Susitna-Watana Hydroelectric Project (FERC No. 14241)

Waterbird Migration, Breeding, and Habitat Use (10.15)

Appendices A-S

Initial Study Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

ABR, Inc.—Environmental Research & Services

Anchorage and Fairbanks, Alaska, and Forest Grove, Oregon

February 2014 Draft

APPENDICES

Appendix A: Documentation of Consultation Among AEA, ABR, USFWS, and ADF&G Regarding Radar and Visual Migration Sampling Protocols Proposed in the RSP.

Appendix B: Numbers of Waterbirds by Species Observed During Spring and Fall Migration Surveys, 2013.

Appendix C: Abundance and Percentages of Birds Recorded During Diurnal Audio-Visual Observations in Spring and Fall 2013.

Appendix D: Flight Lines for Swans Observed During Spring Diurnal Visual Surveys.

Appendix E: Flight Lines for Waterfowl Observed During Spring Diurnal Visual Surveys.

Appendix F: Flight Lines for Eagles Observed During Spring Diurnal Visual Surveys.

Appendix G: Flight Lines for Raptors Observed During Spring Diurnal Visual Surveys.

Appendix H: Flight Lines for Sandhill Cranes Observed During Spring Diurnal Visual Surveys.

Appendix I: Flight Lines for Shorebirds Observed During Spring Diurnal Visual Surveys.

Appendix J: Flight Lines for Loons and Larids Observed During Spring Diurnal Visual Surveys.

Appendix K: Flight Lines for Swans Observed During Fall Diurnal Visual Surveys.

Appendix L: Flight Lines for Waterfowl Observed During Fall Diurnal Visual Surveys.

Appendix M: Flight Lines for Eagles Observed During Fall Diurnal Visual Surveys.

Appendix N: Flight Lines for Raptors Observed During Fall Diurnal Visual Surveys.

Appendix O: Flight Lines for Sandhill Cranes Observed During Fall Diurnal Visual Surveys.

Appendix P: Flight Lines for Loons and Larids Observed During Fall Diurnal Visual Surveys.

Appendix Q: Relative Abundance and Peak Dates of Occurrence of Avian Species Groups from Selected Alaska Spring Migration Studies.

Appendix R: Relative Abundance and Peak Dates of Occurrence of Avian Species Groups from Selected Alaska Fall Migration Studies.

Appendix S: Flight Altitudes of Avian Species from Visual Observations During Selected Alaska Migration Studies.

APPENDIX A: DOCUMENTATION OF CONSULTATION AMONG AEA, ABR, USFWS, AND ADF&G REGARDING RADAR AND VISUAL MIGRATION SAMPLING PROTOCOLS PROPOSED IN THE RSP, FEBRUARY 21–MARCH 22, 2013.

Meeting Summary
Susitna–Watana Hydroelectric Project Licensing
Bird Migration Study Plan Meeting
March 1, 2013 11:00–11:45 am
via Teleconference

Attendees:

Organization	**Name**
Alaska Department of Fish & Game (ADF&G)	Mark Burch
ADF&G	Mike Petrula
U.S. Fish & Wildlife Service (USFWS)	Steve Matsuoka
USFWS	Bob Platte
USFWS	Maureen de Zeeuw
ABR, Inc.	Brian Lawhead
ABR, Inc.	Jon Plissner
MWH	Kirby Gilbert
Solstice Alaska Consulting, Inc.	Robin Reich

Brian opened the meeting and provided background for the discussion.

AEA submitted the Revised Study Plan (RSP) to the Federal Energy Regulatory Commission (FERC) on December 14, 2012. In its Study Plan Determination on February 1, FERC accepted 44 of the 58 studies described in the RSP, including all 16 wildlife studies. The bird migration study using radar and visual observations (included in RSP Section 10.15 – Waterbirds, but which will cover all birds) was one of three studies that were accepted with changes recommended by USFWS.

USFWS's recommended change, which was accepted by FERC, was to use four observers for visual observations, monitoring all four cardinal directions simultaneously. Brian mentioned that implementing this approach would effectively double the cost of the study to exceed $1 million.

The purpose of this meeting was to provide additional description and details on the migration study methods to determine whether the original RSP methods would be acceptable to the USFWS, without the additional observers. Maureen stated that she was open to the discussion because the RSP did not provide enough details for her to be comfortable with the technical approach described in the RSP.

Accordingly, Jon (ABR's study lead for the radar/visual migration monitoring) described in detail the radar and visual observation methods proposed for the migration study.

The methods proposed for use in the migration study are based on methods that have been used successfully in recent years at wind farm sites on Fire Island and Eva Creek in recent years, as well as at Tok and Gakona in the late 1980s and early 1990s.

The Project migration study proposes to use a combination of radar and visual observations during the day and at night (using night-vision goggles). The radar will give total numbers of flocks moving through the area; however, the outputs of radar are limited. Although radar can accurately determine the speed of targets and some information on target size, it cannot provide specific information on species or flock sizes. Also, smaller targets flying within 10 meters of each other can look like larger birds. Therefore, observers using night-vision goggles will be employed to gather additional information on specific targets flying near (within 100 meters) the observers. For example, observers using night-vision goggles will gather information on the identity of waterfowl, passerines, etc. and to estimate flock sizes that are detected by the radar.

AEA is proposing to do some night-vision observations, but they are not proposing to use multiple observers or to observe throughout entire nights. Limitations in the detection range and field of view of night-vision optics limit their utility for use in obtaining passage rates. Therefore, night-vision work is not designed to get information on rates of certain taxa moving through the area, but it does provide a sample of percentages of taxa of interest, which can be applied to radar data to derive taxon-specific rates.

For the diurnal migration study work, AEA is proposing to use a single observer during most time periods. Based on ABR's experience elsewhere, using a single observer for daytime observations gives adequate sampling coverage, especially since observers will be working in shifts over entire 24-hour sampling periods. Different observers will rotate throughout the day. For other studies, ABR has used single observers for up to eight hours and every other day instead of every day.

Additional methods will be employed if migratory flight activity gets very busy, including using digital voice recorders so the observers will not have to look down to write observations.

When migration becomes very heavy, observers will switch to a sampling scheme where they will focus their observations on transects, instead of the entire sampling area, rotating focal transects among the four cardinal directions every 5-10 minutes within an hour and adjusting rates accordingly. Based on work at Eva Creek, Gakona, and Tok, birds in the Project region predominantly migrate east-southeast in the fall and west-northwest in the spring. For this reason, passage rates and other descriptions of migration can be derived from birds crossing just the north and south transects, whereas birds that only cross the east or west transects are largely local movements and provide some supplemental information on general flight patterns, but are less important for migration characterization. Under conditions of high flock densities, therefore, observers would prioritize their focus on north-south transects (e.g., 40 minutes/h), while still sampling (20 minutes/h) along the other transects as well.

Multiple observers were not proposed because of the likelihood of double counting birds that cross multiple transects and because methods are in place to get good, comparable information on migration rates under all likely scenarios.

Maureen was concerned that birds that might not be traveling during the day would not be counted. Jon and Brian said that all flying birds within range would be counted, either by radar or visual observations.

The point of the study is to get baseline information on what birds might be traveling right near dam site to assess the potential risk to birds flying into lights at the dam; therefore, the radar would be located near the dam site. The study also will document the volume and rate of bird migration over the Susitna River valley, which is considered more likely to be used as a migratory corridor than are the mountains to the north and south of the valley. In addition to the radar and visual observations, AEA will conduct repeated aerial surveys for waterbirds and separate migration watches for raptors (and other birds) in the transmission corridors.

The raptor migration watches would be completed by two crews of two observers. The crews would be dropped off by helicopter within the transmission corridors for a certain amount of time (several hours at each site). The study points would be sampled between mid-April and mid-May. The raptor migration study will also record all waterbirds, landbirds, and shorebirds that are observed. Good observation sites along the three transmission routes will be selected in the field.

The preliminary location selected for the radar site is just north of the proposed dam site within scattered spruce woodland. An open or semi-open site will be selected so the area can be monitored with minimal clutter on the radar screen. The visual observers will be located on the ground or in an observation stand at a safe distance from the radar. The radar site has been selected using high-quality DEM and LiDAR imagery for the area.

ABR developed this radar/visual methodology for bird migration monitoring and has used it in 15 to 20 other studies, primarily for wind farm predevelopment assessments throughout the United States. They have also used the methodology for monitoring migration of endangered species in Hawaii and for other bird studies in Spain and Israel.

Maureen said that this meeting provided the additional information she wanted on the migration study methods. She stated that she approved the migration study plan proposed in the RSP now that she has these additional details. She said that AEA could tell FERC that USFWS is fine with the original study. Brian and Kirby said that AEA and FERC would like the USFWS's written approval of the migration study plan described in the RSP. Maureen said that after she receives and reviews the notes of the meeting with the details of the migration study as discussed, she will send written verification of USFWS approval.

SUSITNA-WATANA HYDROELECTRIC PROJECT

EMAIL RECORD

From: deZeeuw, Maureen

Sent: Friday, March 22, 2013 1:09 PM

To: Betsy McGregor

Cc: Bob_Platte@fws.gov; Petrula, Michael J (DFG); steve_matsuoka@fws.gov; Jon Plissner; Robin Reich; Kirby Gilbert; Charles Sensiba; Burch, Mark E (DFG); Brian Lawhead

Subject: Susitna-Watana migration study - FWS/AEA differences have been satisfied

Dear Betsy,

The material presented by ABR and discussed in a meeting March 1st among ABR, the State, Fish and Wildlife Service staff including myself, and other stakeholders satisfied my concerns about the proposed radar and visual surveys for bird migration monitoring, as indicated in Brian Lawhead's meeting notes. The use of 4 observers conducting simultaneous observations will not be necessary. Would you mind also forwarding this to Wayne Dyok as well? Let me know if you have any questions.

Sincerely,
Maureen de Zeeuw
(currently on detail as Acting CPA/Energy Coordinator at 907-786-3509)
--
Maureen de Zeeuw
Fish & Wildlife Biologist

U.S. Fish and Wildlife Service
605 West 4th Avenue, Rm G-61
Anchorage, Alaska 99504
907-271-2777
907-271-2786 (fax)

On Mon, Mar 18, 2013 at 3:03 PM, Brian Lawhead <lawhead@abrinc.com>wrote:

All,
I received a reply from Mark Burch last week, but none from anyone else. If you need more time to review, please let me know right away. Otherwise, I will assume that no response means that you think no revisions of the meeting notes are required.

Maureen,
At your earliest convenience, please send a letter to Wayne Dyok and Betsy McGregor indicating that the meeting on March 1 satisfied your concerns about the proposed radar and visual surveys for migration monitoring, as indicated by the meeting notes, and reiterating your conclusion from the meeting that the use of four observers conducting simultaneous observations will not be necessary.

Thank you very much,
–Brian

From: Brian Lawhead [mailto:lawhead@abrinc.com]
Sent: Thursday, March 07, 2013 4:41 PM
To: Maureen_deZeeuw@fws.gov; Burch, Mark E (DFG); Bob_Platte@fws.gov; Petrula, Michael J (DFG); steve_matsuoka@fws.gov
Cc: Jon Plissner; Robin Reich; Betsy McGregor; Kirby Gilbert; Charles Sensiba
Subject: Re: Teleconference requested on Susitna-Watana migration study

Attached are the draft notes from last Friday's meeting. Please review and send back to me by next Wednesday, March 13, with any comments regarding the accuracy of these notes. Once finalized, they will provide the documentation for USFWS's concurrence with the methodology described in the Revised Study Plan.

Thank you,

Brian

On Fri, Mar 1, 2013 at 10:44 AM, Brian Lawhead <lawhead@abrinc.com>wrote:

Our call starts in 15 minutes. To aid in the discussion, we are providing the attached visual aid to show examples of the proposed sampling schedule.

–Brian

From: Brian Lawhead [mailto:lawhead@abrinc.com]
Sent: Monday, February 25, 2013 11:23 AM
To: 'Maureen_deZeeuw@fws.gov'; 'Burch, Mark E (DFG)'; 'Bob_Platte@fws.gov'; 'Petrula, Michael J (DFG)'; 'steve_matsuoka@fws.gov'
Cc: Jon Plissner; Robin Reich (robin@solsticeak.com); Betsy McGregor; Kirby Gilbert; Charles Sensiba (CRS@vnf.com); Dave Tessler (david.tessler@alaska.gov)
Subject: RE: Teleconference requested on Susitna-Watana migration study

For our teleconference at 11:00 AM this Friday:
The call-in number is 1-800-315-6338 and the conference code is 3957 #
Talk to you then,

Brian

From: Brian Lawhead [mailto:lawhead@abrinc.com]
Sent: Friday, February 22, 2013 12:41 PM
To: 'Maureen_deZeeuw@fws.gov'; 'Burch, Mark E (DFG)'; 'Bob_Platte@fws.gov'; 'Petrula, Michael J (DFG)'; 'steve_matsuoka@fws.gov'
Cc: Jon Plissner; Robin Reich (robin@solsticeak.com); Betsy McGregor; Kirby Gilbert; Charles Sensiba (CRS@vnf.com); Dave Tessler (david.tessler@alaska.gov)
Subject: RE: Teleconference requested on Susitna-Watana migration study

Thanks to all who responded (Bob Platte is currently out of the office). Let's plan on a week from today, please: Friday the 1st at 11:00 AM Alaska time. We will use AEA's conference bridge, for which I will forward the number and code soon.

The purpose of the meeting will be to describe and discuss the technical approach that we proposed for the migration study using radar and visual sampling. It was described in the waterbird study plan (RSP Section 10.15) but will include other species of birds too.

–Brian

From: Brian Lawhead [mailto:lawhead@abrinc.com]
Sent: Thursday, February 21, 2013 5:20 PM
To: 'Maureen_deZeeuw@fws.gov'; 'Burch, Mark E (DFG)'; 'Bob_Platte@fws.gov'; 'Petrula, Michael J (DFG)'; 'steve_matsuoka@fws.gov'; Dave Tessler (david.tessler@alaska.gov)
Subject: Teleconference requested on Susitna-Watana migration study

Hello,

I would like to schedule a teleconference with USFWS and ADF&G participants next week, in advance of the March 4 TWG meeting, to discuss the USFWS recommendations for changes to the radar/visual migration study component of the waterbirds study plan. I think the call can be accomplished in a half-hour.

I have to travel out of town on Wednesday and Thursday, so I am asking if you can participate on Monday the 25th, Tuesday the 26th, or Friday the 1st.

At minimum, it would great to have Maureen and Bob on the call from USFWS and Mark and Mike from ADF&G. If possible, it would be good to include Steve and Dave too.

Please reply regarding your availability on Monday, Tuesday, or Friday. If necessary, I can circulate a Doodle poll to facilitate planning.

Thank you very much!
Brian

~~~~~~

Brian E. Lawhead
Senior Scientist
ABR, Inc.—Environmental Research & Services
PO Box 80410
Fairbanks, AK 99708
Phone (907) 455-6777 ext 121
Fax (907) 455-6781
www.abrinc.com
~~~~~~

APPENDIX B: NUMBERS OF WATERBIRDS BY SPECIES OBSERVED DURING SPRING AND FALL MIGRATION SURVEYS, 2013.

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
Dam/Camp Area																		
Trumpeter Swan	0	0	0	0	0	0	0	2	2	0	0	0	2	0	0	0	0	0
American Wigeon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Mallard	0	0	0	0	0	0	2	0	0	0	5	0	1	9	0	0	0	0
Northern Pintail	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Green-winged Teal	0	0	0	0	0	0	14	7	0	0	0	0	0	0	0	2	0	0
Unidentified dabbler	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Ring-necked Duck	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Unidentified scaup	0	0	0	0	0	0	0	0	0	0	0	1	3	8	4	6	0	0
Harlequin Duck	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
White-winged Scoter	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Unidentified goldeneye	0	0	0	0	0	0	2	6	0	4	3	7	7	2	8	2	0	3
Red-breasted Merganser	0	0	0	0	0	0	4	0	0	3	0	0	0	3	0	0	0	0
Unidentified duck	0	0	0	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	1	2	6	2	0	0	0	0	0	0	0
Dam/Camp Area Total	0	0	0	0	0	0	29	16	16	14	11	9	13	22	12	13	0	3
Watana Reservoir																		
Greater White-fronted Goose	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Canada Goose	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trumpeter Swan	0	0	2	14	15	23	15	19	10	8	12	8	16	12	21	8	5	3
American Wigeon	0	0	0	40	81	45	60	38	15	10	17	41	137	2	23	20	0	0

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
Watana Reservoir (continued)																		
Mallard	0	0	0	32	96	37	50	32	14	17	53	42	43	36	33	108	8	6
Northern Shoveler	0	0	0	16	4	35	36	16	0	5	16	7	10	1	0	0	0	0
Northern Pintail	0	0	2	30	64	73	38	40	24	10	15	50	42	8	12	5	0	0
Green-winged Teal	0	0	0	58	14	65	46	70	32	11	9	64	117	1	7	12	0	0
Unidentified teal	0	0	0	6	4	5	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified dabbler	0	0	0	0	58	0	2	18	0	0	0	0	0	0	0	0	0	0
Ring-necked Duck	0	0	0	2	8	12	16	38	36	21	9	24	37	37	0	14	0	1
Unidentified scaup	0	0	0	0	10	74	283	418	250	509	505	420	357	251	232	144	8	28
Harlequin Duck	0	0	0	0	11	238	78	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	35	36	31	58	39	44	14	31	23	3	0	4
White-winged Scoter	0	0	0	0	0	0	38	18	8	9	17	17	20	4	5	7	0	10
Black Scoter	0	0	0	0	0	0	0	12	10	26	12	11	8	9	11	12	0	0
Unidentified scoter	0	0	0	0	0	0	0	0	7	10	0	0	0	0	0	0	0	0
Long-tailed Duck	0	0	0	0	0	0	45	17	10	15	12	5	13	9	11	9	0	0
Bufflehead	0	0	2	5	16	7	12	16	15	11	13	17	25	16	25	32	18	14
Unidentified goldeneye	0	0	0	16	41	49	34	70	27	53	27	45	48	54	62	70	2	27
Common Merganser	0	0	0	3	0	10	0	0	0	0	0	0	0	0	0	0	0	0
Red-breasted Merganser	0	0	0	0	2	11	2	11	15	15	0	9	6	1	8	0	0	0
Unidentified merganser	0	0	0	0	7	2	0	0	0	0	0	0	3	0	0	0	0	0
Unidentified duck	0	0	0	0	6	13	8	45	26	8	0	0	7	6	1	0	0	1
Red-throated Loon	0	0	0	0	0	0	1	5	0	3	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	3	0	2	1	0	0	0	0	0	0	0
Common Loon	0	0	0	0	0	0	0	7	6	9	3	4	4	0	3	2	0	0

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
Watana Reservoir (continued)																		
Horned Grebe	0	0	0	0	0	5	1	2	0	1	3	4	2	0	3	3	0	2
Red-necked Grebe	0	0	0	0	0	0	0	3	5	1	1	1	0	0	0	0	1	0
Unidentified grebe	0	0	0	0	0	0	0	2	0	5	0	0	0	0	0	0	0	0
Unidentified diver	0	0	0	0	0	0	0	0	4	0	2	1	1	0	1	0	0	2
Bonaparte's Gull	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
Mew Gull	0	0	0	44	1	5	16	1	0	0	0	0	0	0	0	0	0	0
Unidentified gull	0	0	0	0	0	21	0	2	0	0	0	0	0	0	0	0	0	0
Watana Reservoir Total	0	0	6	270	438	733	817	940	545	817	766	814	910	478	481	449	42	100
Denali Corridor																		
Canada Goose	0	0	0	10	7	19	3	0	0	0	0	0	0	0	0	0	0	0
Trumpeter Swan	0	1	13	12	18	15	27	40	47	57	46	45	47	28	24	30	4	7
Unidentified swan	0	0	0	6	12	20	0	0	0	0	0	0	0	0	0	0	0	0
American Wigeon	0	0	0	62	76	118	80	263	302	255	266	304	98	15	43	54	0	0
Mallard	0	8	0	61	64	87	20	148	99	93	62	50	39	4	41	55	1	0
Northern Shoveler	0	0	9	46	40	46	18	43	16	29	22	21	19	0	0	3	0	0
Northern Pintail	0	0	0	83	80	145	106	121	54	186	68	99	79	6	8	17	0	0
Green-winged Teal	0	0	0	22	22	31	37	236	140	112	87	236	131	3	3	12	0	0
Unidentified teal	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified dabbler	0	0	0	4	15	0	0	13	0	0	0	0	0	0	0	0	0	0
Redhead	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Ring-necked Duck	0	0	0	0	0	3	23	33	33	49	13	0	9	7	2	0	0	0
Unidentified scaup	0	0	0	0	0	18	186	435	399	384	349	360	323	171	123	45	16	14

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
Denali Corridor (continued)																		
Harlequin Duck	0	0	0	0	0	20	59	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	28	0	1	6	0	2	0	3	2	0	0	0
White-winged Scoter	0	0	0	0	0	0	20	0	0	2	0	0	0	0	0	0	0	5
Black Scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
Long-tailed Duck	0	0	0	0	0	0	23	49	48	37	27	19	11	1	0	0	0	0
Bufflehead	0	0	0	0	4	25	15	9	20	13	10	16	31	18	10	4	4	2
Unidentified goldeneye	0	0	0	4	9	12	16	21	20	21	22	18	22	11	16	151	1	1
Common Merganser	0	0	0	3	9	1	3	8	19	0	7	0	0	0	0	0	0	0
Red-breasted Merganser	0	0	0	0	2	4	22	8	12	19	16	1	0	0	1	5	0	0
Unidentified merganser	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	15	0
Unidentified duck	0	0	0	0	8	2	8	20	9	1	0	0	0	0	0	0	0	0
Red-throated Loon	0	0	0	0	0	0	4	2	7	3	0	2	2	0	0	0	0	0
Common Loon	0	0	0	0	0	0	1	3	4	3	0	3	0	0	0	0	0	0
Yellow-billed Loon	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Horned Grebe	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0
Red-necked Grebe	0	0	0	0	0	0	0	0	9	0	0	2	0	0	0	0	0	2
Unidentified grebe	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
Unidentified diver	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Sandhill Crane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
Bonaparte's Gull	0	0	0	2	0	0	4	2	0	0	0	0	0	0	0	0	0	0
Mew Gull	0	0	0	31	6	14	19	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Denali Corridor Total	0	9	22	361	376	580	727	1,455	1,241	1,274	995	1,178	812	267	290	376	47	31

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
Chulitna Corridor																		
Trumpeter Swan	0	5	8	0	2	4	3	5	4	4	7	2	2	2	2	6	0	0
American Wigeon	0	0	0	2	2	2	7	0	1	0	0	0	5	0	0	0	0	0
Mallard	0	2	5	4	6	10	8	15	3	8	1	20	13	0	2	9	0	0
Northern Shoveler	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0
Northern Pintail	0	0	8	0	0	7	2	0	2	0	3	0	1	11	0	0	0	0
Green-winged Teal	0	0	0	0	6	6	5	6	4	1	11	19	12	0	0	2	0	0
Ring-necked Duck	0	0	0	10	6	0	10	10	7	6	4	0	0	0	0	4	0	0
Unidentified scaup	0	0	0	0	4	4	7	58	35	52	40	47	25	17	0	0	7	27
Harlequin Duck	0	0	0	0	0	6	12	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	1
Long-tailed Duck	0	0	0	0	0	0	0	19	14	10	12	14	2	0	0	0	0	0
Bufflehead	0	5	10	5	8	5	4	0	0	3	4	3	2	0	0	2	9	0
Unidentified goldeneye	2	6	6	6	2	11	12	36	26	36	40	40	17	7	0	5	20	0
Common Merganser	1	2	3	4	0	7	13	0	0	0	0	0	0	0	0	0	0	0
Red-breasted Merganser	0	0	0	0	0	0	1	4	4	7	0	6	5	0	0	0	1	0
Unidentified merganser	0	0	0	0	0	2	0	0	0	0	0	0	0	31	0	0	0	0
Unidentified duck	0	0	0	4	0	0	0	0	16	1	0	0	0	0	0	0	0	0
Red-throated Loon	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	1	0	3	3	2	1	1	0	0	0	0
Common Loon	0	0	0	0	0	0	0	7	10	4	5	9	5	1	0	1	0	2
Horned Grebe	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Red-necked Grebe	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Mew Gull	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
Chulitna Corridor (continued)																		
Chulitna Corridor Total	3	20	40	35	38	67	90	162	127	135	130	164	90	71	5	29	39	33
Gold Creek Corridor																		
Canada Goose	0	0	0	0	5	2	0											
Trumpeter Swan	2	6	7	12	16	10	7	20	4	24	15	13	11	8	10	1	15	4
Unidentified swan	0	0	0	0	0	0	0	0	10	0	10	14	21	76	69	65	0	0
American Wigeon	0	0	0	76	18	52	18	35	41	86	23	49	58	142	168	73	15	29
Mallard	2	2	4	58	34	49	28	27	22	51	24	25	21	56	133	159	77	125
Northern Shoveler	0	0	0	8	23	28	10	5	0	1	0	0	4	0	0	0	20	0
Northern Pintail	0	0	16	50	8	38	5	31	12	23	14	3	16	0	29	34	0	26
Green-winged Teal	0	0	0	34	6	20	12	5	8	15	17	18	10	0	22	4	4	0
Unidentified teal	0	0	0	22	11	2	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified dabbler	0	0	0	4	4	30	2	0	0	0	0	0	0	0	0	0	0	0
Canvasback	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Ring-necked Duck	0	0	0	2	28	33	13	37	15	22	19	18	31	5	13	26	20	1
Unidentified scaup	0	0	0	0	110	94	186	95	103	135	127	125	184	175	221	223	66	119
Harlequin Duck	0	0	0	2	9	289	34	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	10	41	3	23	10	25	15	3	13	1	27	7
White-winged Scoter	0	0	0	0	0	0	5	0	0	4	0	0	0	9	7	6	9	9
Black Scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	43	0
Unidentified scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Long-tailed Duck	0	0	0	0	0	0	33	0	1	5	6	6	1	0	0	0	0	0
Bufflehead	0	0	2	4	14	77	2	0	0	0	1	5	0	9	8	13	22	10

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
Gold Creek Corridor (continued)																		
Unidentified goldeneye	0	0	3	38	36	86	31	50	44	51	40	49	54	91	95	100	74	41
Common Merganser	0	0	2	4	17	2	7	0	0	0	0	0	0	0	0	0	0	0
Red-breasted Merganser	0	0	0	0	1	39	1	10	21	17	23	24	16	6	19	9	0	2
Unidentified merganser	0	0	0	0	8	13	3	3	0	18	0	0	4	5	3	4	38	0
Unidentified duck	0	0	0	7	19	33	2	0	5	2	0	0	0	23	0	0	0	0
Red-throated Loon	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0
Pacific Loon	0	0	0	0	0	0	0	14	6	10	6	7	4	1	0	1	0	1
Common Loon	0	0	0	0	0	0	2	7	4	9	5	2	2	0	0	0	0	0
Horned Grebe	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	1	0	1
Red-necked Grebe	0	0	0	0	0	0	1	2	4	0	0	1	1	0	0	0	3	1
Unidentified grebe	0	0	0	0	0	0	0	2	0	7	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0
Mew Gull	0	0	2	34	6	9	8	2	0	0	1	0	0	0	0	0	0	0
Herring Gull	0	0	0	0	0	9	1	2	0	0	0	0	0	0	0	0	0	0
Unidentified gull	0	0	0	0	0	3	1	0	0	0	0	0	0	1	0	0	0	0
Arctic Tern	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Gold Creek Corridor Total	4	8	36	356	375	919	427	390	303	503	343	384	455	611	815	724	433	382
All Survey Areas																		
Greater White-fronted Goose	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Canada Goose	0	0	0	14	12	21	3	0	0	0	0	0	0	0	0	0	0	0
Trumpeter Swan	2	12	30	38	51	52	52	86	67	93	80	68	78	50	57	45	24	14
Unidentified swan	0	0	0	6	12	20	0	0	10	0	10	14	21	76	69	65	0	0

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
All Survey Areas (continued)																		
American Wigeon	0	0	0	180	177	217	165	336	359	351	306	394	298	159	234	150	15	29
Mallard	2	12	9	155	200	183	108	222	138	169	145	137	117	105	209	331	86	131
Northern Shoveler	0	0	9	70	69	111	66	64	16	35	38	28	33	1	0	3	20	0
Northern Pintail	0	0	26	163	152	263	151	192	93	219	100	152	138	25	49	56	0	26
Green-winged Teal	0	0	0	114	48	122	114	324	184	139	124	337	270	4	32	32	4	11
Unidentified teal	0	0	0	43	15	7	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified dabbler	0	0	0	8	77	30	8	31	0	0	0	0	0	0	0	0	0	0
Canvasback	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Redhead	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Ring-necked Duck	0	0	0	14	42	48	62	118	95	98	45	42	77	49	15	44	20	2
Unidentified scaup	0	0	0	0	124	190	662	1,006	787	1,080	1,021	953	892	622	580	418	97	188
Harlequin Duck	0	0	0	2	20	553	186	0	0	0	0	0	0	0	0	0	0	0
Surf Scoter	0	0	0	0	0	0	73	77	35	87	49	72	29	38	39	4	29	12
White-winged Scoter	0	0	0	0	0	0	63	18	8	15	18	17	20	13	12	13	9	24
Black Scoter	0	0	0	0	0	0	0	12	10	26	12	11	8	9	15	16	49	
Unidentified scoter	0	0	0	0	0	0	0	0	7	10	0	0	0	0	1	0	0	0
Long-tailed Duck	0	0	0	0	0	0	101	85	73	67	57	44	27	10	11	9	0	0
Bufflehead	0	5	14	14	42	114	33	25	36	27	28	41	58	43	43	51	53	26
Unidentified goldeneye	2	6	9	64	88	158	95	183	117	165	132	159	148	165	181	328	97	72
Common Merganser	1	2	5	14	26	20	23	8	19	0	7	0	0	0	0	0	0	0
Red-breasted Merganser	0	0	0	0	5	54	30	33	52	61	39	40	27	10	28	14	1	2
Unidentified merganser	0	0	0	0	15	17	3	3	0	22	0	0	7	36	3	4	53	
Unidentified duck	0	0	0	11	33	48	18	65	62	13	0	0	7	29	1	0	0	1

Survey Area / Species	Spring Migration							Fall Migration										
	April		May					August			September					October		
	23	29	5	11	18–19	23–24	28–29	14–18	23–25	29–30	4–6	10–12	16–18	22–23	27–29	4–6	10–12	17–18
All Survey Areas (continued)																		
Red-throated Loon	0	0	0	0	0	0	8	8	8	6	1	2	2	0	0	0	0	
Pacific Loon	0	0	0	0	0	0	0	19	8	21	12	9	5	2		1	0	1
Common Loon	0	0	0	0	0	0	3	24	24	25	13	18	11	1	3	3	0	2
Yellow-billed Loon	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
Horned Grebe	0	0	0	0	0	6	4	2	0	1	4	4	4	1	4	4	0	3
Red-necked Grebe	0	0	0	0	0	0	1	5	18	1	1	6	1	0	0	0	4	3
Unidentified grebe	0	0	0	0	0	0	0	5	2	12	0	0	0	0	0	0	0	0
Unidentified diver	0	0	0	0	0	0	0	0	4	0	2	1	2	0	1	0	0	2
Sandhill Crane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
Bonaparte's Gull	0	0	0	3	0	4	7	2	0	0	0	0	0	0	0	0	0	0
Mew Gull	0	0	2	109	13	28	46	3	0	0	1	0	0	0	0	0	0	0
Herring Gull	0	0	0	0	0	9	3	2	0	0	0	0	0	0	0	0	0	0
Unidentified gull	0	0	0	0	0	24	1	2	0	0	0	0	0	1	0	0	0	0
Arctic Tern	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Total All Survey Areas	7	37	104	1,022	1,227	2,299	2,090	2,963	2,232	2,743	2,245	2,549	2,280	1,449	1,603	1,591	561	549

APPENDIX C: ABUNDANCE AND PERCENTAGES OF BIRDS RECORDED DURING DIURNAL AUDIO-VISUAL OBSERVATIONS IN SPRING AND FALL 2013.

Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Waterfowl		229	9.68	2,658	32.46	37	3.00	372	5.77
Greater White-fronted Goose	*Anser albifrons*	12	0.51	166	2.03	0	0.00	0	0.00
Canada Goose	*Branta canadensis*	12	0.51	74	0.90	2	0.16	19	0.29
Unidentified Goose		12	0.51	68	0.83	0	0.00	0	0.00
Trumpeter Swan	*Cygnus buccinator*	20	0.85	55	0.67	8	0.65	59	0.92
Tundra Swan	*Cygnus columbianus*	38	1.61	934	11.41	3	0.24	26	0.40
Unidentified Swan		14	0.59	97	1.18	19	1.54	216	3.35
American Wigeon	*Anas americana*	1	0.04	5	0.06	0	0.00	0	0.00
Mallard	*Anas platyrhynchos*	12	0.51	43	0.53	0	0.00	0	0.00
Northern Shoveler	*Anas clypeata*	4	0.17	33	0.40	0	0.00	0	0.00
Northern Pintail	*Anas acuta*	2	0.08	4	0.05	0	0.00	0	0.00
Greater Scaup	*Aythya marila*	1	0.04	3	0.04	0	0.00	0	0.00
Surf Scoter	*Melanitta perspicillata*	8	0.34	145	1.77	0	0.00	0	0.00
White-winged Scoter	*Melanitta fusca*	7	0.30	100	1.22	0	0.00	0	0.00
Black Scoter	*Melanitta americana*	2	0.08	28	0.34	0	0.00	0	0.00

Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Common Goldeneye	*Bucephala clangula*	1	0.04	7	0.09	0	0.00	0	0.00
Barrow's Goldeneye	*Bucephala islandica*	1	0.04	2	0.02	0	0.00	0	0.00
Common Merganser	*Mergus merganser*	1	0.04	10	0.12	0	0.00	0	0.00
Red-breasted Merganser	*Mergus serrator*	2	0.08	9	0.11	0	0.00	0	0.00
Unidentified Duck		76	3.21	747	9.12	1	0.08	3	0.05
Unidentified Waterfowl		3	0.13	128	1.56	4	0.32	49	0.76
Grouse		1	0.04	2	0.02	1	0.08	1	0.02
Unidentified Ptarmigan		1	0.04	2	0.02	0	0.00	0	0.00
Unidentified Grouse		0	0.00	0	0.00	1	0.08	1	0.02
Loons		23	0.97	23	0.28	5	0.41	7	0.11
Red-throated Loon	*Gavia stellata*	1	0.04	1	0.01	0	0.00	0	0.00
Pacific Loon	*Gavia pacifica*	2	0.08	2	0.02	0	0.00	0	0.00
Common Loon	*Gavia immer*	12	0.51	12	0.15	2	0.16	2	0.03
Unidentified Loon		8	0.34	8	0.10	3	0.24	5	0.08

Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Falconiforms		422	17.84	461	5.63	159	12.88	171	2.65
Osprey	*Pandion haliaetus*	8	0.34	8	0.10	1	0.08	1	0.02
Bald Eagle	*Haliaeetus leucocephalus*	84	3.55	94	1.15	32	2.59	37	0.57
Northern Harrier	*Circus cyaneus*	47	1.99	48	0.59	5	0.41	5	0.08
Sharp-shinned Hawk	*Accipiter striatus*	28	1.18	32	0.39	22	1.78	22	0.34
Northern Goshawk	*Accipiter gentilis*	3	0.13	3	0.04	4	0.32	4	0.06
Unidentified Accipiter		0	0.00	0	0.00	1	0.08	1	0.02
Red-tailed Hawk	*Buteo jamaicensis*	3	0.13	3	0.04	8	0.65	9	0.14
Rough-legged Hawk	*Buteo lagopus*	25	1.06	27	0.33	8	0.65	10	0.16
Unidentified Buteo		5	0.21	5	0.06	10	0.81	10	0.16
Golden Eagle	*Aquila chrysaetos*	95	4.02	101	1.23	14	1.13	14	0.22
Unidentified Eagle		18	0.76	20	0.24	1	0.08	1	0.02
American Kestrel	*Falco sparverius*	1	0.04	1	0.01	0	0.00	0	0.00
Merlin	*Falco columbarius*	27	1.14	31	0.38	15	1.22	16	0.25
Gyrfalcon	*Falco rusticolus*	6	0.25	9	0.11	3	0.24	3	0.05

Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Peregrine Falcon	*Falco peregrinus*	33	1.39	36	0.44	23	1.86	25	0.39
Unidentified Falcon		7	0.30	8	0.10	0	0.00	0	0.00
Unidentified Raptor		32	1.35	35	0.43	12	0.97	13	0.20
Cranes		12	0.51	23	0.28	33	2.67	1,754	27.21
Sandhill Crane	*Grus canadensis*	12	0.51	23	0.28	33	2.67	1,754	27.21
Shorebirds		188	7.95	1,181	14.42	0	0.00	0	0.00
American Golden Plover	*Pluvialis dominica*	4	0.17	19	0.23	0	0.00	0	0.00
Semipalmated Plover	*Charadrius semipalmatus*	1	0.04	3	0.04	0	0.00	0	0.00
Spotted Sandpiper	*Actitis macularius*	1	0.04	3	0.04	0	0.00	0	0.00
Solitary Sandpiper	*Tringa solitaria*	2	0.08	2	0.02	0	0.00	0	0.00
Lesser Yellowlegs	*Tringa flavipes*	4	0.17	5	0.06	0	0.00	0	0.00
Whimbrel	*Numenius phaeopus*	15	0.63	32	0.39	0	0.00	0	0.00
Pectoral Sandpiper	*Calidris melanotos*	12	0.51	68	0.83	0	0.00	0	0.00
Long-billed Dowitcher	*Limnodromus scolopaceus*	7	0.30	23	0.28	0	0.00	0	0.00

Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Wilson's Snipe	*Gallinago delicata*	64	2.70	87	1.06	0	0.00	0	0.00
Red-necked Phalarope	*Phalaropus lobatus*	2	0.08	5	0.06	0	0.00	0	0.00
Unidentified Shorebird		76	3.21	934	11.41	0	0.00	0	0.00
Larids		111	4.69	333	4.07	3	0.24	3	0.05
Mew Gull	*Larus canus*	18	0.76	23	0.28	0	0.00	0	0.00
Herring Gull	*Larus argentatus*	63	2.66	183	2.23	1	0.08	1	0.02
Unidentified Gull		24	1.01	58	0.71	2	0.16	2	0.03
Arctic Tern	*Sterna paradisaea*	4	0.17	66	0.81	0	0.00	0	0.00
Long-tailed Jaeger	*Stercorarius longicaudus*	2	0.08	3	0.04	0	0.00	0	0.00
Owls		7	0.30	7	0.09	2	0.16	2	0.03
Northern Hawk Owl	*Surnia ulula*	0	0.00	0	0.00	2	0.16	2	0.03
Short-eared Owl	*Asio flammeus*	5	0.21	5	0.06	0	0.00	0	0.00
Boreal Owl	*Aegolius funereus*	2	0.08	2	0.02	0	0.00	0	0.00
Woodpeckers		19	0.80	21	0.26	3	0.24	3	0.05

Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Hairy Woodpecker	*Picoides villosus*	0	0.00	0	0.00	1	0.08	1	0.02
Northern Flicker	*Colaptes auratus*	18	0.76	20	0.24	0	0.00	0	0.00
Unidentified Woodpecker		1	0.04	1	0.01	2	0.16	2	0.03
Corvids		149	6.30	199	2.43	200	16.21	331	5.14
Gray Jay	*Perisoreus canadensis*	41	1.73	60	0.73	84	6.81	111	1.72
Black-billed Magpie	*Pica hudsonia*	20	0.85	30	0.37	8	0.65	9	0.14
Common Raven	*Corvus corax*	88	3.72	109	1.33	108	8.75	211	3.27
Passerines (Non-Corvids)		1,204	50.89	3,279	40.05	790	64.02	3,793	58.85
Alder Flycatcher	*Empidonax alnorum*	2	0.08	2	0.02	2	0.16	2	0.03
Northern Shrike	*Lanius excubitor*	1	0.04	1	0.01	30	2.43	34	0.53
Tree Swallow	*Tachycineta bicolor*	31	1.31	59	0.72	0	0.00	0	0.00
Violet-green Swallow	*Tachycineta thalassina*	9	0.38	12	0.15	0	0.00	0	0.00
Bank Swallow	*Riparia riparia*	22	0.93	38	0.46	0	0.00	0	0.00
Cliff Swallow	*Petrochelidon pyrrhonota*	1	0.04	1	0.01	0	0.00	0	0.00

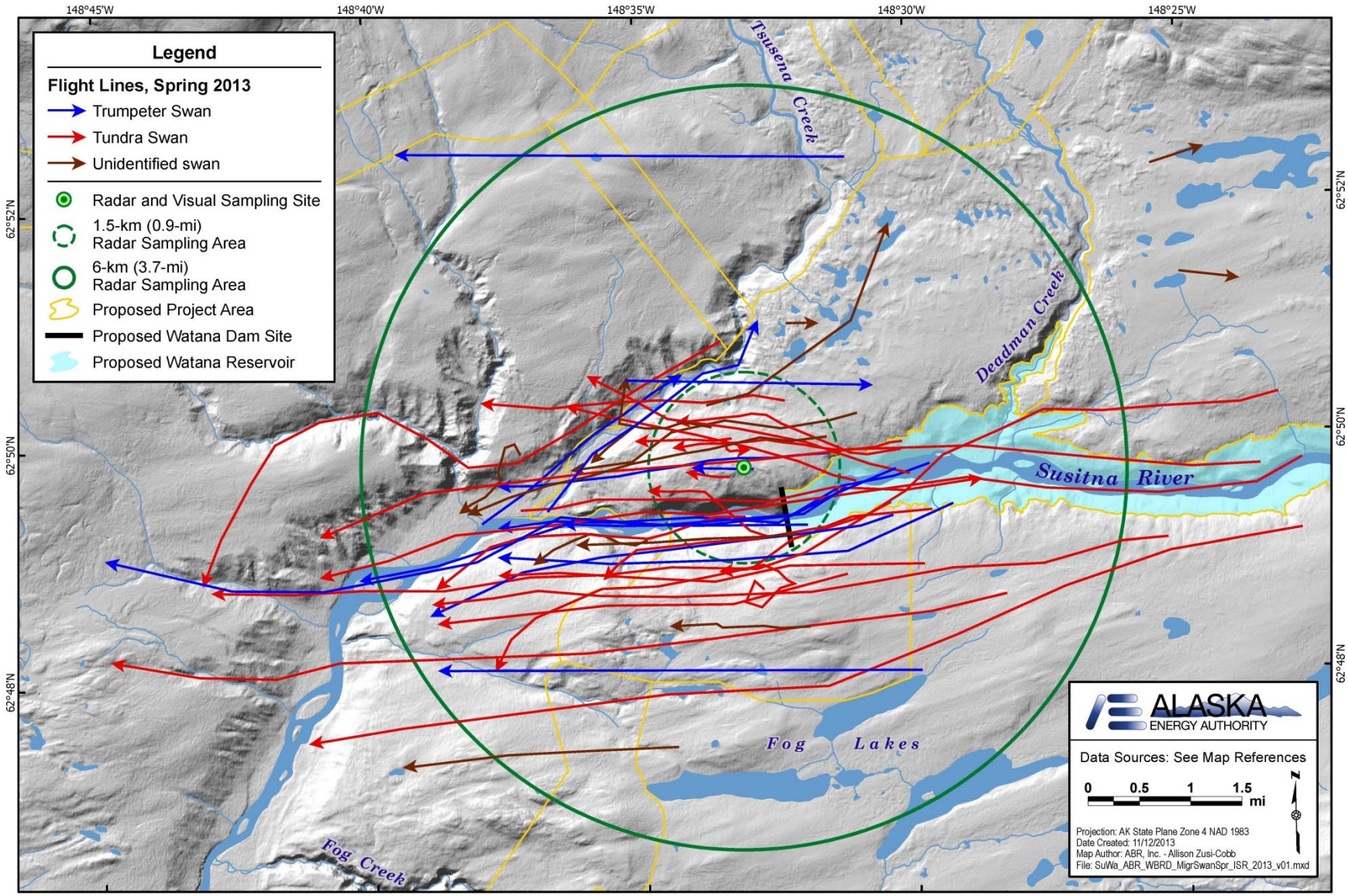
Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Black-capped Chickadee	*Poecile atricapillus*	0	0.00	0	0.00	1	0.08	1	0.02
Boreal Chickadee	*Poecile hudsonicus*	12	0.51	18	0.22	10	0.81	16	0.25
Ruby-crowned Kinglet	*Regulus calendula*	14	0.59	18	0.22	1	0.08	1	0.02
Northern Wheatear	*Oenanthe oenanthe*	6	0.25	39	0.48	0	0.00	0	0.00
Townsend's Solitaire	*Myadestes townsendi*	6	0.25	7	0.09	3	0.24	3	0.05
Gray-cheeked Thrush	*Catharus minimus*	6	0.25	7	0.09	1	0.08	1	0.02
Swainson's Thrush	*Catharus ustulatus*	13	0.55	14	0.17	2	0.16	6	0.09
Hermit Thrush	*Catharus guttatus*	10	0.42	11	0.13	14	1.13	29	0.45
American Robin	*Turdus migratorius*	91	3.85	210	2.56	71	5.75	230	3.57
Varied Thrush	*Ixoreus naevius*	28	1.18	31	0.38	18	1.46	19	0.29
American Pipit	*Anthus rubescens*	17	0.72	32	0.39	4	0.32	5	0.08
Bohemian Waxwing	*Bombycilla garrulus*	32	1.35	140	1.71	12	0.97	156	2.42
Orange-crowned Warbler	*Oreothlypis celata*	11	0.46	13	0.16	8	0.65	12	0.19
Yellow Warbler	*Dendroica petechia*	0	0.00	0	0.00	2	0.16	2	0.03
Yellow-rumped Warbler	*Setophaga coronata*	66	2.79	93	1.14	42	3.40	73	1.13

Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
Blackpoll Warbler	*Setophaga striata*	15	0.63	15	0.18	2	0.16	4	0.06
Wilson's Warbler	*Cardellina pusilla*	29	1.23	35	0.43	13	1.05	20	0.31
American Tree Sparrow	*Spizella arborea*	11	0.46	23	0.28	1	0.08	1	0.02
Savannah Sparrow	*Passerculus sandwichensis*	11	0.46	13	0.16	1	0.08	1	0.02
Fox Sparrow	*Passerella iliaca*	28	1.18	64	0.78	27	2.19	32	0.50
Lincoln's Sparrow	*Melospiza lincolnii*	0	0.00	0	0.00	1	0.08	1	0.02
White-crowned Sparrow	*Zonotrichia leucophrys*	46	1.94	133	1.62	41	3.32	72	1.12
Golden-crowned Sparrow	*Zonotrichia atricapilla*	2	0.08	3	0.04	2	0.16	3	0.05
Dark-eyed Junco	*Junco hyemalis*	30	1.27	55	0.67	29	2.35	65	1.01
Lapland Longspur	*Calcarius lapponicus*	17	0.72	339	4.14	0	0.00	0	0.00
Smith's Longspur	*Calcarius pictus*	2	0.08	21	0.26	0	0.00	0	0.00
Snow Bunting	*Plectrophenax nivalis*	14	0.59	36	0.44	0	0.00	0	0.00
Rusty Blackbird	*Euphagus carolinus*	36	1.52	74	0.90	3	0.24	10	0.16
Gray-crowned Rosy-finch	*Leucosticte tephrocotis*	7	0.30	44	0.54	0	0.00	0	0.00
Pine Grosbeak	*Pinicola enucleator*	12	0.51	21	0.26	1	0.08	2	0.03

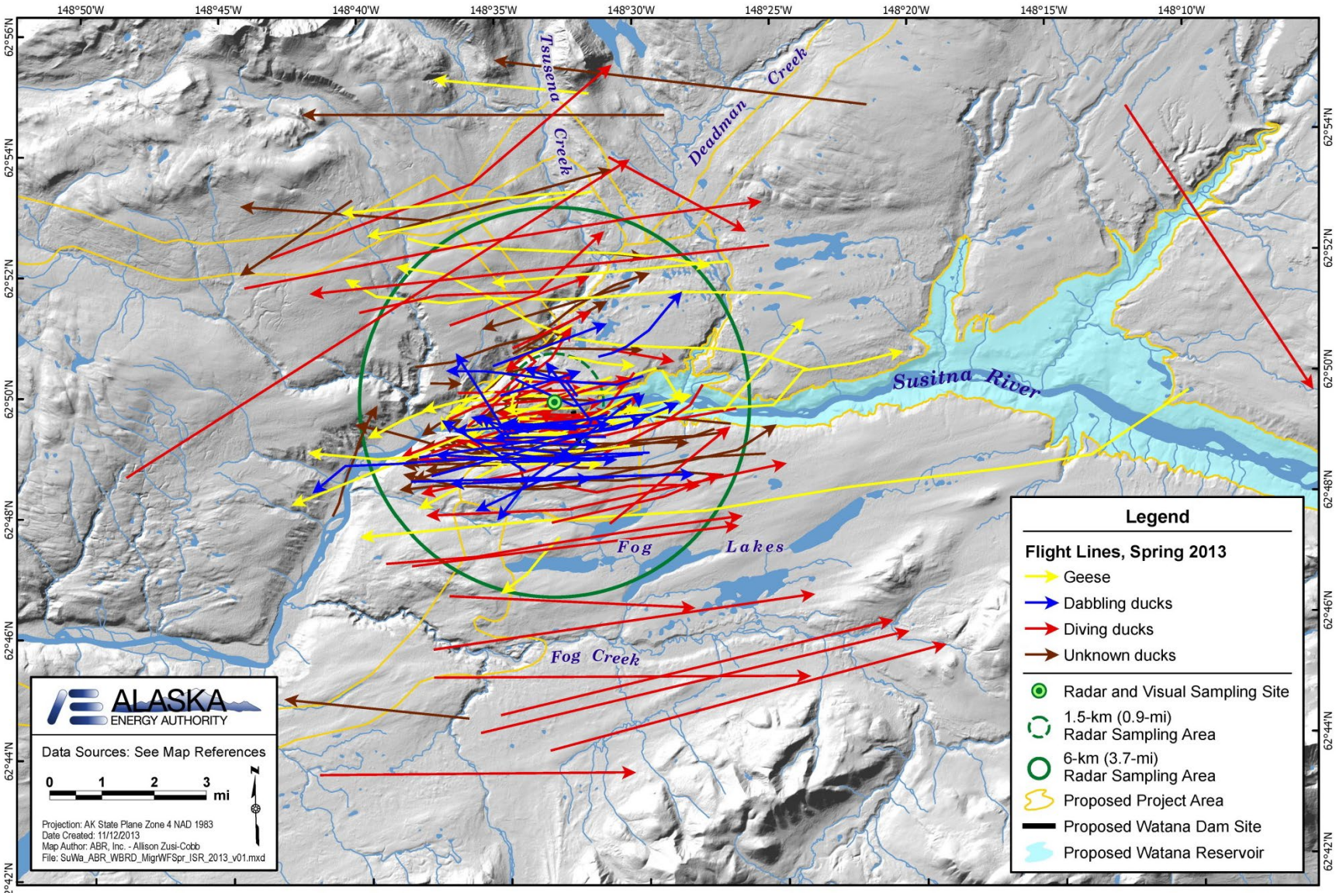
Species-group/ Common name	Scientific name	Season							
		Spring				Fall			
		Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals	Sum of Flocks	% Flocks	Sum of Individuals[1]	% Individuals
White-winged Crossbill	*Loxia leucoptera*	9	0.38	181	2.21	1	0.08	6	0.09
Common Redpoll	*Acanthis flammea*	100	4.23	404	4.93	231	18.72	1,992	30.91
Pine Siskin	*Spinus pinus*	4	0.17	5	0.06	0	0.00	0	0.00
Unidentified Passerine		453	19.15	1,067	13.03	216	17.50	994	15.42
Unidentified Birds		1	0.04	1	0.01	1	0.08	8	0.12
Total Birds		2,366	100.00	8,188	100.00	1,234	100.00	6,445	100.00

1 Audio-only records assumed to be one individual unless otherwise designated.

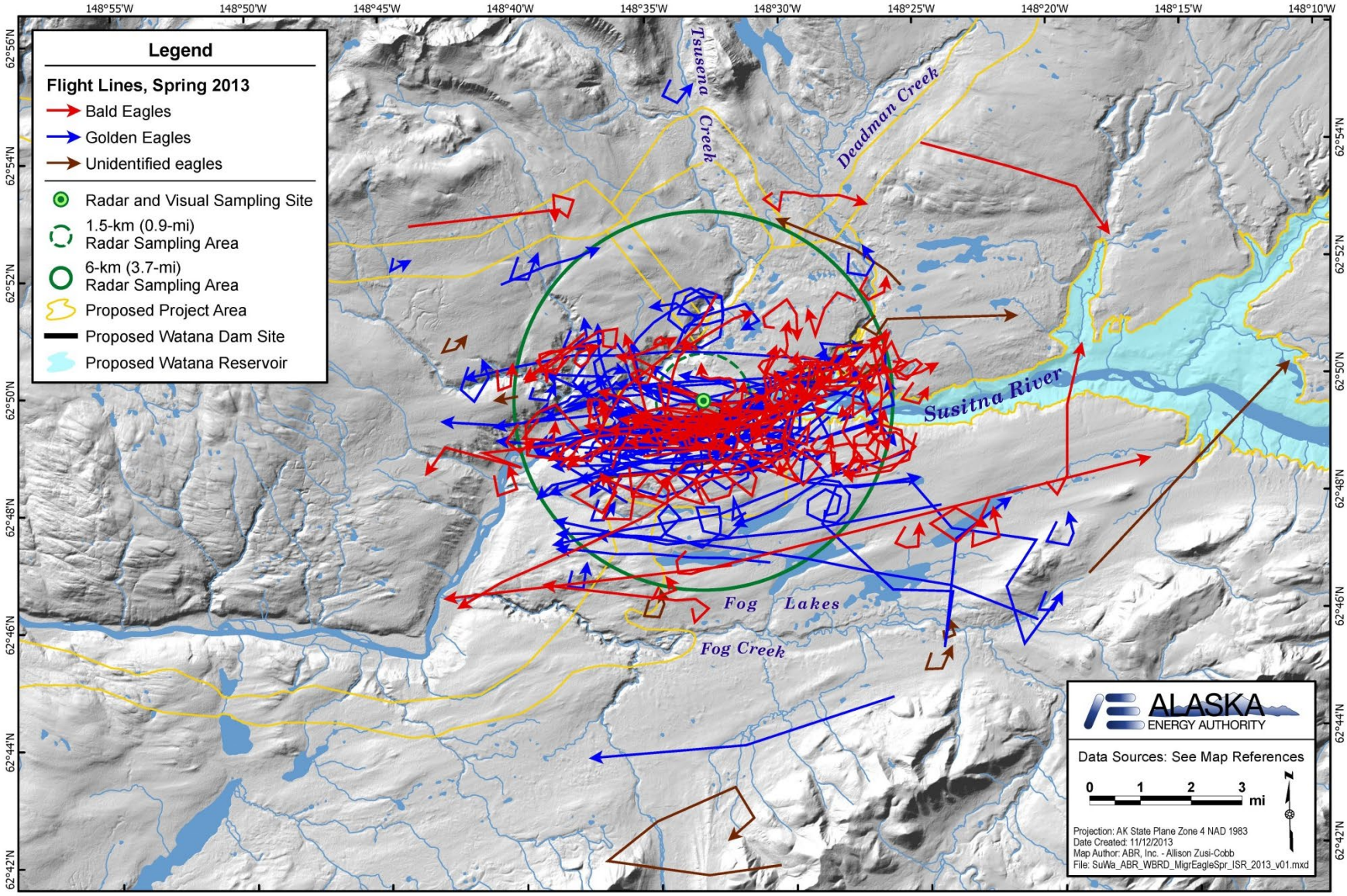
APPENDIX D: FLIGHT LINES FOR SWANS OBSERVED DURING SPRING DIURNAL VISUAL SURVEYS.


148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
62°52'N
62°50'N
62°48'N
Legend
Flight Lines, Spring 2013
Trumpeter Swan
Tundra Swan
Unidentified swan
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrSwanSpr_ISR_2013_v01.mxd

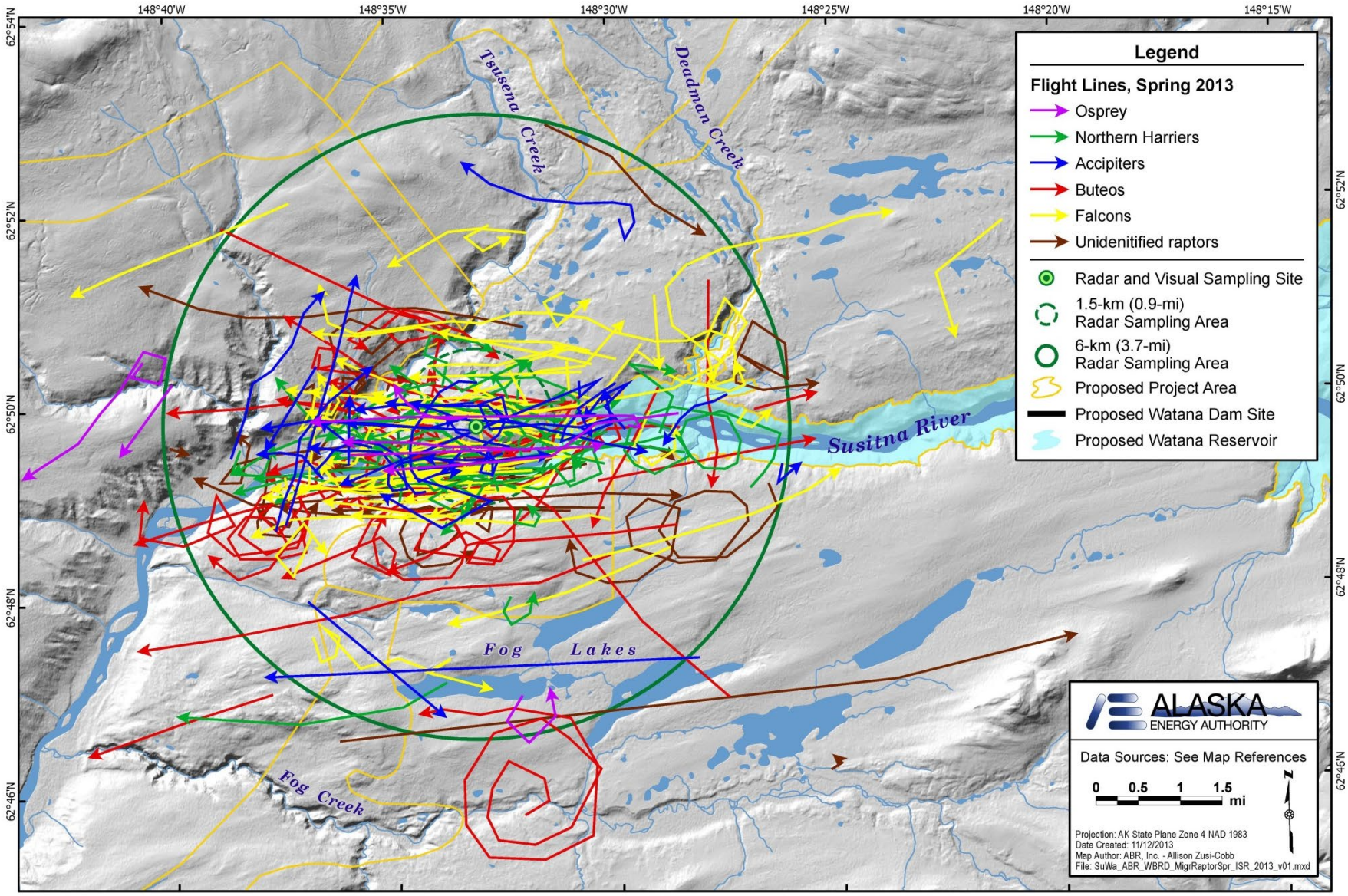
APPENDIX E: FLIGHT LINES FOR WATERFOWL (EXCEPT SWANS) OBSERVED DURING SPRING DIURNAL VISUAL SURVEYS.


148°50'W
148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
148°15'W
148°10'W
62°56'N
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
62°44'N
62°42'N
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 1 2 3 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrWFSpr_ISR_2013_v01.mxd
Legend
Flight Lines, Spring 2013
Geese
Dabbling ducks
Diving ducks
Unknown ducks
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir

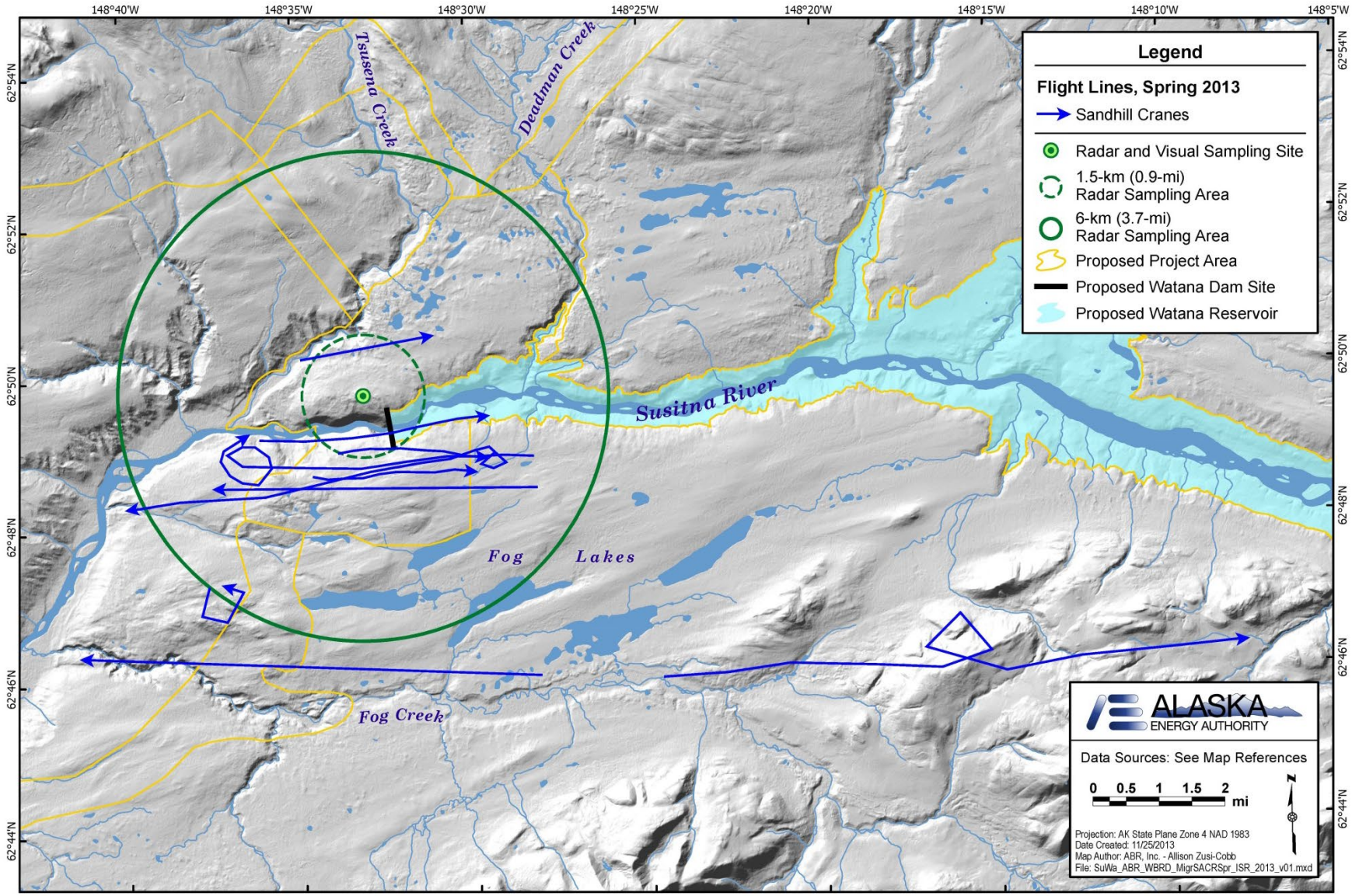
APPENDIX F: FLIGHT LINES FOR EAGLES OBSERVED DURING SPRING DIURNAL VISUAL SURVEYS.


148°55'W
148°50'W
148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
148°15'W
148°10'W
62°56'N
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
62°44'N
62°42'N
Legend
Flight Lines, Spring 2013
Bald Eagles
Golden Eagles
Unidentified eagles
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 1 2 3 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrEagleSpr_ISR_2013_v01.mxd

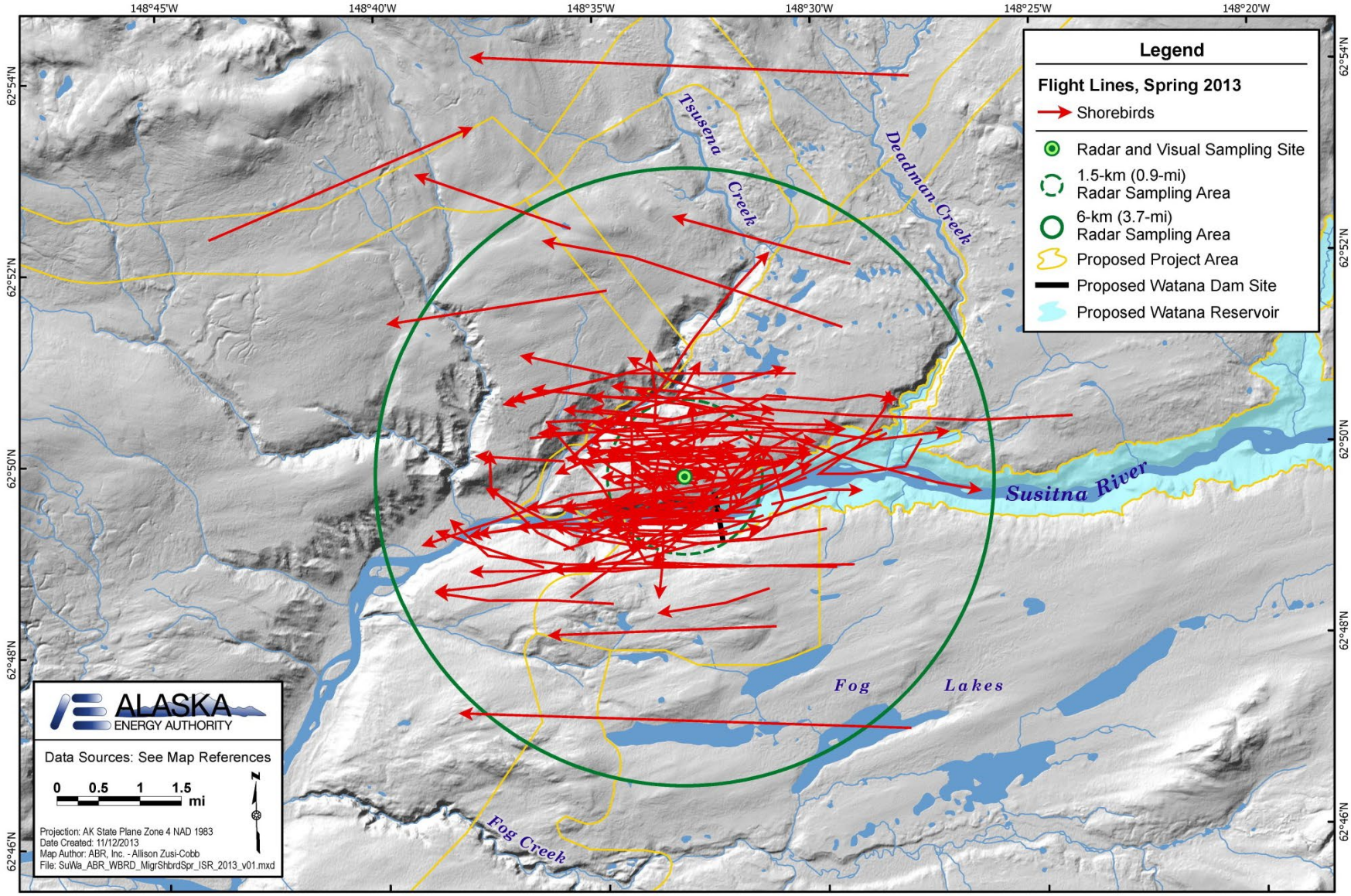
APPENDIX G: FLIGHT LINES FOR RAPTORS (EXCEPT EAGLES) OBSERVED DURING SPRING DIURNAL VISUAL SURVEYS.


148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
148°15'W
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
Legend
Flight Lines, Spring 2013
Osprey
Northern Harriers
Accipiters
Buteos
Falcons
Unidenitified raptors
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
N
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrRaptorSpr_ISR_2013_v01.mxd

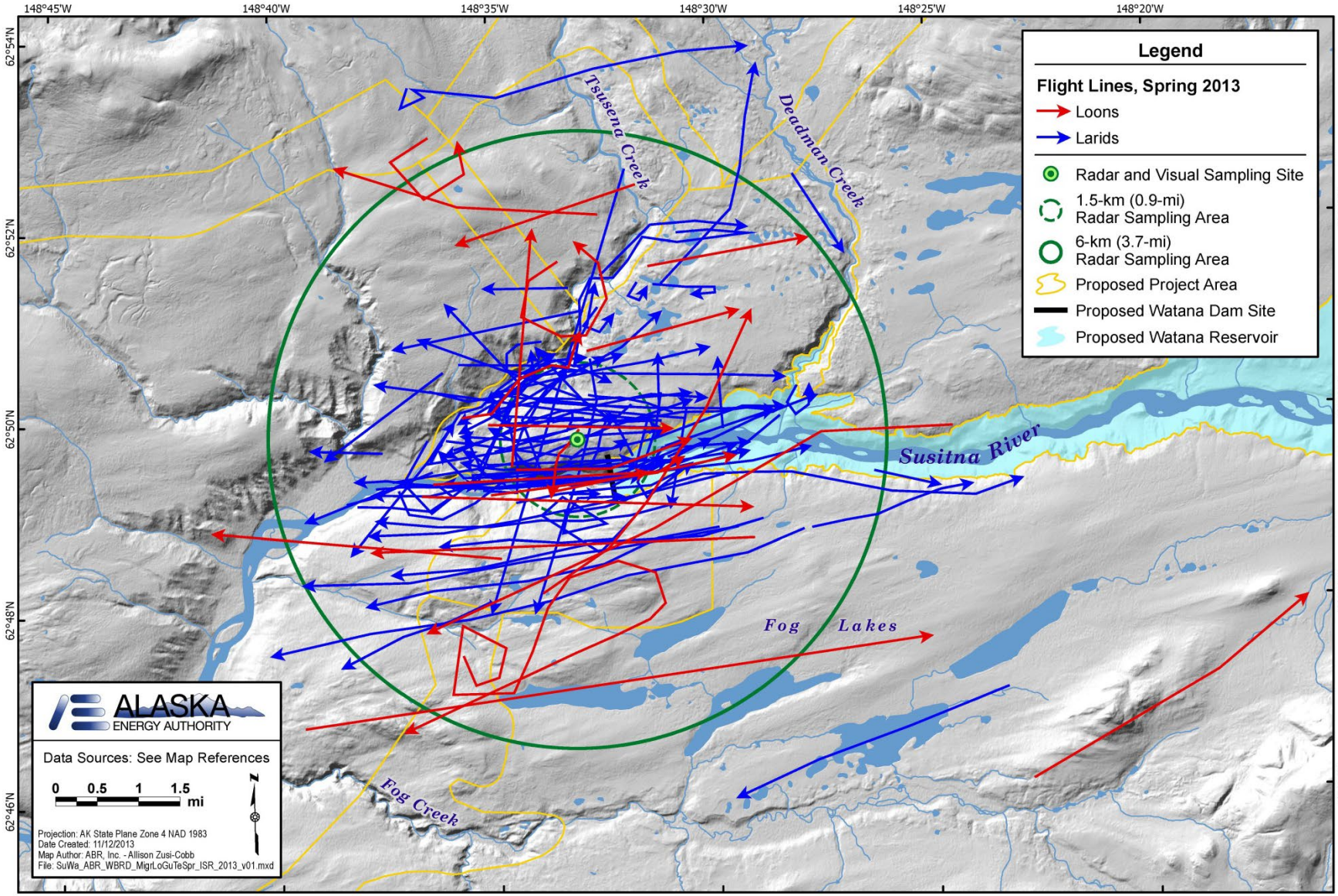
APPENDIX H: FLIGHT LINES FOR SANDHILL CRANES OBSERVED DURING SPRING DIURNAL VISUAL SURVEYS.


148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
148°15'W
148°10'W
148°5'W
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
62°44'N
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
Legend
Flight Lines, Spring 2013
Sandhill Cranes
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 2 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/25/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrSACRSpr_ISR_2013_v01.mxd

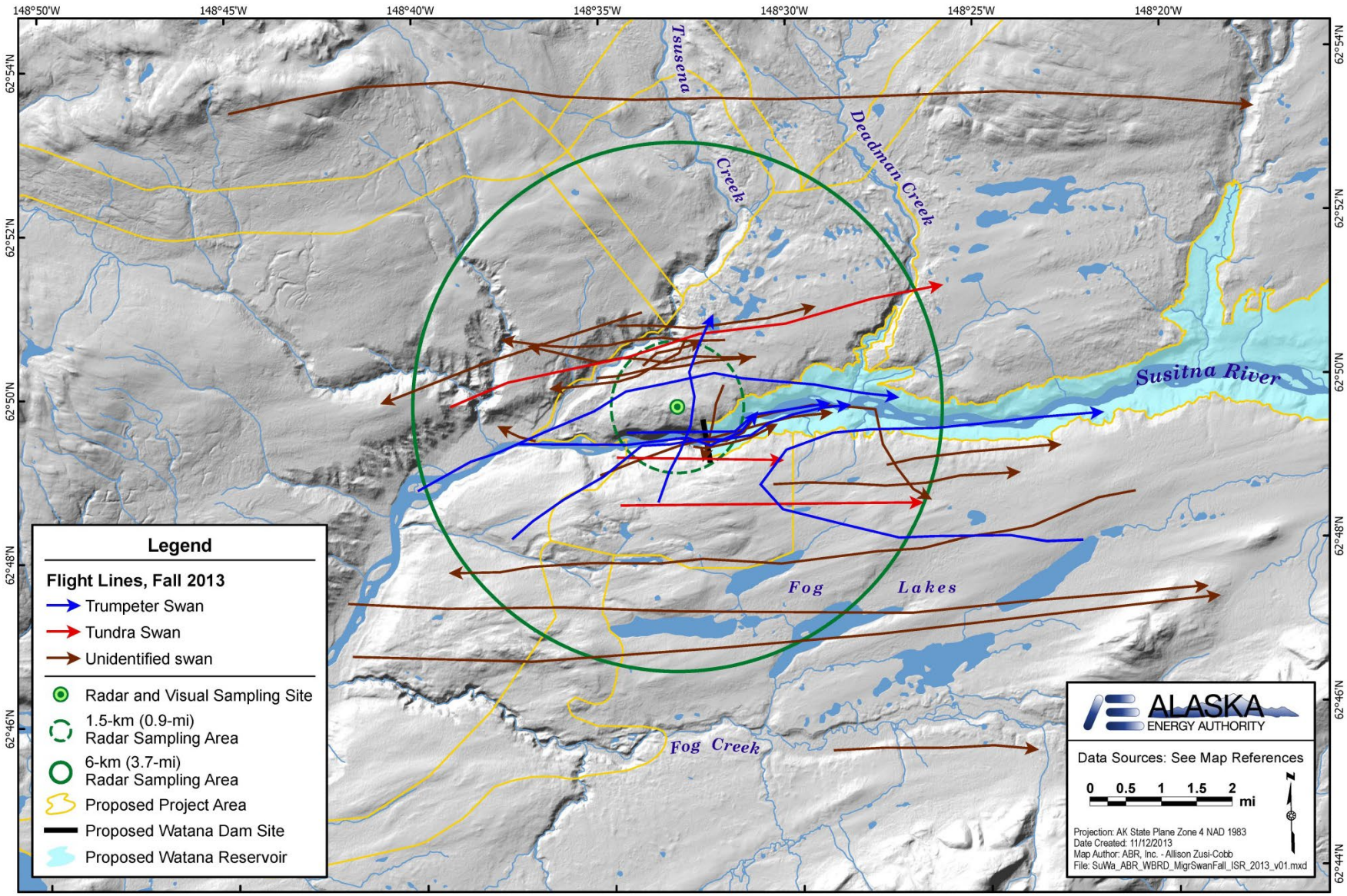
APPENDIX I: FLIGHT LINES FOR SHOREBIRDS OBSERVED DURING SPRING DIURNAL VISUAL SURVEYS.


148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
Legend
Flight Lines, Spring 2013
Shorebirds
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrShbrdSpr_ISR_2013_v01.mxd

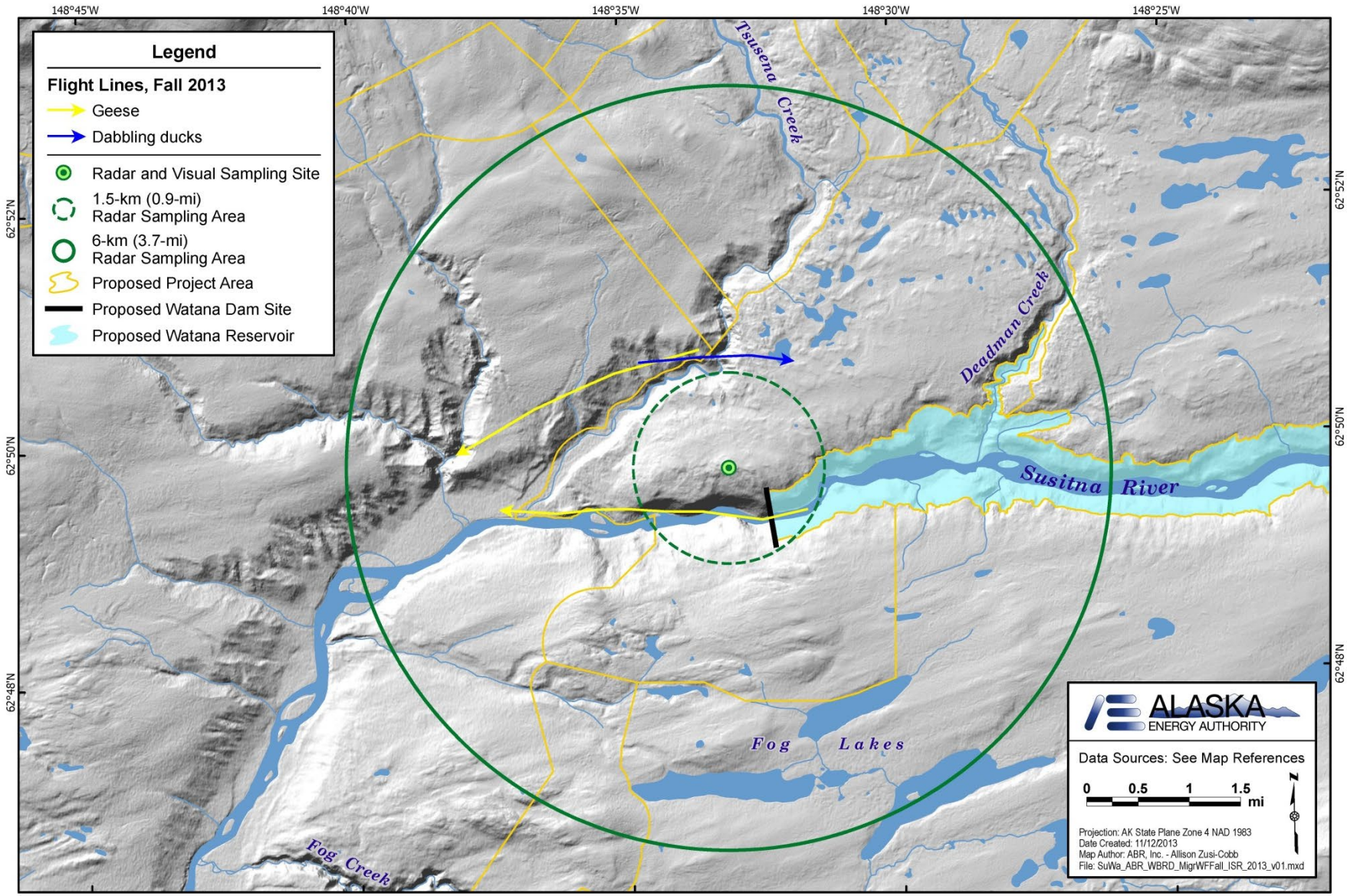
APPENDIX J: FLIGHT LINES FOR LOONS AND LARIDS OBSERVED DURING SPRING DIURNAL VISUAL SURVEYS.


148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
Legend
Flight Lines, Spring 2013
Loons
Larids
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrLoGuTeSpr_ISR_2013_v01.mxd

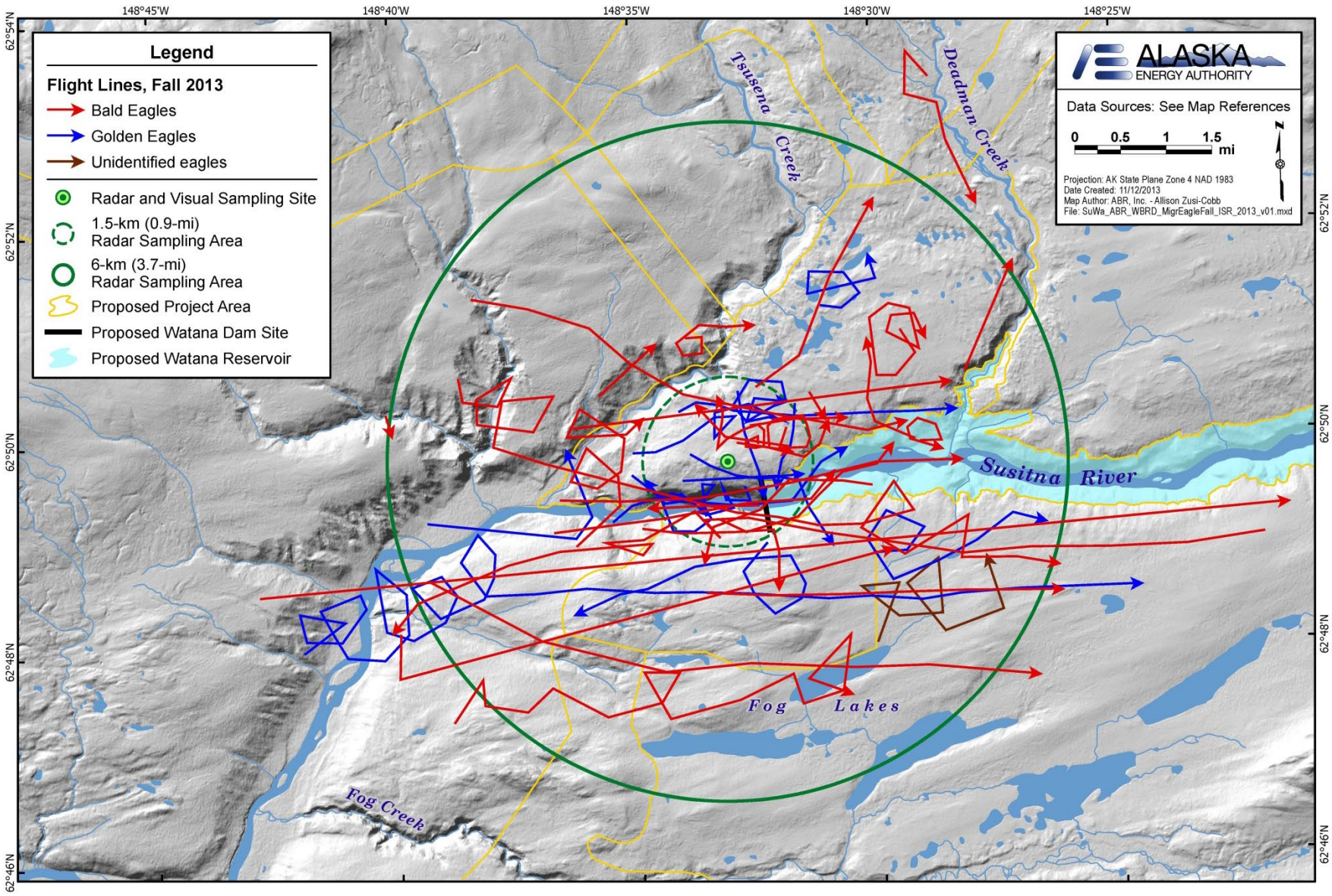
APPENDIX K: FLIGHT LINES FOR SWANS OBSERVED DURING FALL DIURNAL VISUAL SURVEYS.


148°50'W
148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
62°44'N
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
Legend
Flight Lines, Fall 2013
Trumpeter Swan
Tundra Swan
Unidentified swan
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 2 mi
N
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrSwanFall_ISR_2013_v01.mxd

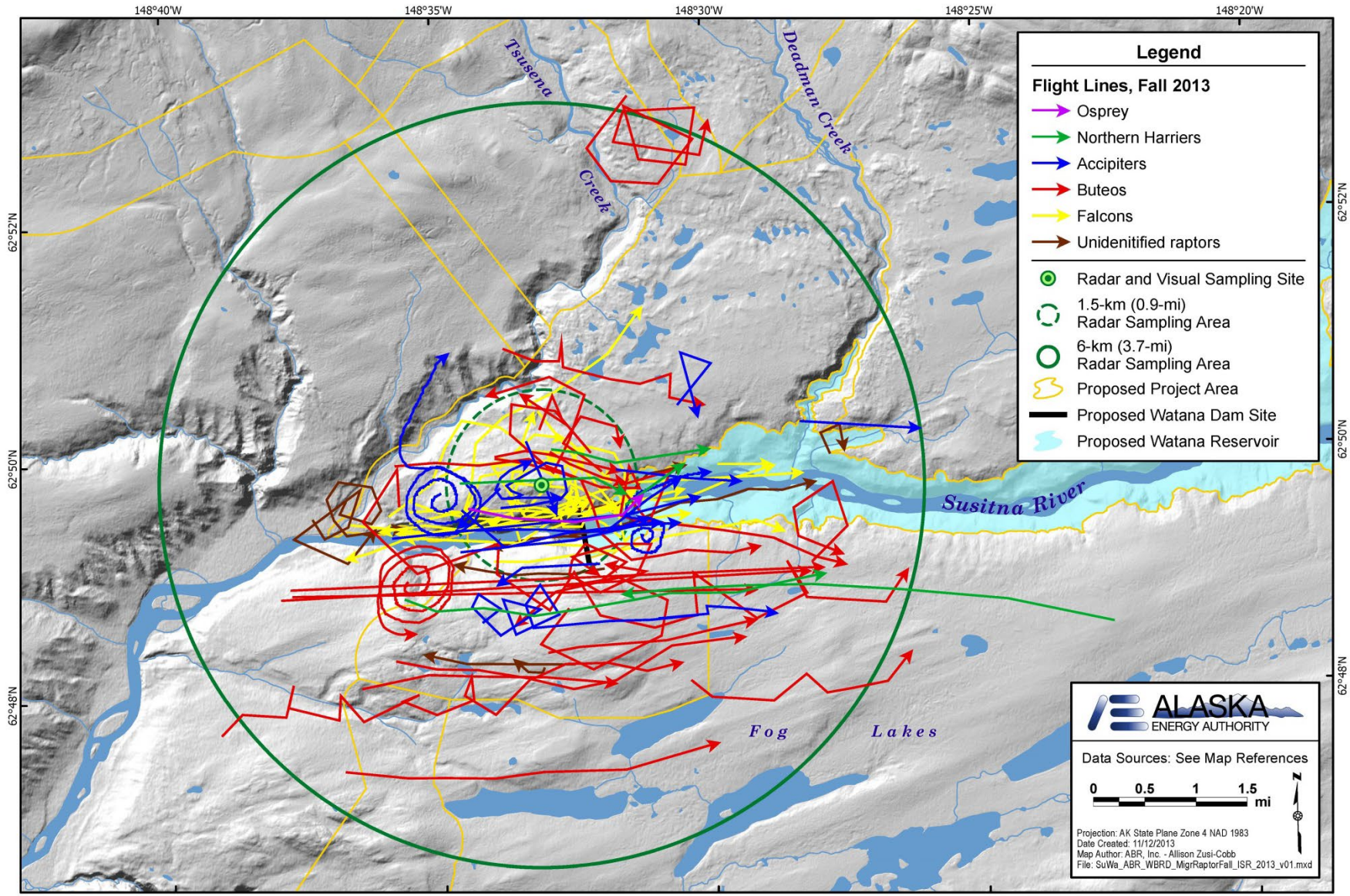
APPENDIX L: FLIGHT LINES FOR WATERFOWL (EXCEPT SWANS) OBSERVED DURING FALL DIURNAL VISUAL SURVEYS.


148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
62°52'N
62°50'N
62°48'N
Legend
Flight Lines, Fall 2013
Geese
Dabbling ducks
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrWFFall_ISR_2013_v01.mxd

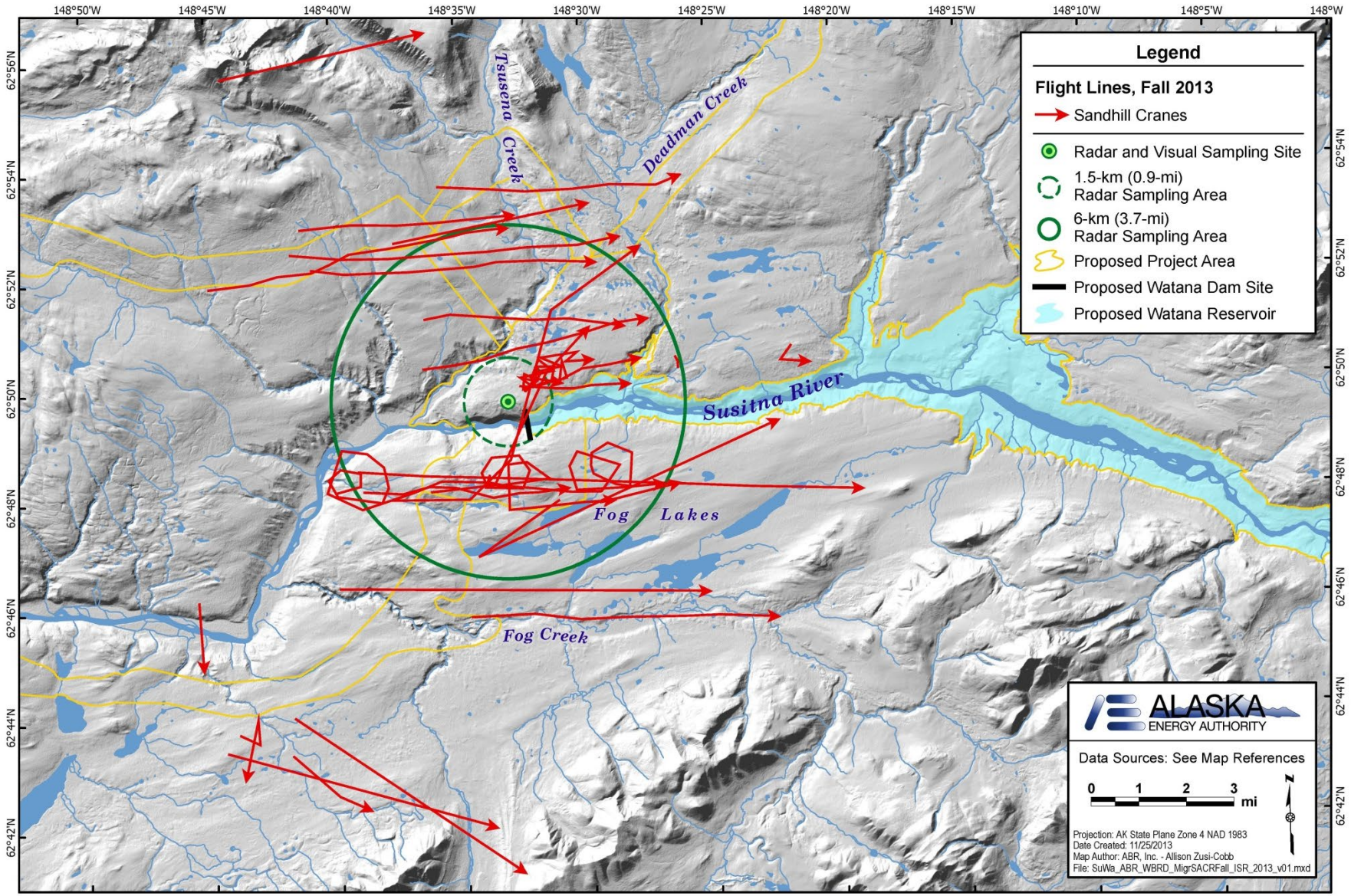
APPENDIX M: FLIGHT LINES FOR EAGLES OBSERVED DURING FALL DIURNAL VISUAL SURVEYS.


148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
Legend
Flight Lines, Fall 2013
Bald Eagles
Golden Eagles
Unidentified eagles
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrEagleFall_ISR_2013_v01.mxd
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek

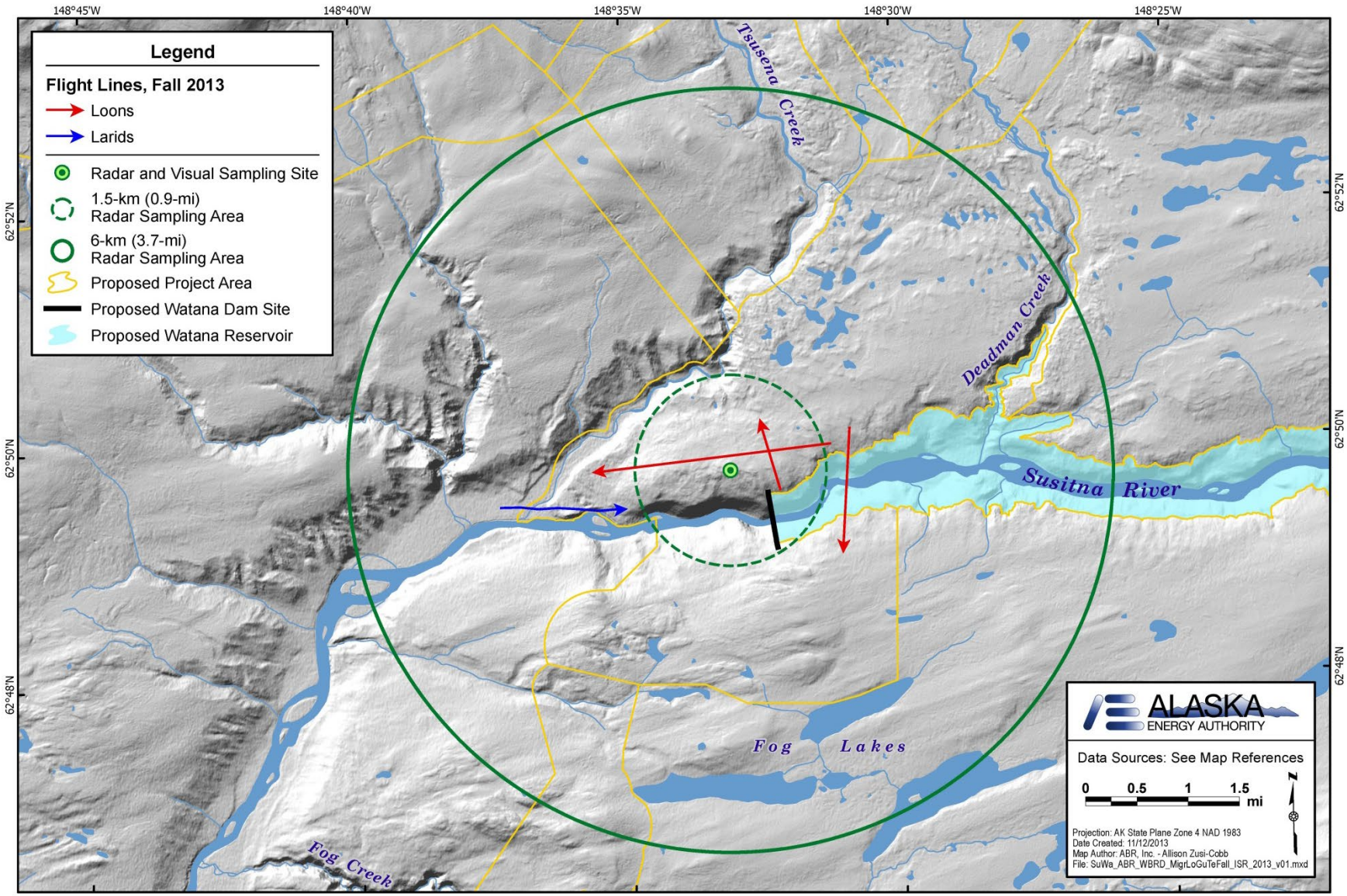
APPENDIX N: FLIGHT LINES FOR RAPTORS (EXCEPT EAGLES) OBSERVED DURING FALL DIURNAL VISUAL SURVEYS.


148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
62°52'N
62°50'N
62°48'N
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Legend
Flight Lines, Fall 2013
Osprey
Northern Harriers
Accipiters
Buteos
Falcons
Unidenitified raptors
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
N
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrRaptorFall_ISR_2013_v01.mxd

APPENDIX O: FLIGHT LINES FOR SANDHILL CRANES OBSERVED DURING FALL DIURNAL VISUAL SURVEYS.


148°50'W
148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
148°20'W
148°15'W
148°10'W
148°5'W
148°W
62°56'N
62°54'N
62°52'N
62°50'N
62°48'N
62°46'N
62°44'N
62°42'N
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
Legend
Flight Lines, Fall 2013
Sandhill Cranes
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 1 2 3 mi
N
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/25/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrSACRFall_ISR_2013_v01.mxd

APPENDIX P: FLIGHT LINES FOR LOONS AND LARIDS OBSERVED DURING FALL DIURNAL VISUAL SURVEYS.


148°45'W
148°40'W
148°35'W
148°30'W
148°25'W
62°52'N
62°50'N
62°48'N
Legend
Flight Lines, Fall 2013
Loons
Larids
Radar and Visual Sampling Site
1.5-km (0.9-mi) Radar Sampling Area
6-km (3.7-mi) Radar Sampling Area
Proposed Project Area
Proposed Watana Dam Site
Proposed Watana Reservoir
Tsusena Creek
Deadman Creek
Susitna River
Fog Lakes
Fog Creek
ALASKA ENERGY AUTHORITY
Data Sources: See Map References
0 0.5 1 1.5 mi
N
Projection: AK State Plane Zone 4 NAD 1983
Date Created: 11/12/2013
Map Author: ABR, Inc. - Allison Zusi-Cobb
File: SuWa_ABR_WBRD_MigrLoGuTeFall_ISR_2013_v01.mxd

APPENDIX Q: RELATIVE ABUNDANCE AND PEAK DATES OF OCCURRENCE OF AVIAN SPECIES GROUPS FROM SELECTED ALASKA SPRING MIGRATION STUDIES.

Species-group Species-subgroup	Study Location							
	Watana Dam Site[1]	Eva Creek[2]	Tok[3]	Gulkana[4]	Delta River[5]	Delta Junction[6]	GVEA Intertie[7]	Fire Island[8]
Waterfowl	2,658 (5/5)	1,797[9] (nr)	20,248–33,883 (nr)	2,177–13,647 (nr)	15 (nr)	23, 795 (nr)	11,331[9] (nr)	22,684 (4/19)
Swans	1,086 (5/5[10])	1,622 (4/26)	3,994–14,369 (4/24–4/27)	1,289–8,907 (4/23–4/26)	2 (nr)	13,851 (nr)	3,236 (5/15)	100 (4/23)
Geese	308 (5/7)	nr	6,827–15,428 (4/24–4/26)	127–978 (4/23–4/26)	0 (nr)	6,921 (nr)	5,055 (nr)	22,407 (4/19)
Ducks	1,136 (5/28)	nr	3,239–7,771 (4/25–4/27)	761–3,762 (4/28–4/29)	13 (nr)	252 (nr)	5,357 (nr)	125 (5/11)
Raptors	468 (5/21)	nr	797–1,196 (4/22–4/29)	201–563 (4/28–4/29)	49 (4/30)	156 (nr)	159 (4/25)	362 (4/28)
Eagles	215 (5/21)	26 (nr)	nr	nr	9 (nr)	20 (nr)	56 (nr)	243 (nr)
Other raptors	218 (5/9)	102 (nr)	nr	nr	nr	nr	79 (nr)	91 (nr)
Cranes	23 (5/9)	12,757 (5/4)	31,311–113,167 (5/4–5/10)	nr	339 (5/5)	31,163 (5/6)	30,509 (5/11)	83 (4/23)
Shorebirds	1,181 (5/17)	44 (nr)	668–4,115 (5/15–5/18)	69–147 (5/10–5/11)	8 (nr)	50 (nr)	37 (nr)	502 (5/11)
Passerines	3,369[11] (5/17)	493[11] (nr)	7,030–9,290 (4/30–5/11)	357–912 (4/29–5/6)	270 (5/7)	911 (nr)	797[11] (nr)	1,967[11] (4/24)

1 This study (April 20–June 3, 2013, 45 days).

2 Shook et al. 2011 (April 25–May 16, 2010, 21 days).

3 Cooper et al. 1991 (April 20–May 24, 1987, 45 days; April 5–May 21, 1988, 47 days; April 5–May 25, 1989, 50 days); values are ranges across 3 years of study.

4 Cooper et al. 1991 (April 16–May 15, 1987, 26 days; April 16–May 13, 1988, 28 days; April 16–May 15, 1989, 30 days); values are ranges across 3 years of study.

5 ABR 2010 (April 30–May 9, 2009, 10 days).

6 Parrett and Day 2009 (April 27–May 6, 2009, 9 days).

7 Day et al. 2011 (April 23–May 15, 2000, 18 days).

8 Day et al. 2005 (April 17–May 13, 2004, 22 days).

9 Excluding swans.

10 More flocks heard on May 3; individual count lower due to poor visibility.

11 Excluding ravens.

APPENDIX R: RELATIVE ABUNDANCE AND PEAK DATES OF OCCURRENCE OF AVIAN SPECIES GROUPS FROM SELECTED ALASKA FALL MIGRATION STUDIES.

Species-group Species-subgroup	Study Location						
	Watana Dam Site[1]	Eva Creek[2]	Tok[3]	Gulkana[4]	Delta River[5]	GVEA Intertie[6]	Fire Island[7]
Waterfowl	372 (9/23)	1,958 (nr)	31,392–37,212 (nr)	919–2,975 (nr)	100 (10/2)	1,186[8] (nr)	3,636 (10/16)
Swans	301 (9/30)	1,693 (9/7)	7,836–20,440 (9/28–10/11)	853–2,383 (10/8–10/13)	100 (nr)	12,304 (9/11)	206 (10/16)
Geese	19 (9/23)	nr	9,434–28,511 (8/20–9/8)	3–230 (8/22–10/10)	0 (nr)	139 (nr)	3,218 (10/16)
Ducks	3 (10/2)	nr	683–2,325 (9/8–10/11)	63–362 (9/9–10/5)	0 (nr)	961 (nr)	171 (10/17)
Raptors	173 (9/28)	275 (9/11)	1,237–1,787 (9/13–9/16)	179–279 (9/28–9/30)	99 (9/30)	442 (9/11)	351 (9/14)
Eagles	52 (9/28)	57 (nr)	nr	nr	17 (nr)	132 (nr)	163 (nr)
Other raptors	108 (9/28)	nr	nr	nr	nr	259 (nr)	134 (nr)
Cranes	1,754 (9/24)	48,276 (9/10)	43,442–97,988 (9/13–9/15)	nr	200 (9/10)	84,979 (9/23)	111 (9/23)
Shorebirds	0	8 (nr)	31–54 (8/27–10/8)	2–15 (9/8–10/5)	0 (nr)	6 (nr)	32 (nr)
Passerines	3,913[9] (9/12)	1,252[9] (9/10)	5,959–9,318 (8/29–10/14)	600–866 (9/4–10/13)	460 (9/15)	2,116[9] (nr)	2,546[9] (9/11)

1 This study (August 16–October 15, 2013, 61 days).

2 Shook et al. 2011 (August 26–October 7, 2010, 43 days).

3 Cooper et al. 1991 (August 16–October 6, 1987, 52 days; August 16–October 17, 1988, 33 days; August 16–October 18, 1989, 64 days); values are ranges across 3 years of study.

4 Cooper et al. 1991 (September 1– October 23, 1987, 46 days; September 3–October 19, 1988, 47 days; September 6– October 18, 1989, 43 days); values are ranges across 3 years of study.

5 ABR 2010 (September 9–19 and September 30–October 6, 2009, 18 days).

6 Day et al. 2011 (September 9–19 and September 29–October 9, 1999, 22 days).

7 Day et al. 2005 (September 2–October 17, 2004, 31 days).

8 Excluding swans.

9 Excluding ravens.

APPENDIX S: FLIGHT ALTITUDES OF AVIAN SPECIES FROM VISUAL OBSERVATIONS DURING SELECTED ALASKA MIGRATION STUDIES.

Season/Avian group	Study Location					
	Watana Dam Site[1]	Eva Creek[2]	Tok[3]	Tok[3]	Tok[3]	Fire Island[4]
Spring						
Waterfowl	160.7 ± 29.8 (41)[5]	319.4 ± 0.65 (9)[5]				
Swans	248.8 ± 38.0 (21)	266.7 ± 2.2 (29)	126 ± 10 (60)	138 ± 11 (73)	89 ± 8 (147)	142.3 ± 137.9 (353)
Geese			170 ± 11 (91)	147 ± 11 (59)	109 ± 9 (83)	47.3 ± 24.7 (9)
Ducks			63 ± 9 (139)	56 ± 9 (162)	47 ± 7 (231)	158.5 ± 138.5 (308)
Raptors			82 ± 10 (365)	67 ± 10 (309)	52 ± 9 (252)	16.9 ± 24.6 (34)
Eagles	204.9 ± 23.3(51)	148.8 ± 2.0 (26)				46.6 ± 55.5 (275)
Other raptors	104.8 ± 14.1(101)	49.1 ± 6.7 (66)				none reported
Cranes	100 (1)	364.0 ± 6.6 (103)	173 ± 10 (127)	201 ± 11 (44)	113 ± 10 (43)	76.6 ± 40.9 (19)
Shorebirds	77.4 ± 10.3 (90)		53 ± 8 (182)	32 ± 7 (192)	30 ± 7 (626)	24.7 ± 33.6 (17)
Passerines	50.7 ± 2.6 (677)[6]	28.5 ± 15.4 (100)[6]	17 ± 5 (1567)	21 ± 5 (1362)	17 ± 5 (2466)	16.1 ± 33.8 (189)
Fall						
Waterfowl	100 (1)[5]	620 ± 247.3 (5)[5]				59.2 ± 81.0 (118)
Swans	149.0 ± 80.2 (10)	248.9 ± 35.1 (36)	143 ± 11 (48)	204 ± 13 (317)	150 ± 13 (125)	125.5 ± 141.8 (10)
Geese			353 ± 16 (73)	354 ± 16 (61)	294 ± 15 (120)	76.5 ± 80.2 (67)
Ducks			49 ± 8 (12)	108 ± 13 (72)	27 ± 7 (30)	14.3 ± 21.2 (36)
Raptors			80 ± 12 (664)	123 ± 14 (609)	63 ± 11 (533)	30.4 ± 57.3 (286)
Eagles	204.3 ± 56.4 (21)	363.5 ± 61.7(41)				none reported

Season/Avian group	Study Location					
	Watana Dam Site[1]	Eva Creek[2]	Tok[3]	Tok[3]	Tok[3]	Fire Island[4]
Other raptors	65.7 ± 15.8 (51)	108.2 ± 15.1(139)				
Cranes	335.0 ± 142.2 (5)	248.7 ± 14.7(287)	224 ± 13 (61)	349 ± 16 (23)	155 ± 11 (25)	106.7 ± 40.7 (3)
Shorebirds	none reported	none reported	71 ± 12 (19)	59 ± 12 (18)	12 ± 4 (20)	none reported
Passerines	26.8 ± 2.1 (401)[6]	38.4 ± 4.5(164)[6]	32 ± 8 (1001)	23 ± 6 (1534)	27 ± 6 (2251)	18.6 ± 19.7 (613)

1 This study (Spring: April 20–June 3, 2013, 45 days; Fall: August 16–October 15, 2013, 61 days).

2 Shook et al. 2011 (Spring: April 25–May 16 2010, 21 days; Fall: August 26–October 7, 2010, 43 days).

3 Cooper and Ritchie 1995 (Spring: April 10–May 24 1987, 45 days; April 5–May 21, 1988, 47 days; April 5–May 25, 1989, 50 days; Fall: August 16–October 6, 1987, 52 days; August 16–October 17, 1988, 33 days; August 16–October 18, 1989, 64 days).

4 Day et al. 2011 (Spring: April 17–May 13, 2004, 22 days; Fall:August 2–October 17, 2004, 31 days).

5 Excluding swans.

6 Excluding ravens.