wigeon											7.11			1.78					7.11
Mallard											5.53			1.38					5.53
Northern Shoveler							0.17	0.02			0.40			0.10					0.57
Northern Pintail							0.17	0.02			1.58			0.40					1.75
Green-winged Teal											8.30			2.08					8.30
Harlequin Duck	0.64	1.72	0.60	0.20	0.48		2.87	0.93		0.22	0.79	3.79	0.26	1.27		0.58	0.69	0.64	12.84
Common Goldeneye							0.34	0.05											0.34
Barrow's Goldeneye					0.48			0.07											0.48
Common Merganser										0.22				0.06					0.22
Red-breasted Merganser										0.22		1.58		0.45					1.80
Mew Gull							0.51	0.07			0.40	0.32		0.18		0.29		0.15	1.52
Waterbird Total	**0.64**	**1.72**	**0.60**	**0.20**	**0.96**		**4.05**	**1.17**		**0.67**	**24.11**	**5.68**	**0.26**	**7.68**		**0.87**	**0.69**	**0.78**	**2.39**
Spotted Sandpiper				1.42	0.72	1.11	4.73	1.14		2.68	1.58	8.83	5.22	4.58		0.87	2.54	1.71	29.70
Solitary Sandpiper			0.20					0.03											0.20
Wilson's Snipe												0.32		0.08					0.32
Shorebird Total			**0.20**	**1.42**	**0.72**	**1.11**	**4.73**	**1.17**		**2.68**	**1.58**	**9.15**	**5.22**	**4.66**		**0.87**	**2.54**	**1.71**	**30.22**
Bald Eagle					0.72			0.10											0.72
Great Horned Owl				0.20				0.03											0.20
Raptor Total				**0.20**	**0.72**			**0.13**											**0.92**
Olive-sided Flycatcher			0.20					0.03											0.20
Alder Flycatcher						0.55	0.51	0.15				3.15		0.79			0.69	0.35	0.07
Gray Jay			0.60					0.09		0.22				0.06					0.82
Tree Swallow				0.20				0.03			0.79			0.20					0.99
Violet-green Swallow						0.37		0.05				2.52		0.63					2.89
Bank Swallow												0.63	3.39	1.01					4.02
Boreal Chickadee												0.95		0.24		0.29		0.15	1.24
American Dipper	0.32							0.05								0.29		0.15	0.61
Ruby-crowned Kinglet	0.32		1.40			0.55	0.17	0.35		0.22		0.95	0.26	0.36		0.87	0.23	0.55	4.97
Gray-cheeked Thrush		0.25	1.60					0.26											1.85
Swainson's Thrush				1.22		0.18		0.20		0.22		0.63		0.21		1.16	0.23	0.70	3.64
Hermit Thrush		0.25			0.24	0.18		0.10		0.89		2.21	0.26	0.84		0.29		0.15	4.32
American Robin											0.40			0.10					0.40
Varied Thrush			0.20				0.17	0.05		0.22	0.40		0.26	0.22			0.46	0.23	1.71
Northern Waterthrush		0.49	3.20	1.42	0.48	0.18		0.82		1.12	0.79			0.48			0.92	0.46	8.60
Orange-crowned Warbler			1					0.14											1.00
Yellow Warbler											0.40			0.10					0.40
Blackpoll Warbler		1.23	5.60	2.24	0.24			1.33		0.22		0.95	0.26	0.36		0.58	0.92	0.75	12.24
Yellow-rumped Warbler	0.32		0.80	0.20		0.74	0.17	0.32		0.22		1.89		0.53		0.87	0.23	0.55	5.44
Wilson's Warbler		0.98	0.40	4.67	0.24			0.90		1.56	0.79	2.52		1.22		0.29	0.46	0.38	11.91
American Tree Sparrow												0.95		0.24					0.95

	Tributary Transects[1]									Susitna River Transects[2]						Combined Tributary/Susitna River Transects			
Common Name	**Tsusena Creek**	**Deadman Creek**	**PRM 194.8**	**Watana Creek**	**Kosina Creek**	**Jay Creek**	**PRM 218–224**	**Tributary Average**		**PRM 229–232**	**PRM 200–205**	**PRM 205–209**	**PRM 214–219**	**Susitna Average**		**PRM 227–228**	**Goose Creek/ PRM 233–235**	**Tributary/Susitna Average**	**Total**
Savannah Sparrow					0.24	1.11	0.34	0.24				2.21		0.55			0.23	0.12	4.13
Fox Sparrow			2.20	0.41	0.24		0.51	0.48		1.56	0.40	2.52		1.12		0.58	0.92	0.75	9.34
Lincoln's Sparrow			0.60					0.09											0.60
White-crowned Sparrow	0.32		0.40	0.20		0.18	0.34	0.21			0.79	4.42		1.30		2.03	0.46	1.25	9.14
Dark-eyed Junco	0.32		0.20	0.20			0.17	0.13		0.22	0.40	0.32		0.24		0.87		0.44	2.70
Unidentified redpoll			0.80					0.11		1.12		0.95		0.52					2.87
Pine Siskin			0.40					0.06											0.40
Landbird Total	**1.60**	**3.19**	**19.60**	**10.77**	**1.69**	**4.06**	**2.36**	**6.18**		**7.81**	**5.14**	**27.76**	**4.44**	**11.29**		**8.12**	**5.77**	**6.95**	**7.70**
Grand Total	**2.24**	**4.90**	**20.40**	**12.60**	**4.10**	**5.17**	**11.15**	**8.65**		**11.16**	**30.83**	**42.59**	**9.92**	**23.63**		**9.86**	**9.01**	**9.44**	**12.72**

Notes:

1. Unnamed creeks labeled according to the Project River Mile (PRM) at the confluence with the Susitna River.
2. Susitna River transects labeled according to the PRMs covered on each transect.

PART A - APPENDIX G: PHOTOGRAPHS OF SELECTED COLONIES MONITORED DURING SWALLOW NESTING SURVEYS, 2013.

Photo 1: Colony S14, erosional slope, near Susitna River.

Photo 2: Colony S4, cliff face, Susitna River.

Photo 3: Colony S15, cut bank, Susitna River.

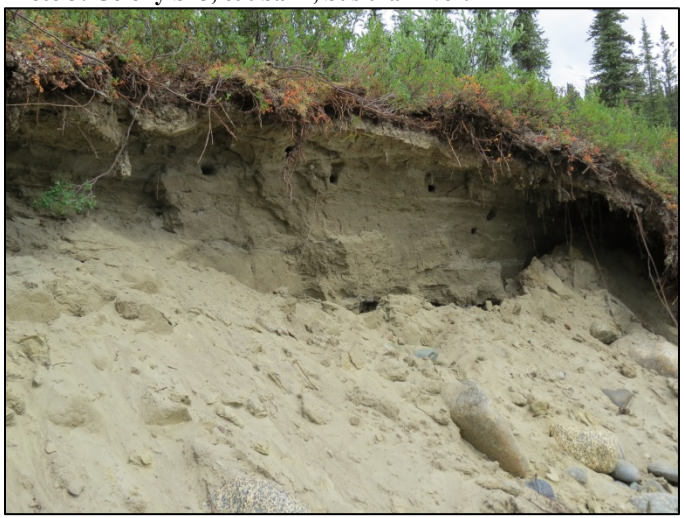

Photo 4: Colony S8, cut bank, sign of bear predation.