Final Environmental Impact Statement for Eagle Take Permits for the Chokecherry and Sierra Madre Phase I Wind Energy Project

Volume 3 — Attachment A, Part 2

U.S. Fish and Wildlife Service
Mountain-Prairie Region

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Attachment A (continued)

Eagle Take Permit Applications and Eagle Conservation Plan

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Appendix G

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April 2011–March 2012 Supplemental Wildlife Report
Chokecherry and Sierra Madre Wind Energy Project

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INTRODUCTION

Between April 2011 and March 2012, SWCA Environmental Consultants (SWCA) performed a second year of avian and bat surveys for the Power Company of Wyoming, LLC (PCW) within the Chokecherry and Sierra Madre Wind Energy Project (Project) site. These Year Two survey efforts included long-watch raptor surveys, aerial raptor nest surveys within 5-miles of the Project, migratory bird point counts, breeding bird grid surveys, waterbird surveys, greater sage-grouse monitoring, and acoustic bat monitoring. Year One surveys were conducted between June 2008 and June 2009 with the primary intent of collecting data for the development of an Environmental Impact Statement (EIS) for the Project. Year One surveys consisted primarily of 20-minute avian point counts, aerial raptor nest surveys within 1-mile of the Project, greater sage-grouse monitoring, and acoustic bat monitoring.

All protocols and survey methodologies used to assess wildlife in the Project site during Year Two surveys were developed in consultation with the U.S. Fish and Wildlife Service (Service), and are in accordance with recommendations made by the Service, the Bureau of Land Management (BLM), and the Wyoming Game and Fish Department (WGFD). Many of the Year Two data pertaining to eagles, raptors, nests, and greater sage-grouse have been previously analyzed and presented in the Project Eagle Conservation Plan (ECP), Bird and Bat Conservation Strategy (BBCS), 2011 and 2012 Summary Nest Reports, and Sage-grouse Conservation Plan, respectively. More detailed summaries of data from other survey efforts are contained herein.

RAPTOR SURVEYS

Bi-weekly long-watch raptor surveys were completed at 15 sites between April 4 and November 16, 2011. Monthly surveys were completed between December 2011 and March 2012. Long-watch raptor surveys were conducted at 4,000-meter (m) radius plots strategically distributed across the Chokecherry and Sierra Madre Wind Development Areas (WDAs). Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage for the purposes of identifying high-use areas while maintaining observer confidence in species identification. For the purposes of this report, only a brief summary is presented for raptor surveys; more detailed summaries and analyses for eagles and raptors are provided in the Project ECP and BBCS, respectively.

Year Two surveys were conducted for a total of 129,750 minutes, or 49.4% of the total 262,800 daylight minutes in the year. During Year Two, 324 long-watch raptor surveys were conducted between April 2011 and March 2012. Of the 324 total surveys, 109 were conducted in the spring, 45 in the summer, 110 in the fall, and 60 during the winter (Table 1). The total 129,750 minutes of survey conducted during all Year Two long-watch surveys were evenly distributed between sites and between spring and fall; however, summer and winter survey minutes were lower because the survey effort was scaled down between July 2 and August 14, and between November 17 and March 31.

Table 1. Summary of Observations from Year Two Long-watch Surveys.

Season	Surveys	Raptor Observations
Spring	109	486
Summer	45	94
Fall	110	341
Winter	60	102
Total	**324**	**1,023**

In total, 178 surveys were conducted in the Chokecherry WDA, while 146 surveys were conducted in the Sierra Madre WDA. Across all seasons, 1,023 raptor observations were made at all long-watch locations; however, most of the observations were likely the same birds being observed multiple times per survey date. This is often detailed in observational notes taken by field personnel during raptor surveys, and is further exemplified by the raptor use calculations presented in the Project BBCS, as well as information presented in the 2011 and 2012 Summary Nest Reports. The Raptor use calculations presented in the BBCS show relatively consistent use between all seasons during Year Two, which indicates there are not large influxes of migrant raptors moving into the Project during the spring and fall months. Additionally, the results presented in the 2011 and 2012 Summary Nest Reports show relatively low numbers of nesting raptors occurring in the Project site and immediate surrounding area. These data indicate that the majority of the 1,023 raptor observations are likely repeat observations of the same resident individuals as there does not appear to be strong raptor migration through the area, nor are there high numbers of nesting raptors occurring in the Project.

MIGRATORY BIRD SURVEYS

Migratory bird point count surveys were completed in conjunction with the long-watch raptor surveys, and therefore the number of sites as well as the weekly scheduling was identical to the raptor surveys. Each migratory bird survey point was established in representative habitat near each raptor monitoring site at sufficient distance to ensure that the observer for the raptor surveys would not likely impact migratory bird species behavior at the point count location.

Point count surveys were conducted across all daylight hours to account for time-of-day effects. For any individual point, surveys were conducted between 7:30 am and 6:30 pm on a pre-determined, systematic schedule. All birds detected within a 200-m radius were recorded during the point count surveys. The data collected during these counts included species, number of individuals, radial distance from observer, behavior, and general demographic data. Standard survey and environmental data (e.g., time, date, wind speed, temperature) were also collected.

The metrics used to characterize avian use are number of species, number of individuals, number of flocks, species frequency (the percentage of 20-minute surveys on which a species was observed), occurrence frequency (percentage of surveys with at least one bird detection), and mean use (average number of individuals per 20-minute survey).

Vegetation data collected across 500 transect surveys conducted by SWCA in 2009 was used to characterize major habitat types at each point. Table 2 summarizes the percentage of major habitat types (minimum 5% of total acreage) within the 200-m radius survey area (31.03 acres) of each location center.

Table 2. Percentage of Major Habitat Categories within 200-m Radius of Migratory Bird Survey Points (Minimum 5%).

Survey Site	Habitat Category							
	Aspen-Mixed Conifer	Dense Sagebrush	Sagebrush Steppe	Salt Desert Shrub	Upland Grassland	Sparsely Vegetated	Lowland Mesic Zone	Montane Shrubland
1		18	74		6			
2				95				
3	39		54					
4	23		30		30	5		6
5			62	6	30			
6			67		31			
7			52		43			
8		16	69		14			
9			75	9	11			
10			89	7				
11		11	75		9			
12			45		51			
13		17	70				8	
14			16	63		18		
15		13	45	37				

Note: Due to rounding error and minimum requirement of 5% coverage, total habitat coverage may not equal 100%.

Sagebrush steppe comprised a substantial portion (≥30%) of 13 survey sites. Salt desert shrub dominated at survey sites 2 and 14 (95% and 63%, respectively). Aspen-mixed conifer was well-represented at survey sites 3 and 4 (39% and 23%, respectively), as was upland grassland with ≥30% coverage at survey sites 4, 5, 6, 7, and 12. Dense sagebrush, sparsely vegetated, lowland mesic zone, and montane shrubland were also identified with >5% coverage at several survey sites. Barren ground was the only major habitat category to not register at least 5% coverage on any site.

Between April 4, 2011, and March 27, 2012, 295 migratory bird surveys were conducted. Point count locations were each surveyed 16 to 23 times, with the variation in number of surveys due to safety and accessibility concerns arising from inclement weather. These same factors are also the cause of differences in the overall number of migratory bird surveys relative to long-watch raptor surveys.

In sum, 1,518 individuals in 969 flocks representing 43 species were recorded during all surveys combined in the 12-month survey period (Table 3). Of the 295 surveys completed, no birds were recorded on 74 of the surveys for an occurrence frequency of 75% (221 of 295 surveys). Mean use was 5.1 individuals/survey. Horned lark (*Eremophila alpestris*)

dominated the number of observations, accounting for 951 (62%) individuals with a mean use of 3.2 individuals/survey. Horned lark was also the most frequently encountered species on surveys, with the species recorded on 67% of surveys.

Table 3. The Number of Individuals, Flocks, Species Frequency, and Mean Use for All Migratory Bird Survey Point Locations Combined, April 2011–March 2012.

Species	# of Individuals	# of Flocks	Species Frequency (as %) (n = 295)	Mean Use
Horned Lark	935	530	67	3.2
Brewer's Sparrow	70	65	13	0.2
Vesper Sparrow	68	67	15	0.2
American Crow	55	2	<1	0.2
Rock Wren	43	40	11	0.1
Sage Thrasher	41	39	11	0.1
Sage Sparrow	42	34	6	0.1
Common Raven	34	27	8	0.1
Western Meadowlark	29	25	6	0.1
Sparrow sp.	29	19	6	0.1
American Robin	18	10	3	0.1
Greater Sage-grouse	18	3	1	0.1
Mountain Bluebird	16	11	4	0.1
Common Nighthawk	12	9	2	0.0
Undetermined sp.	12	11	3	0.0
Passerine sp.	9	6	2	0.0
American Kestrel	8	7	2	0.0
Green-tailed Towhee	7	7	3	0.0
White-throated Swift	6	1	<1	0.0
Barn Swallow	5	3	1	0.0
Black-billed Magpie	5	3	1	0.0
Tree Swallow	5	4	1	0.0
American Goldfinch	4	4	2	0.0
Song Sparrow	4	4	2	0.0
Violet-green Swallow	4	4	1	0.0
Warbler sp.	4	2	1	0.0
Chipping Sparrow	3	3	1	0.0
Evening Grosbeak	3	3	<1	0.0
Mourning Dove	3	2	1	0.0
Savannah Sparrow	3	3	1	0.0
Brown-headed Cowbird	2	2	1	0.0
Dark-eyed Junco	2	2	1	0.0
Northern Flicker	2	2	1	0.0
Gray-crowned Rosy-Finch	2	1	<1	0.0
Turkey Vulture	2	1	<1	0.0
Brewer's Blackbird	1	1	1	0.0
Golden Eagle	1	1	<1	0.0
House Finch	1	1	<1	0.0
House Wren	1	1	1	0.0
Killdeer	1	1	<1	0.0

Species	# of Individuals	# of Flocks	Species Frequency (as %) (n = 295)	Mean Use
Loggerhead Shrike	1	1	<1	0.0
Northern Harrier	1	1	<1	0.0
Red-tailed Hawk	1	1	<1	0.0
Rufous Hummingbird	1	1	<1	0.0
Sharp-shinned Hawk	1	1	<1	0.0
Swallow sp.	1	1	<1	0.0
Western Kingbird	1	1	<1	0.0
Woodpecker sp.	1	1	<1	0.0
Total (43)	**1,518**	**969**	**75***	**5.1**

* Seventy-four surveys resulted in zero bird detections; therefore, percentage of surveys with at least one bird detection was 75%.

Note: Because of rounding error, mean use values may not equal total shown.

Summary results for individual point count locations are presented in Table 4. Values for number of species (range = 6–18), number of individuals (range = 26–168), number of flocks (range = 23–94), and mean use (range = 1.3–8.1) varied between sites.

Table 4. Summary of Key Metrics for Individual Migratory Bird Point Count Locations, April–November 2011.

Survey Site	# of Surveys	# of Species	# of Individuals	# of Flocks	% of Surveys w/ Bird Detections	Mean Use[1]
1	20	6	86	60	60	4.3
2	20	6	26	23	70	1.3
3	16	17	120	57	81	7.5
4	19	11	76	50	84	4.0
5	20	9	113	76	70	5.7
6	20	10	111	94	70	5.6
7	20	7	67	41	70	3.4
8	21	11	118	93	81	5.6
9	19	6	94	64	79	4.9
10	20	12	161	72	80	8.1
11	20	10	88	71	75	4.4
12	19	10	99	70	74	5.2
13	23	18	168	91	74	7.3
14	19	8	116	50	79	6.1
15	19	9	75	57	79	3.9
Total	**295**	**43[2]**	**1,518**	**969**	**75%[3]**	**5.1**

[1] Because of rounding error, mean use values may not equal total shown.

[2] The same species were observed at multiple sites; therefore, this total represents the number of individual species observed at all sites.

[3] Seventy-four surveys resulted in zero bird detections; therefore, percentage of surveys with at least one bird detection was 75%.

Survey site 2 had relatively few birds (26 individuals; mean use = 1.3) recorded on the 20 surveys conducted at that site. Survey sites 10 and 13 had the highest number of individuals (161 and 168, respectively), and sites 3 and 10 had the highest mean use (7.5 and 8.1, respectively). All sites had at least three surveys when no birds were recorded.

BREEDING BIRD SURVEYS

SWCA established and conducted 15 breeding bird survey grids in the Project site following protocols established in Rocky Mountain Bird Observatory's *Field Protocol for Spatially Balanced Sampling of Landbird Populations* (Hanni et al. 2010). This study design allows for analyses of population trends for diurnal, regular-breeding landbird species. Its application in the Project site would allow for integration into and comparison with Rocky Mountain Bird Observatory's similar efforts in the Atlantic Rim Natural Gas Development Project Area (Van Lanen et al. 2011), as well those across broader landscapes where similar studies are conducted (see White et al. 2011).

Survey areas for each grid were selected using generalized random-tessellation stratification (GRTS), a spatially balanced sampling algorithm (Stevens and Olsen 2004), without sample weighting (i.e., not accounting for any factor expected to influence a species' distribution [e.g., habitat type]). By using GRTS, data-embedded information on spatial autocorrelation can increase density estimate precision. This spatially balanced sampling design also allows for adjustment of sampling effort among years while preserving a random sampling design (Hanni et al. 2010).

Each survey site consisted of 16 point count locations in a 4 × 4 grid, with 250 m spacing between points. Each grid was surveyed once in June 2011. Surveys were initiated within 30 minutes of local sunrise and were completed by 10:00 am. Habitat information was collected at each point count location prior to conducting the avian count to allow birds time to adjust to the presence of field personnel. Habitat data collected included proximity to human-made structures (e.g., roads, fences) and variables used to describe overstory, shrub layer, and groundcover components. Standard weather (e.g., wind speed, cloud cover) variables were also collected prior to starting the avian survey. Upon completion of the habitat data collection, biologists conducted an avian survey at each point for 6 minutes. All bird detections were recorded regardless of distance. Data for each detection included species, number of individuals, horizontal distance from observer, age, sex, and how detected.

The 15 grids of 16 point counts were surveyed in June 2011 for a total of 240 individual sampling points. For all sites combined, 1,944 individuals representing 63 species were recorded (Table 5). The most prevalent species, based on total number of individuals recorded and frequency of detection (on grids and individual points), was horned lark (411 individuals, 100% occurrence on the 15 grids, and on 73% of the 240 point counts). Following horned lark, in order of prevalence, were Brewer's sparrow (*Spizella breweri*; 283, 100%, 65%), vesper sparrow (*Pooecetes gramineus*; 216, 93%, 55%), and sage thrasher (*Oreoscoptes montanus*; 138, 80%, 46%), all species closely associated with sagebrush communities. These four species combined for 1,048 individuals or 54% of all detections.

Table 5. Summary Statistics for Grid-based Breeding Bird Surveys, June 2011.

Species	# of Individuals	% Frequency on Grids (n = 15)	% Frequency on Individual Points (n = 240)
Horned Lark	411	100	73
Brewer's Sparrow	283	100	65
Vesper Sparrow	216	93	55
Sage Thrasher	138	80	46
Green-tailed Towhee	116	87	35
Rock Wren	104	67	31
Sage Sparrow	89	47	25
Western Meadowlark	58	60	15
Brown-headed Cowbird	49	60	13
American Robin	47	40	16
Common Raven	41	73	13
Sparrow sp.	32	93	10
Common Nighthawk	28	53	10
Greater Sage-grouse	23	13	<0.5
Warbling Vireo	23	27	8
House Wren	22	20	6
American Goldfinch	21	27	5
Yellow Warbler	21	20	6
Red-winged Blackbird	17	13	5
MacGillivray's Warbler	16	27	5
Mountain Bluebird	15	33	4
Chipping Sparrow	14	20	3
Dusky Flycatcher	11	7	3
Sora	10	13	3
Orange-crowned Warbler	9	13	3
Brewer's Blackbird	8	7	3
Killdeer	8	20	2
Mourning Dove	8	20	2
Savannah Sparrow	8	13	3
Northern Flicker	7	20	3
N. Rough-winged Swallow	7	20	1
Red-tailed Hawk	7	27	2
Undetermined sp.	7	27	3
Song Sparrow	6	20	2
Broad-tailed Hummingbird	5	20	2
Common Yellowthroat	4	7	1
Say's Phoebe	4	13	1
Tree Swallow	4	20	2
Wilson's Snipe	4	7	1
Ruby-crowned Kinglet	3	7	1
Western Wood-Pewee	3	7	1
American Kestrel	2	13	<0.5
Bald Eagle	2	7	1

Species	# of Individuals	% Frequency on Grids (n = 15)	% Frequency on Individual Points (n = 240)
Black-capped Chickadee	2	7	1
Black-crowned Night Heron	2	7	<0.5
Common Merganser	2	7	<0.5
Common Poorwill	2	13	1
Dark-eyed Junco	2	13	<0.5
Hermit Thrush	2	13	1
Lark Sparrow	2	7	<0.5
Northern Harrier	2	7	<0.5
Yellow-rumped Warbler	2	7	<0.5
Barn Swallow	1	7	<0.5
Bewick's Wren	1	7	<0.5
Black-billed Magpie	1	7	<0.5
Blackbird sp.	1	7	<0.5
Blue-gray Gnatcatcher	1	7	<0.5
Cliff Swallow	1	7	<0.5
Empidonax sp.	1	7	<0.5
Hammond's Flycatcher	1	7	<0.5
Loggerhead Shrike	1	7	<0.5
Mountain Chickadee	1	7	<0.5
Oriole sp.	1	7	<0.5
Swainson's Thrush	1	7	<0.5
Violet-green Swallow	1	7	<0.5
Wilson's Warbler	1	7	<0.5
Yellow-breasted Chat	1	7	<0.5
Total (63)	**1,944**	**100**	**99***

* One point count survey resulted in zero bird detections; although rounding to the nearest whole number would result in a 100% frequency (239 of 240 = 99.58%); this table shows 99% to recognize the single point count with no birds.

The number of species and number of individuals varied between survey grid sites (Table 6). The mean number of species per grid was 16 (range of 9–30), while the mean number of individuals was 130 (range of 58–182). Although the number of species at four survey locations (sites 42, 49, 94, and 263) differed from the mean by more than 50%, only one site (163) differed by 50% from the mean in the number of individuals recorded.

Table 6. The Number of Species and Number of Individuals per Grid-based Breeding Bird Survey Site, June 2011.

Grid Identifier	# of Species	# of Individuals
42	30	182
49	29	131
94	30	157
151	10	113
163	11	58
208	10	92
224	9	121
263	28	169
321	15	143
335	15	173
358	13	155
470	12	119
482	12	121
575	12	123
605	10	87
Total	**63**[1]	**1,944**

[1] The same species were observed at multiple sites; therefore, this total represents the number of individual species observed at all sites.

WATERBIRD SURVEYS

Waterbird surveys were conducted in 2011 during spring (April 26–May 4), summer (August 23–24), and fall (October 20–21) at each of the four major reservoirs (Kindt, Rasmussen, Sage Creek, and Teton) occurring within the Project site and surrounding area. These surveys were conducted to help build a baseline of potential prey species and assess their spatiotemporal abundance in the Project site at locations with the potential to attract and/or concentrate eagles and other raptor species. Surveys were conducted using spotting scopes to maximize coverage from a minimal number of viewing locations, as well as to facilitate species identification. Along with standard survey information (i.e., date, location, observer, time, weather conditions), species-specific data collected included species, age, sex, and number of individuals.

SPRING SURVEYS

Spring waterbird surveys were conducted between April 26 and May 4, 2011. These surveys resulted in a total count of 1,415 individuals representing 35 species (Table 7). American coot (*Fulica americana*) was the most abundant species accounting for 364 individuals (26% of total count). Scaup (*Aythya* sp.), *Aechmophorus* grebes (i.e., western and Clark's), and eared grebe (*Podiceps nigricollis*) were the next most abundant species with 351, 209, and 113 individuals, respectively. Collectively, those four groups accounted for 1,037 individuals or 73% of all birds detected.

Table 7. Species, Number of Individuals, and Spring Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 5/2/11	Rasmussen 5/4/11	Sage Creek 4/26/11	Teton 5/4/11	Total Count
Aechmophorus sp.		71			**71**
American Avocet	2	4	2		**8**
American Coot	198	5	100	61	**364**
American White Pelican	2	1		3	**6**
American Wigeon	5	1			**6**
Bufflehead	6	2	1	1	**10**
Calidris sp.	3				**3**
Canada Goose				5	**5**
Canvasback	4				**4**
Cinnamon Teal				3	**3**
Clark's Grebe				1	**1**
Common Loon		4	1		**5**
Common Merganser	53		7	14	**74**
Double-crested Cormorant				6	**6**
Eared Grebe	59	31	6	17	**113**
Gadwall	8	8	5	11	**32**
Greater Scaup	4				**4**
Greater Yellowlegs	2				**2**
Green-winged Teal	2	6		6	**14**
Horned Grebe			1		**1**
Killdeer	16		5	1	**22**
Least Sandpiper	1				**1**
Lesser Scaup	84	19			**103**
Lesser Yellowlegs	1				**1**
Mallard	4			2	**6**
Marbled Godwit	7	1			**8**
Northern Pintail	2			1	**3**
Northern Shoveler		2		6	**8**
Pied-billed Grebe			1		**1**
Redhead	69	11		5	**85**
Ring-billed Gull		1		1	**2**
Ring-necked Duck	8	2		16	**26**
Ruddy Duck	9				**9**
Scaup sp.	200	44			**244**
Western Grebe	39	50	34	14	**137**
White-faced Ibis		3			**3**
Willet	17	2	2		**21**
Wilson's Phalarope	3				**3**
Total	**808**	**268**	**165**	**174**	**1,415**
Number of Species	**25**	**18**	**12**	**19**	**35**

More species and individuals were counted at Kindt Reservoir (25 species, 808 individuals) than the other three reservoirs (Table 7). The fewest species and number of individuals (12 species, 165 individuals) were recorded at Sage Creek Reservoir during spring surveys.

SUMMER SURVEYS

A total of 1,708 individuals representing 29 species were recorded on summer waterbird surveys conducted on August 23 and 24, 2011 (Table 8). Redhead (*Aythya americana*) had the highest number of individuals (815) accounting for 48% of all birds detected during summer surveys. Lesser scaup (*Aythya affinis*), mallard (*Anas platyrhynchos*), and American coot were the next most abundant species with 157, 149, and 99 individuals, respectively. Collectively, those four species accounted for 1,221 individuals or 71% of all birds detected.

The highest number of individuals (920) was recorded at Rasmussen Reservoir, where 89% (780 individuals) were redheads (Table 8). Nearly all of the season's redheads (780 of 815) were recorded at Rasmussen Reservoir. Despite the high number of birds recorded at Rasmussen Reservoir, biologists recorded the fewest number of species (12) at that location.

Table 8. Species, Number of Individuals, and Summer Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 8/23/11	Rasmussen 8/24/11	Sage Creek 8/23/11	Teton 8/24/11	Total Count
American Avocet	10	4	5	6	**25**
American Coot	30		45	24	**99**
American White Pelican	10		12	2	**24**
American Wigeon	2		4	5	**11**
Black-crowned Night Heron			4	3	**7**
Blue-winged Teal		14	6		**20**
California Gull				2	**2**
Canada Goose	16	12			**28**
Common Loon		2			**2**
Common Merganser	1	16			**17**
Double-crested Cormorant			5	6	**11**
Eared Grebe	27	9	7	7	**50**
Gadwall	26			10	**36**
Great Blue Heron			1	1	**2**
Green-winged Teal	26			42	**68**
Herring Gull	3				**3**
Killdeer	1	5	1	3	**10**
Lesser Scaup	80	18	59		**157**
Mallard	102	13	25	9	**149**
Northern Pintail	4		6		**10**
Pied-billed Grebe	3			7	**10**
Redhead		780	35		**815**
Ring-billed Gull		4	2		**6**
Ruddy Duck			9		**9**

Species	Kindt 8/23/11	Rasmussen 8/24/11	Sage Creek 8/23/11	Teton 8/24/11	Total Count
Snowy Egret			1		**1**
Spotted Sandpiper	2		2		**4**
Unknown dabbling duck			35	12	**47**
Unknown gull		13		1	**14**
Western Grebe	3	30	24	10	**67**
Willet	1				**1**
Wilson's Phalarope				3	**3**
Total	**347**	**920**	**288**	**153**	**1,708**
Number of Species	**18**	**12**	**19**	**16**	**29**

FALL SURVEYS

Surveys during the fall migration period on October 20 and 21, 2011, resulted in a total of 11,473 individuals of 29 species recorded (Table 9). Similar to spring, in the fall American coot accounted for the majority of individuals (8,024, 70% of total individuals). A total of 1,692 American wigeon (*Anas americana*) were also recorded. Combined, American coot and American wigeon accounted for 9,716 individuals (85% of all individuals).

More individuals (8,773) and species (22) were recorded at Kindt Reservoir during fall surveys than at other reservoirs (Table 9). Of the 8,024 American coots and 1,692 American wigeons recorded at all reservoirs combined, the survey at Kindt Reservoir accounted for 5,810 coots (66%) and 1,690 wigeon (99%).

Table 9. Species, Number of Individuals, and Fall Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 10/21/11	Rasmussen 10/21/11	Sage Creek 10/20/11	Teton 10/20/11	Total Count
American Avocet			8		**8**
American Coot	5,810	2,088		126	**8,024**
American Wigeon	1,690	1	1		**1,692**
Bufflehead	2			1	**3**
Canada Goose	38		5		**43**
Canvasback	5		1		**6**
Common Loon		2			**2**
Common Merganser			64	6	**70**
Eared Grebe	3	98	9		**110**
Gadwall	554	20	3		**577**
Greater Yellowlegs	4				**4**
Green-winged Teal	10	33	44		**87**
Herring Gull		1		2	**3**
Hooded Merganser			3		**3**
Horned Grebe	16	13	5		**34**
Lesser Scaup	24				**24**

Species	Kindt 10/21/11	Rasmussen 10/21/11	Sage Creek 10/20/11	Teton 10/20/11	Total Count
Long-billed Dowitcher	4				**4**
Mallard	121	20	8	3	**152**
Northern Pintail	50	4	3		**57**
Northern Shoveler	1	1	11		**13**
Pectoral Sandpiper	1				**1**
Pied-billed Grebe	6	3			**9**
Redhead	328	27	4		**359**
Ring-billed Gull	1	7	11	9	**28**
Ring-necked Duck	84				**84**
Ruddy Duck	17	13	4		**34**
Surf Scoter		6			**6**
Western Grebe	4	25	3	1	**33**
White-winged Scoter		3			**3**
Total	**8,773**	**2,365**	**187**	**148**	**11,473**
Number of Species	**22**	**18**	**17**	**7**	**29**

ACOUSTIC BAT MONITORING

Anabat (Titley Electronics, Australia) is a bat detection system that uses a broadband microphone that can detect ultrasonic sounds and record them onto a compact flash data card. This system uses a frequency division technique called Zero-Crossings Analysis to produce sonograms that can be viewed on a PDA or computer screen using the AnalookW program. These sonograms display the shape of individual pulses on a frequency graph plotted against time. Bat species produce echolocation vocalizations based on their ecological niche requirements, which may demand different frequency bandwidth, pulse duration, and other characteristics discernible in the sonograms. Sonograms produced through Zero-Crossings Analysis generally have enough information to label a pulse sequence as belonging to a group of bats with similar acoustic characteristics (e.g., 25-kilohertz [kHz] bats) and even allow for identification of acoustically distinctive species (e.g., hoary bat [*Lasiurus cinereus*]) (Kunz et al. 2007). In North America, *Myotis* bat species are generally recognized as being the most difficult to differentiate due to similarities in vocalization characteristics and pulses are often placed within a frequency group (e.g., 40-kHz Myotis).

An index of bat activity was calculated by counting the number of bat passes per detector-hour past sunset (Kunz et al. 2007) for data collected in 2011. The number of detector-hours per night was calculated by summing the number of minutes surveyed between sunset and sunrise and dividing by 60 for each night surveyed. A bat pass was defined as a pulse sequence (commonly referred to as a "call") consisting of at least one individual pulse that was separated by >1 second from the next pulse (White and Gehrt 2001). An index of activity is used because the number of bats cannot be quantified from acoustic data (Kunz et al. 2007). Individual bats are not identifiable in an acoustical dataset as pulses may have been produced by the same or different individuals over the course of a single night survey period (Hayes 2000 in Kunz et al. 2007). All bat passes were categorized through assessment of both qualitative (e.g., shape) and quantitative (e.g., characteristic frequency) qualities (Weller and

Baldwin 2012). Individual passes were labeled by characteristic frequency type (e.g., 25 kHz, 30 kHz, 40 kHz), then grouped into low (<25 kHz), mid- (30–40 kHz), and high (>50 kHz) characteristic frequency groups. Diagnostic call sequences were labeled by species. For reporting purposes, except where indicated, species-specific passes were combined with the appropriate frequency group.

In 2011, four locations (sites 2-1, 3-1, 3-2, and 4-1) were surveyed for nightly bat activity. Table 10 provides the level of effort (number of nights and number of survey-hours), the total number of bat passes, and the number of passes per survey-hour.

Table 10. Level of Effort and Bat Pass Summary for Locations Surveyed in 2011.

Site	Date Span	# of Survey Nights	# of Survey-Hours	Total # of Bat Passes	# of Bat Passes per Survey-Hour
2-1	Jun 15–27	13	114.4	19	0.2
3-1	Jun 30–Jul 26	27	244.9	79	0.3
3-2	Jul 27–Aug 22	27	267.1	33	0.1
4-1	Sep 23–Oct 20	28	349.7	7	0.0
Total	**Jun 15–Oct 20**	**95**	**976.1**	**138**	**0.1**

The average number of bat passes per survey-hour across a season may be beneficial to delineate approximate dates of local bat activity, including arrival of spring migrants and departure of fall migrants. Furthermore, variation in the number of bat passes per night at an individual site may be useful in identifying migratory pulses.

Activity levels were inconsistent during the survey period (Figure 1). This inconsistency is likely due to lack of recognizable foraging areas (e.g., slow-moving streams, ponds, wooded sites) at the survey locations and the seemingly random occurrence of a bat traveling between roost and foraging sites being detected by the Anabat. The steep increase in the number of bat passes on July 24 (26 bat passes in 9.3 survey-hours = 2.8 bat passes/survey-hour) is four times higher than the next highest average count at that site. Activity levels decreased in mid-August. No survey data were collected from August 23 to September 22 due to system error. Activity levels were low during the September 23 to October 20 survey period with no more than 0.1 bat pass per survey-hour on any given night.

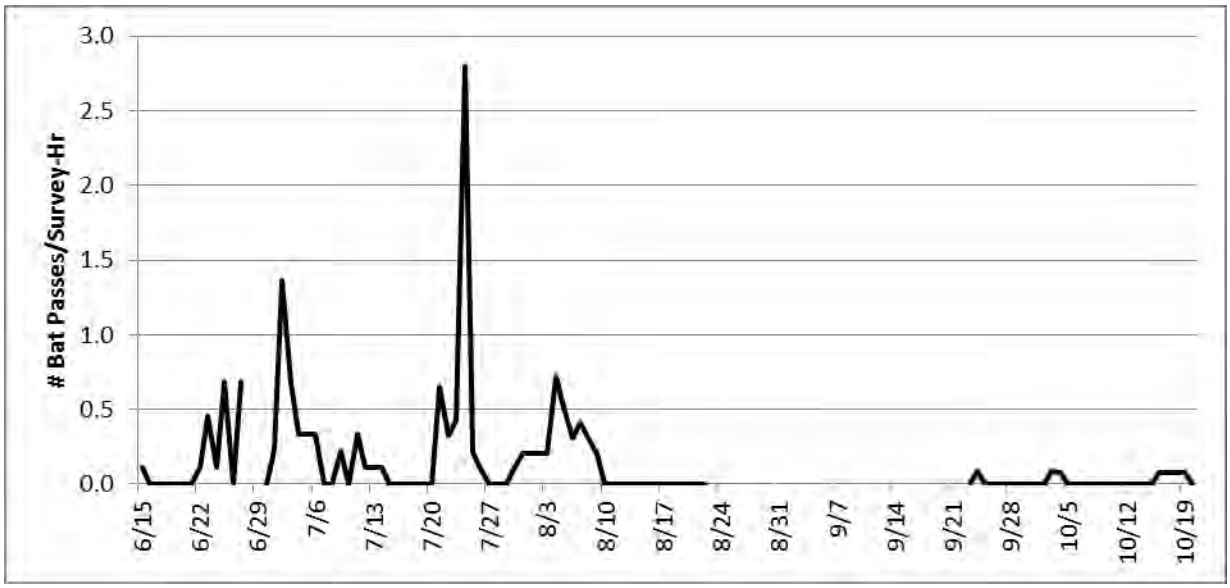

Figure 1. Average number of bat passes per survey-hour, June 15–October 20, 2011.

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Appendix H

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APPENDIX H

Relevant Correspondence

This appendix, Appendix H, contains relevant correspondence between PCW and USFWS related to the development of this Phase I ECP. This Appendix is not intended to be a comprehensive record of all correspondence between PCW and USFWS. This Appendix, however, does provide additional context regarding the information in the Phase I ECP and the long history of coordination between PCW and USFWS on the CCSM Project, including Phase I. The correspondence in this Appendix at times refers to avoidance and minimization measures, turbine layouts, and turbine counts that differ in some respect from those presented in this final Phase I ECP being submitted to the USFWS with PCW's formal ETP applications. These differences are attributable to the fact that this final Phase I ECP and the final Phase I wind turbine layout it addresses are the result of more than four years of coordination between PCW and USFWS and over three years of intensive data collection and monitoring. The development of the Phase I wind turbine layout and the final avoidance and minimization measures was an iterative process that continually evolved to take into account the site-specific data, the most recent regulatory guidance, recommendations of USFWS and the requirements of the BLM's Record of Decision on the CCSM Project. This Phase I ECP sets forth the final avoidance and minimization measures and the major revisions to the Phase I wind turbine layout; however, it was not practical to present every revision that PCW made to the CCSM Project as a result of these factors in this Phase I ECP. To the extent the information presented in this Appendix differs from the information and commitments contained in this Phase I ECP, the information and commitments presented in this Phase I ECP supersedes the information in this Appendix as it represents the most current information.

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December 21, 2010

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Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Messrs. McCreedy and Sanderson:

Thank you for meeting with us on December 10, 2010 for a discussion of the Chokecherry and Sierra Madre Wind Energy Project. This letter is to confirm our understanding with respect to the draft Avian Monitoring Protocols for the Project.

As you know, Power Company of Wyoming LLC plans to construct and operate the 2,000 to 3,000 MW Chokecherry and Sierra Madre Wind Energy Project in Carbon County, Wyoming. The Project involves public lands under the management of the Bureau of Land Management, private lands and a small number of State lands. PCW has applied for a wind energy development right-of-way grant for the public lands. The Bureau of Land Management is analyzing the potential impacts of the Project under an environmental impact statement in compliance with its obligations under the National Environmental Policy Act.

As a part of the EIS process, the BLM through a third party environmental contractor conducted avian point count surveys of the Project between June 2008 and June 2009. We understand these data have been provided to the Service. As we have discussed, the Service and PCW believe that additional avian monitoring data will be useful in evaluating potential Project impacts to bald and golden eagles, as well as other migratory bird species. In conjunction with the efforts to collect additional avian monitoring data, receiving early technical advice from the Service with respect to site-specific metrics and methods by which potential Project impacts to bald and golden eagles will be evaluated is critical.

Attached as Exhibit A to this letter are draft Avian Monitoring Protocols for the Chokecherry and Sierra Madre Wind Energy Project. Marine radar technology has been identified by the Service and BLM as a desired method to map areas of high avian use. The Protocols; therefore, combine marine radar surveys with standard point count and breeding bird methodologies to determine raptor and other avian use across the Project area. The study design follows recommendations made by the Service, BLM, and Wyoming Game and Fish Department. The marine radar technology will also enable better identification of bat use areas and relative densities of bats in the Project area.

We understand that you will review the adequacy and appropriateness of these Protocols and provide to us your comments, suggestions and recommendations for revising and implementing the Protocols. Upon completion of the Service's review, additional evaluations of bald and golden eagle use of the Project will be made on a site-specific basis using these Protocols. We further understand that data from the 2008 and 2009 point count surveys, data generated from the implementation of these Protocols, and any additional site-specific data provided to PCW by the Service during implementation of these Protocols will be adequate to characterize site-specific eagle activities, develop an Avian Protection Plan, identify impacts from construction and operation of the Project on eagles, and identify avoidance, minimization, and mitigation efforts upon which the Service will evaluate the APP.

We have been informed that the Service is developing and will soon release for public comment guidance for APPs for wind energy projects. PCW's intent is to develop an APP based upon the following:

1. The APP will address conservation measures to avoid, minimize and mitigate direct and indirect impacts of the Project compatible with the Service's management objectives for bald and golden eagles.

2. The eagle use areas upon which impacts from construction and operation of the Project are to be evaluated shall be nests within four miles of the Project site, and breeding territories, communal roosts, and important foraging areas within the Project site.

3. The APP will identify practicable means by which impacts to eagles from the Project may be avoided, minimized, and mitigated, and in particular:

    a. the APP shall include, but shall not be limited to, the avoidance measure of prohibiting the construction of a turbine within 825 feet of an active eagle nest[1];

[1] Bureau of Land Management. 2008. *Record of Decision and Approved Rawlins Resource Management Plan.* pg. 2-53.

b. the APP shall include, but shall not be limited to, the minimization measure of implementing the recommendations of the Avian Power Line Interaction Committee[2];
c. the APP may include effective on- or off-site mitigation measures.

4. The APP will identify those adaptive management techniques that PCW will implement if post-construction monitoring demonstrates a statistically meaningful difference between estimated and actual levels of impact from the operation of the Project.

As discussed at our meeting, PCW is prepared to proceed with implementing the Protocols, including the purchase and deployment of a Merlin Avian Radar System, upon receipt of the Service's written concurrence confirming the appropriateness of the Protocols for the Chokecherry and Sierra Madre Wind Energy Project.

Thank you very much for your time and consideration and we look forward to hearing from you.

Sincerely,

Garry L. Miller
Director – Land and Environmental Affairs

cc: Jon Kehmeier, SWCA Environmental Consultants
Roxane Perruso, PCW

[2] Avian Power Line Interaction Committee (APLIC). 2006. *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006.* Edison Electric Institute, APLIC, and the California Energy Commission. Washington, D.C. and Sacramento, CA.

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CONFIDENTIAL AND PROPRIETARY PRELIMINARY REVIEW DRAFT
NOT FOR DISTRIBUTION

EXHIBIT A

PRELIMINARY DRAFT

Avian and Bat Monitoring Protocols for the Chokecherry and Sierra Madre Wind Energy Development Project

Prepared for:

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Prepared by:

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October 2010

DRAFT

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In accordance with the U.S. Fish and Wildlife Service (USFWS) Wind Turbine Guidelines Advisory Committee *Recommendations on Developing Effective Measures to Mitigate Impacts to Wildlife and Their Habitats Related to Land-Based Wind Energy Facilities* (USFWS 2010), the Wyoming Department of Game and Fish (WGFD) *Wildlife Protection Recommendations for Wind Energy Development in Wyoming* (WGFD 2010), and the Bureau of Land Management (BLM) Rawlins Field Office *Wildlife Survey Protocols for Wind Energy Development*, an analysis of biological surveys conducted for the proposed Chokecherry and Sierra Madre Wind Energy Development Project (Project) has been completed to determine compliance with the recommended protocols of each agency.

As part of the BLM's NEPA process for the Project, WEST, Inc. (WEST) conducted avian point surveys of the Chokecherry and Sierra Madre wind resource areas between June 26, 2008 and June 15, 2009. A portion of these data are analyzed in WEST's report, "*Baseline Avian Use Studies for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Summer and Fall Interim Report, June 26-October 14, 2008*" (Johnson et al. 2008). WEST also prepared a report summarizing bat surveys conducted between July 13 through October 13, 2008 titled, "*Bat Surveys for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Report*" (Solick et al. 2008). SWCA has completed additional analyses of all data collected in 2008 and 2009 to determine compliance with the agency monitoring recommendations.

Between June 2008 and June 2009, avian use data were collected for much of the Project area as part of the BLM National Environmental Policy Act (NEPA) process [Johnson et al. 2008]. Data were collected using standard point count methods at 19 locations in all months except January and February when much of the project area was inaccessible due to adverse weather conditions. All sites except for three were visited 31 times during the survey period.

Data collected during the 2008 and 2009 surveys are sufficient to provide estimates of avian use of the Project area as well as to provide initial estimates of the frequency of each species at rotor-swept heights. Horned lark (*Eremophila alpestris*) was predominantly the most common avian species detected in the 2008 and 2009 surveys, having over 800 individual detections. The next most common species were the common raven (*Corvus corax*) with less than 200 detections, and vesper sparrow (*Pooecetes gramineus*) with less than 150 detections. Golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis),* and common raven were most commonly observed within the rotary height of the turbines.

In their recommendations to the Secretary of Interior, the Wind Turbine Guidelines Advisory Committee (Committee) recommends using standard sampling methods to determine avian use of a project area, the presence of sensitive species and other species of interest, and to provide a baseline for assessing displacement effects and habitat loss. The Committee further recommends that the sampling frequency, type, and duration be sufficient to account for variability of avian use between and within sampling periods. When more precise estimates of density are required for a special status species, other methods, including radar or nocturnal surveys are recommended. However, the Committee does not recommend using these types of special surveys unless high risks for collision are expected for migrating songbirds or special status species.

Similarly, the Bureau of Land Management (BLM) Rawlins Field Office Wildlife Survey Protocols for Wind Energy Development recommends that surveys be sufficient to detect temporal and spatial use patterns within the project area. Special emphasis is placed on surveys for raptors and sensitive avian species. BLM survey protocols recommend weekly, 20-minute point counts to record avian use of a project area. Survey times are recommended to be varied weekly to ensure that avian use during daylight hours is adequately documented. In addition to weekly surveys, marine radar is recommended to avian foraging, dispersal, and migration paths.

Wyoming Game and Fish Department's (WGFD) Wildlife Protections Recommendations for Wind Energy Development in Wyoming recommend sufficient numbers of weekly point count surveys during spring and fall migration periods following similar protocols as specific by BLM with survey periods of twenty minutes at each point. WGFD recommends that four surveys be conducted during winter months to capture overwintering avian species. For raptor species, WGFD recommends nest surveys and weekly day-long surveys during spring and fall migration periods.

Data collected during 2008 and 2009 comply with BLM, WGFD, and Committee wind energy survey recommendations and serve as one of the two years of suggested pre-construction monitoring data. Data collected for purposes of NEPA compliance provide estimates of collision risk and enable determination of avian use of the Project area, the presence of sensitive species and other species of interest, as well as providing a baseline for assessing displacement effects and habitat loss.

To supplement the 2008-2009 dataset and to better identify concentrated avian use areas, an intensive one-year survey will be used to better identify avian use areas in the Project area. A combination of marine radar surveys and standard point count surveys will be used to determine raptor use across the Project area. Marine radar technology has been identified by the BLM and USFWS as a desired method to map areas of high avian use. The study design will follow recommendations made by the USFWS, BLM, and WGFD by combining marine radar surveys with standard point count and breeding bird methodologies. The marine radar technology will also enable better identification of bat use areas and relative densities of bats in the Project area.

A single DeTect Merlin Avian Radar System will be used to map avian use across the Project area. The DeTect Merlin radar system is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10–kilowatt (kW) vertically operating magnetron X-band open array radar. The horizontal radar has a range of 2 to 4 miles in a 360-degree pattern around the unit. The vertical radar has a 24-degree beam width and detects flight paths 0.75 to 2.00 miles above the unit.

Marine radar systems require weekly maintenance and fueling and cannot be moved over extremely rough terrain on a regular basis. Additionally, the system will not differentiate between large raptors such as golden eagles and other large birds including geese, other large raptors, and possibly even ravens and should be used in conjunction with field surveys to validate radar recorded data. However, the radar system, when coupled with point count verification of avian use, will allow for accurate horizontal and vertical mapping of avian use in the wind development area. The marine radar system will also enable mapping of high use areas for bat species.

A combination of raptor and point surveys and breeding bird surveys would be conducted in concert with the marine radar system. The intent of this study design is to provide intensive survey information regarding avian use patterns within the radar survey perimeter for each season. Raptor and point counts and breeding bird surveys will be used to validate the radar data and provide estimates of species-specific use patterns. Point count surveys will record the location, flight path, approximate height, and time of use for any individual observed from the point location. Point count locations will be surveyed for eight hours per day during periods with the highest likelihood for detection of migrating birds and/or large raptors. Timing of survey at each location will be varied to determine patterns of avian use during daylight hours.

In addition to the point count and radar surveys, breeding bird surveys will be completed at 15 locations across the wind development areas. Breeding bird surveys will be conducted following the grid monitoring protocols published by the Rocky Mountain Bird Observatory (RMBO) (Hanni et al. 2010). Grid survey locations will be randomly selected using a generalized random tessellation stratified design to ensure a spatially balanced design stratified by major vegetation and habitat types in the Project area. Data collected as part of the grid monitoring efforts would also be used to validate radar data and better determine avian species use to the extent possible. As part of the breeding bird surveys, waterfowl and water bird use surveys would be conducted three times annually (springs, summer, and fall) to identify migrating and resident species.

Locations for placement of the radar and for conducting point count surveys (Figure 1) and breeding bird surveys were determined using a four-tiered approach:

- Tier 1 – Survey areas should determine avian use within the wind development areas.
- Tier 2 – Survey areas should overlap possible foraging areas for large raptors (winter range areas, prairie dog towns, waterfowl use areas, etc.).
- Tier 3 – Survey areas should be in locations to allow for detection of avian movement into and out of the Project area.
- Tier 4 – Survey areas should capture variability in habitat and topography.

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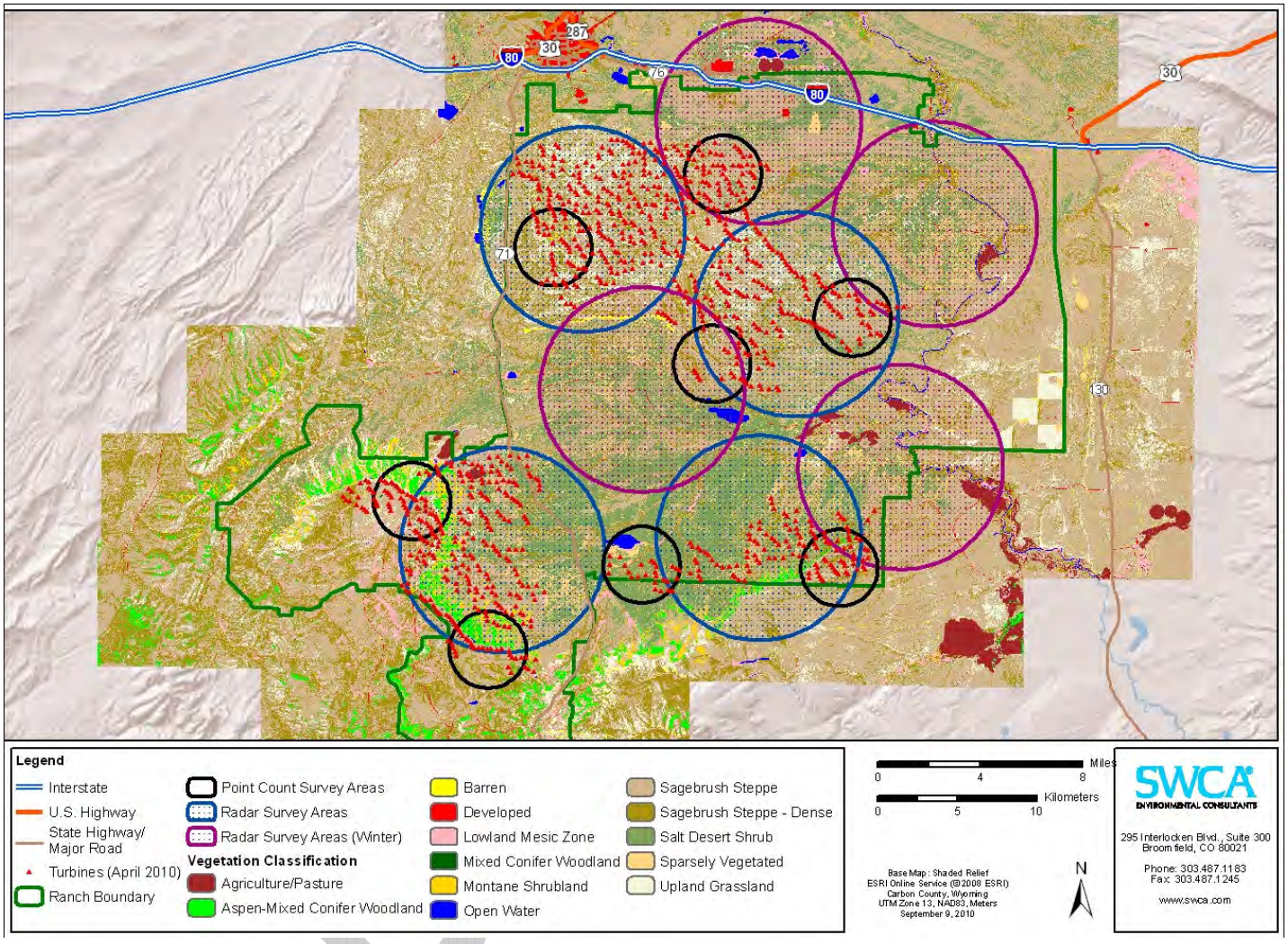

Figure 1. Approximation of area surveyed using avian radar and traditional point count methodologies with respect to possible wind turbine locations. Spring, summer, and fall radar installation locations are the center point of the large blue circles. Proposed point count locations are the center points of the small black circles. Potential winter radar locations are the center points of the large purple circles. Final locations for survey will be determined in coordination with BLM, WGFD, and USFWS.

The radar unit will be placed a 5 locations within the Project area (Figure 1) to cover as many of the turbine locations as possible. Point counts will be completed at nine additional locations to map avian use patterns when radar coverage is not possible. Eight of these point counts will be completed at permanent sampling locations. The ninth point count location will be completed at the radar site to validate the data being collected by the radar unit. This survey date will also be used to service the radar system and will require two technicians. During winter months, the radar will be placed in a location that has high probability of access on a weekly basis. As much of the project area will be covered in snow and large drifts, radar placement in winter will likely be near the Bolton Ranch headquarters, south of I-80 near the North Platte River, on the Bolton Road east of Teton Reservoir, or on the north side of the Chokecherry project area (Figure 1). Winter point count survey locations will also be adjusted as needed to account for winter weather conditions, access issues, and safety concerns.

Based on a four mile radius for radar surveys and a one mile radius for point count surveys, approximately 90-93% of the turbine locations, depending on winter radar placement, will be directly surveyed. It is likely that this percentage is higher than 90-93% for large raptors including bald and golden eagles as many of the point count locations have visibility of several miles. Point count locations outside of the radar survey perimeters have been placed to allow for detection of raptors moving into the project area and between radar surveyed zones.

This protocol assumes that BLM will conduct nest activity and productivity surveys for all known nests in the vicinity of the wind development areas. Incidental observations will be made of nest activity as part of this protocol; however, no formal nest activity or productivity surveys will be completed. Additionally, this protocol assumes that any additional point count surveys beyond the 9 per week specified above would be completed by BLM or USFWS.

The protocols and schedule outlined below will be followed for monitoring and mapping avian and bat use across the wind development area using the marine radar system, point counts, and breeding bird surveys.

1. Fall 2010 – Final radar deployment locations, point count survey locations, and breeding bird survey locations will be identified for all areas of the wind development areas. When possible, point count locations or radar locations will be collocated or closely aligned with the data points surveyed in 2008 and 2009. Radar locations will consider suitable road access for movement of the radar system. Point count locations will be positioned along ridgelines to the extent possible to allow for detection of the highest number of migrating passerines and raptors. Breeding bird survey locations will be determined using a Generalized Random Tessellation Stratified (GRTS) (McDonald 2004; Stevens and Olsen 2004) design with oversampling. This design ensures a spatially balanced random design across all vegetation and habitat types.

2. Winter 2010/2011 – Radar construction, programming, and training. The Draft Avian Protection Plan (APP) will be delivered to USFWS, BLM, and WGFD for review. Among other descriptive sections, the preliminary plan will contain the detailed sampling protocols, preliminary mitigation and avoidance measures, and detailed adaptive management protocols.

3. Spring and Early Summer 2011 – Radar surveys begin in the southern portion of the project area. The radar system will be moved once during the spring migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Breeding bird surveys will be completed at 15 locations across the wind development areas. Surveys for waterfowl and other waterbirds will be conducted once during the spring migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data will be used to identify areas with high avian and bat use. The following schedule will be used for spring and early summer 2011 surveys:

    a. March 1 – May 15, 2011: Radar system will be initialized and debugged prior to main migratory period. Initial installation will occur in an area south of the Bolton Ranch headquarters in the southeastern-most radar survey location identified on Figure 1. This survey location will detect migrating birds in areas adjacent to the Platte River corridor and along the ridgeline north of the Jack Creek road. Weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location south of the Bolton Ranch headquarters.

    b. May 15–July 31, 2011: Radar system will be moved to a location approximately 2 miles east of Miller Hill in the southwestern-most portion of the wind development area (Figure 1). This survey location will detect migrating birds in areas adjacent to and along the ridgeline of Miller Hill as well as in the basin east of Miller Hill. Between May 15 and June 30, weekly point surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location east of Miller Hill. During the month of July, the point count locations will only be visited twice instead of every week in compliance with BLM and WGFD recommendations. Additionally, this time is between migratory periods and typically bird movements are lower because of nesting activities. A point count will be conducted weekly at the radar installation location during this period during routine maintenance activities.

    c. May 25–June 30, 2011: Breeding bird surveys will be completed once at each of 15 locations across the wind development areas to determine relative abundance, species richness, and habitat use patterns. Breeding bird surveys will follow RMBO grid survey protocols (Hanni et al. 2010). Bird flight patterns will be documented to better define risks of wind development activities. All raptors as well as their flight paths and heights will be recorded at all breeding bird locations regardless of whether the raptor falls within the grid survey area.

    d. May 1, 2011: A revised draft APP will be delivered to the agencies for a 30-day review and comment period. The revised draft will contain some preliminary analyses of radar data from early spring migration to allow for more informed discussions of possible mitigation measures.

4. Late Summer – Fall 2011: The radar system will be moved to the Chokecherry portion of the wind development area on August 1, 2011. The radar system will be moved once during the fall migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Waterfowl and wading bird surveys will be conducted once during late summer to detect nesting activity and once during fall migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data collected during spring and early summer will be completed to evaluate bird and bat use and to identify appropriate mitigation measures that could be implemented. The following schedule will be used for late summer and fall 2011 surveys:

    a. August 1: A Final APP will be delivered to the agencies for review and approval. The final APP will contain the mitigation measures that will be applied to remove or minimize risks to avian species. The final APP will also identify the final adaptive management process that will be followed to update the APP and apply additional site-specific mitigation measures as additional data are obtained prior to, during and after construction. An interim report of radar data trends and observations will also be provided with the final APP.

    b. August 1– September 30, 2011: Radar system will installed at the western radar location in the Chokecherry project area radar survey location identified on Figure 1. This survey location will detect migrating birds in the western portion of Chokecherry as well as along the rim of Chokecherry and the basin between Chokecherry and Atlantic Rim. During the month of August, the point count locations will only be visited twice instead of every week. A point count will be conducted weekly at the radar installation location during August as part of routine maintenance activities. During September, weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

    c. October 1–November 15, 2011: Radar system will be moved to a location southwest of the initial Chokecherry installation location (Figure 1). This survey location will detect birds along the southern rim of Chokecherry and the eastern half of the Chokecherry project area. Weekly point count surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location.

5. Winter 2011/2012 (November 16, 2011–March 30, 2012) – The radar system will be deployed in a location near the Bolton Ranch headquarters (Figure 1) or north of the Chokecherry project area to ensure weekly maintenance is possible during winter months. Weekly bird observations will be recorded during routine maintenance activities at the radar location. Weather permitting, monthly counts will be conducted at the point count locations in Figure 1.

6. Spring 2012 – PCW and the agencies will initiate the adaptive management process identified and approved in the final APP to incorporate site-specific mitigation and

avoidance measures into final project designs and the Final Environmental Impact Statement and Record of Decision. A final report documenting the results of the radar and point count efforts will be provided at least two weeks prior to the initiation of the adaptive management process to ensure adequate review time prior to discussions.

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DRAFT

From: Jon Kehmeier
Sent: Tuesday, March 22, 2011 2:25 PM
To: Travis_Sanderson@fws.gov; HCline@blm.gov
Cc: Garry Miller
Subject: PCW Revised Draft Avian Monitoring Plan

Travis and Heath,

I have attached the revised avian monitoring plan to address some of the concerns that Travis made re: the schedule of completing the APP/ECP. Travis, I pushed the development of the final APP into 2012 with some language in there that would allow us to finalize earlier than that if possible. Thanks for taking a look at this. Since we talked a few weeks ago the loaner radar unit was installed above Severson Flats on the eastern portions of Chokecherry. The current install location is about the only place we could get the unit given the road and snow conditions in the project area. PCW's actual unit will be delivered in about 3 weeks and will be initialized in a different location that corresponds with the preliminary locations identified in the attached plan. Depending on snow conditions and field observations we might shift the final placement a bit to decrease clutter and increase detectability of avian targets. Once we have it up and running we will have to do a field tour to check out the radar and the avian observation points. We plan to start survey at the avian points during the first week of April.

Jon

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Avian and Bat Monitoring Protocols

for the

Chokecherry and Sierra Madre Wind Energy Project

DRAFT

Prepared for:

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March 2011

Review of Agency Recommendations

The following protocols have been developed in accordance with the following agency recommendations:

U.S. Fish and Wildlife Service (USFWS)
Wind Turbine Guidelines Advisory Committee *Recommendations on Developing Effective Measures to Mitigate Impacts to Wildlife and Their Habitats Related to Land-Based Wind Energy Facilities* (USFWS 2010)
USFWS Draft Land-Based Wind Energy Guidelines (USFWS 2011a)
Draft Eagle Conservation Plan Guidance (USFWS 2011b)

Wyoming Department of Game and Fish (WGFD)
Wildlife Protection Recommendations for Wind Energy Development in Wyoming (WGFD 2010)

Bureau of Land Management (BLM)
Rawlins Field Office *Wildlife Survey Protocols for Wind Energy Development*,

Generally, UFWS survey recommendations (USFWS 2010, 2011a, and 2011b) include using standard sampling methods to determine avian use of a project area, fatality risk in a project area, the presence of sensitive species and other species of interest, and to provide a baseline for assessing displacement effects and habitat loss. USFWS recommends that sampling frequency, type, and duration be sufficient to account for variability of avian use between and within sampling periods. When more precise estimates of density are required for a special status species, other methods, including radar or nocturnal surveys have been recommended when risks for collision are expected.

Similarly, the Bureau of Land Management (BLM) Rawlins Field Office Wildlife Survey Protocols for Wind Energy Development recommends that surveys be sufficient to detect temporal and spatial use patterns within the project area. Special emphasis is placed on surveys for raptors and sensitive avian species. BLM survey protocols recommend weekly, 20-minute point counts to record avian use of a project area. Survey times are recommended to be varied weekly to ensure that avian use during daylight hours is adequately documented. In addition to weekly surveys, marine radar is recommended to better define avian foraging, dispersal, and migration paths.

Wyoming Game and Fish Department's (WGFD) Wildlife Protections Recommendations for Wind Energy Development in Wyoming recommend sufficient numbers of weekly point count surveys during spring and fall migration periods following similar protocols as specific by BLM with survey periods of twenty minutes at each point. WGFD recommends that four surveys be conducted during winter months to capture overwintering avian species. For raptor species, WGFD recommends nest surveys and weekly day-long surveys during spring and fall migration periods.

Review of Existing Data

In compliance with its obligations under the National Environmental Policy Act of 1969 (NEPA), BLM is preparing an environmental impact statement (EIS) analyzing the potential impacts of the Chokecherry and Sierra Madre Wind Energy Project (Project) on lands and resources within the Project area. Between June 2008 and June 2009, avian use data were collected for much of the Project area as part of the BLM NEPA process [Johnson et al. 2008]. Data were collected using standard point count methods at 19 locations in all months except January and February when much of the Project area was inaccessible due to adverse weather conditions. All sites except for three were visited 31 times during the survey period.

WEST, Inc. (WEST) conducted avian point surveys of the Project area between June 26, 2008 and June 15, 2009. A portion of these data are analyzed in WEST's report, "*Baseline Avian Use Studies for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Summer and Fall Interim Report, June 26-October 14, 2008*" (Johnson et al. 2008). WEST also prepared a report summarizing bat surveys conducted between July 13 through October 13, 2008 titled, "*Bat Surveys for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Report*" (Solick et al. 2008). SWCA has completed additional analyses of all data collected in 2008 and 2009 to determine compliance with various agency monitoring recommendations.

Data collected during the 2008 and 2009 surveys are sufficient to provide estimates of avian use of the Project area as well as to provide initial estimates of the frequency of each species at rotor-swept heights. Horned lark (*Eremophila alpestris*) was predominantly the most common avian species detected in the 2008 and 2009 surveys, having over 800 individual detections. The next most common species were the common raven (*Corvus corax*) with less than 200 detections, and vesper sparrow (*Pooecetes gramineus*) with less than 150 detections. Golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis)*, and common raven were most commonly observed within the rotary height of the turbines.

Data collected during 2008 and 2009 comply with the agency wind energy survey recommendations described in the previous section and serve as one year of suggested pre-construction monitoring data. Data collected for purposes of NEPA compliance provide estimates of collision and fatality risk and enable determination of avian use of the Project area, the presence of sensitive species and other species of interest, as well as providing a baseline for assessing displacement effects and habitat loss.

Project-Specific Protocols

To supplement the 2008-2009 dataset and to better identify concentrated avian use areas for development of a Project-specific Avian Protection Plan (APP) and an Eagle Conservation Plan (ECP), an intensive one-year survey will be used to better identify avian use areas in the Project area. Protocols have been developed following the various agency recommendations discussed above and in coordination with local USFS, BLM, and WGFD biologists. The protocols are consistent with agency recommendations and will provide more detailed site-specific use data than the protocols individually recommended by any of the agencies.

A combination of avian radar, raptor count stations, standard grid sampling, and point count surveys will be used to determine avian use across the Project area with emphasis on large raptors including golden eagles. Avian radar technology has been identified by the BLM and USFWS as a desired method to map areas of high avian use. The sampling design will follow recommendations made by the USFWS, BLM, and WGFD by combining radar surveys with standard point count and breeding bird methodologies. The radar technology will also enable better identification of bat use areas and relative densities of bats in the Project area.

A DeTect Merlin Avian Radar System will be used to map avian use across the Project area. The DeTect Merlin radar system is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10–kilowatt (kW) vertically operating X-band open array radar. The horizontal radar has a range of 2 to 5 miles in a 360-degree pattern around the unit. The vertical radar has a 24-degree beam width and detects flight paths 0.75 to 2.00 miles above the unit.

The avian radar system requires weekly maintenance and fueling and cannot be moved over extremely rough terrain on a regular basis. Additionally, the system will not differentiate between large raptors such as golden eagles and other large birds including geese, other large raptors, and possibly even ravens and; therefore, will be used in conjunction with field surveys to validate radar recorded data. However, the radar system, when coupled with point count verification of avian use, will allow for accurate horizontal and vertical mapping of avian use in the Project area. The radar system will also enable mapping of high use areas for bat species.

A combination of raptor and point surveys and breeding bird grid surveys will be conducted in concert with the radar survey. This design will provide intensive survey information regarding avian use patterns within the radar survey perimeter for each season. Raptor count stations, point counts, and breeding bird surveys will be used to validate the radar data and provide estimates of species-specific use patterns. Raptor stations and point count surveys will record the location, flight path, approximate height, and time of use for any individual observed from the count location. Raptor count locations will be surveyed for 8-12 hours per day during periods with the highest likelihood for detection of migrating birds and/or large raptors. Standard 20-minute point counts will be completed at each raptor count location. Timing of point count surveys at each location will be varied to determine patterns of avian use during daylight hours.

In addition to the raptor, point count, and radar surveys, breeding bird surveys will be completed at 15 locations across the Project area. Breeding bird surveys will be conducted following the grid monitoring protocols published by the Rocky Mountain Bird Observatory (RMBO) (Hanni et al. 2010). Grid survey locations will be randomly selected using a generalized random tessellation stratified design to ensure a spatially balanced design stratified by major vegetation and habitat types in the Project area. Data collected as part of the grid monitoring efforts will also be used to validate radar data and better determine avian species use. As part of the breeding bird surveys, waterfowl and water bird use surveys will be conducted three times annually (springs, summer, and fall) to identify migrating and resident species.

Locations for placement of the radar and for conducting point count surveys (Figure 1) and breeding bird surveys were determined using a four-tiered approach:

- Tier 1 – Survey areas should determine avian use within the Project area.

- Tier 2 – Survey areas should overlap possible foraging areas for large raptors (winter range areas, prairie dog towns, waterfowl use areas, etc.).
- Tier 3 – Survey areas should be in locations to allow for detection of avian movement into and out of the Project area.
- Tier 4 – Survey areas should capture variability in habitat and topography.

Locations of radar placement were refined following attendance at DeTect's radar training courses and during coordination with DeTect's radar placement specialists. Figure 1 reflects the revised radar locations. Final placement of the radar unit and final point locations for survey will be determined in early spring 2011 following radar unit delivery.

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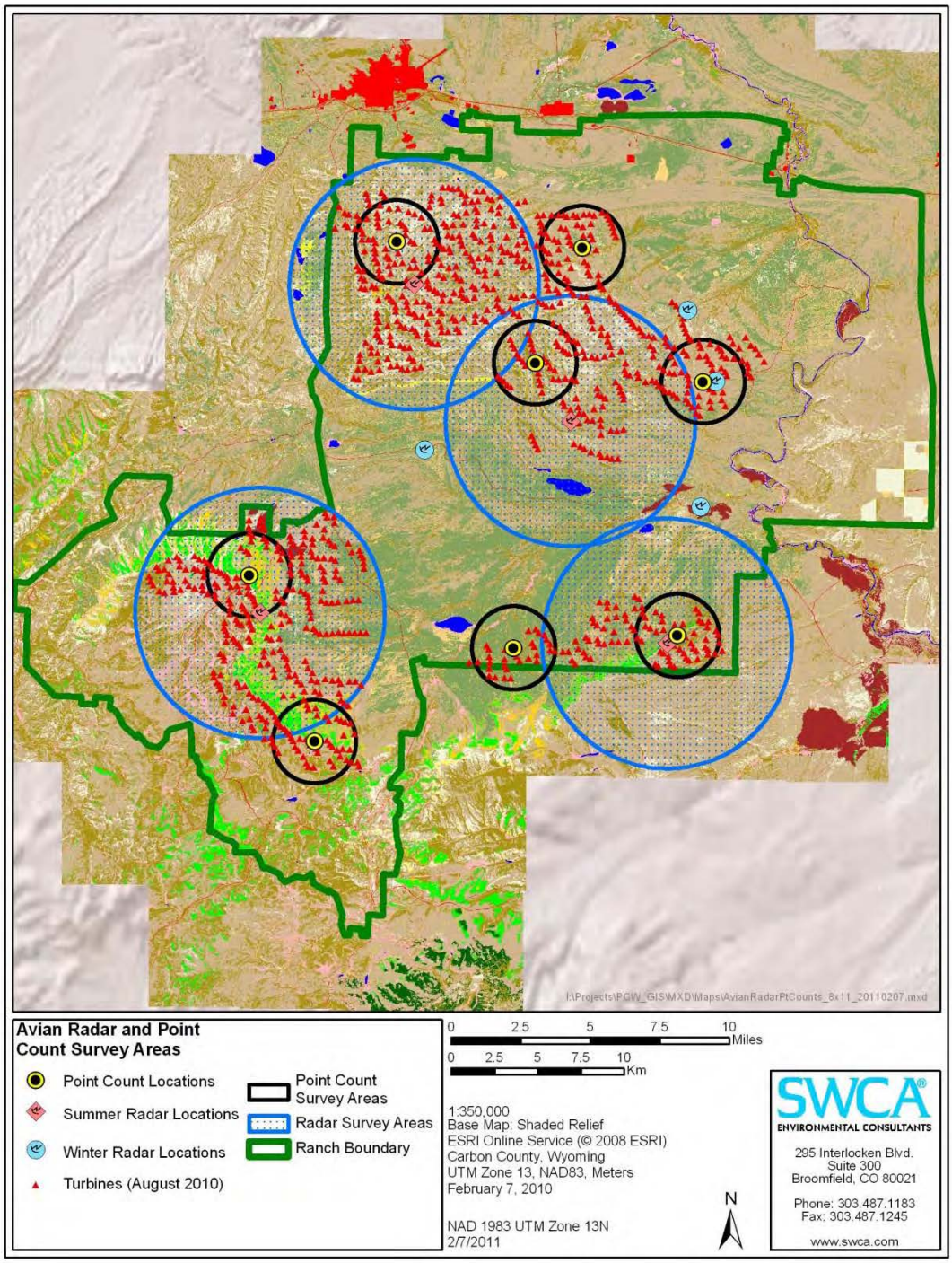

Figure 1. Approximation of area surveyed using avian radar and traditional point count methodologies with respect to possible wind turbine locations. Spring, summer, and fall radar installation locations are the center point of the large blue circles. Proposed point count locations are the center points of the small black circles. Potential winter radar locations are the four blue points. Final locations for survey will be determined in coordination with BLM, WGFD, and USFWS.

The radar unit will be placed at five locations within the Project area (Figure 1). Point counts will be completed at nine additional locations to map avian use patterns where radar coverage is not possible. Eight of these point counts will be completed at permanent sampling locations. The ninth point count location will be completed at the radar site to validate the data being collected by the radar unit. During winter months, the radar will be placed in a location that has high probability of access on a weekly basis. Much of the project area is covered in snow and large drifts during winter; therefore, radar placement in winter will likely be near the Bolton Ranch headquarters, south of I-80 near the North Platte River, on the Bolton Road east of Teton Reservoir, or on the north side of the Chokecherry project area (Figure 1). Winter point count survey locations will also be adjusted as needed to account for winter weather conditions, access issues, and safety concerns.

Based on a four mile radius for radar surveys and a one mile radius for point count surveys, approximately 90-93% of the turbine locations, depending on winter radar placement, will be directly surveyed. It is likely that this percentage is higher than 90-93% for large raptors including bald and golden eagles as many of the point count locations have visibility of several miles and recent radar advancements may allow for detection of large raptors out to 5+ miles. Point count locations outside of the radar survey perimeters have been placed to allow for detection of raptors moving into the Project area and between radar surveyed zones.

Helicopter flights will be completed in mid-April or early May to document eagle nesting activity as well as nesting activity of other raptors that are incidentally observed. Aerial nest activity surveys will be completed in accordance with the recent draft eagle guidance (USFWS 2011b). Following identification of active eagle nests, follow-up productivity surveys will be completed from the ground above/below the nest to determine nesting and fledging success.

The protocols and schedule outlined below will be followed for monitoring and mapping avian and bat use across the Project area using the marine radar system, point counts, and breeding bird surveys.

1. Winter 2010/2011 – Radar construction, programming, and training. The Draft APP/ECP will be delivered to USFWS, BLM, and WGFD for review in late winter/early spring. Among other descriptive sections, the preliminary plan will contain the detailed sampling protocols, preliminary mitigation and avoidance measures, and detailed adaptive management protocols. Monthly reconnaissance surveys will be completed to document eagle use of the Project area during winter months and to help determine best locations for winter 2011/2012 deployment of the radar system.

2. Spring and Early Summer 2011 – Radar surveys will begin in the southern portion of the Project area. The radar system will be moved once during the spring migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Breeding bird surveys will be completed at 15 locations across the Project area. Surveys for waterfowl and other waterbirds will be conducted once during the spring migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data will be

used to identify areas with high avian and bat use. The following schedule will be used for spring and early summer 2011 surveys:

a. March 15 – May 15, 2011: Radar system will be initialized and debugged prior to main migratory period. Initial installation will occur at the southeastern-most radar survey location identified on Figure 1. This survey location will detect migrating birds in areas adjacent to the Platte River corridor and along the ridgeline north of the Jack Creek road. Weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

b. May 15–July 31, 2011: Radar system will be moved to the northeastern survey location (Figure 1). This survey location will detect migrating birds adjacent to and along the Bolten Rim as well as in the basin below the Bolten Rim. Migratory use and raptor soaring locations within and adjacent to the ridgelines in this portion of Chokecherry will also be surveyed using the radar system. Between May 15 and June 30, weekly point surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location. During the month of July, the point count locations will be visited twice instead of every week in compliance with BLM and WGFD recommendations. Additionally, this time is between migratory periods and typically bird movements are lower because of nesting activities. A point count will be conducted weekly at the radar installation location during this period during routine maintenance activities.

c. May 25–June 30, 2011: Breeding bird surveys will be completed once at each of 15 locations across the Project area to determine relative abundance, species richness, and habitat use patterns. Breeding bird surveys will follow RMBO grid survey protocols (Hanni et al. 2010). Bird flight patterns will be documented to better define risks of wind development activities. All raptors as well as their flight paths and heights will be recorded at all breeding bird locations regardless of whether the raptor falls within the grid survey area.

d. May 1, 2011: An agency meeting will be scheduled to discuss preliminary analyses of radar data from early spring migration to allow for more informed use of the radar and survey data that will be used in the APP/ECP.

3. Late Summer – Fall 2011: The radar system will be moved once during the fall migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Waterfowl and wading bird surveys will be conducted once during late summer to detect nesting activity and once during fall migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data collected during spring and early summer will be completed to evaluate bird and bat use and to identify appropriate mitigation measures that could be implemented. The following schedule will be used for late summer and fall 2011 surveys:

a. August 1: A revised Draft APP/ECP will be delivered to the agencies for review and approval. The revised APPECP will contain the mitigation measures that will be applied to remove or minimize risks to avian species. The revised APP/ECP will also identify the adaptive management process that will be followed to update the APP/ECP and apply additional site-specific mitigation measures as additional data are obtained prior to, during and after construction. An interim report of radar data trends and observations will also be provided with the revised APP/ECP.

b. August 1– September 30, 2011: Radar system will be installed at the western radar location in the Chokecherry project area radar survey location identified on Figure 1. This survey location will detect migrating birds in the western portion of Chokecherry as well as along the rim of Chokecherry and the basin between Chokecherry and Atlantic Rim. During the month of August, the point count locations will be visited twice instead of every week. A point count will be conducted weekly at the radar installation location during August as part of routine maintenance activities. During September, weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

c. October 1–November 15, 2011: Radar system will be moved to a location along the rim of Miller Hill in the southwestern portion of the project area (Figure 1). This survey location will detect birds in the Miller Hill area and below the Miller Hill rim in the Sage Creek Basin. Weekly point count surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location.

4. Winter 2011/2012 (November 16, 2011–March 30, 2012) – A preliminary Final APP/ECP will be delivered to the agencies for review. The preliminary Final APP/ECP will identify the avoidance, minimization, and mitigation measures to reduce threats to eagles and other avian species. The radar system will be deployed in a suitable location to ensure weekly maintenance is possible during winter months. Weekly bird observations will be recorded during routine maintenance activities at the radar location. Weather permitting, monthly counts will be conducted at the point count locations in Figure 1.

5. Spring 2012 – PCW and the agencies will initiate the adaptive management process identified in the preliminary Final APP/ECP to incorporate site-specific mitigation and avoidance measures into final project designs and the Final Environmental Impact Statement and Record of Decision. A final report documenting the results of the radar and point count efforts will be provided at least two weeks prior to the initiation of the adaptive management process to ensure adequate review time prior to discussions. The final APP/ECP would be completed following the spring 2012 agency coordination process.

DRAFT

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USFWS. 2011b. Draft eagle conservation plan guidance. January 2011.

Wyoming Game and Fish Department [WGFD]. 2010. Wildlife protection recommendations for wind development in Wyoming. Commission approved version (4-23-2010). 70pp.

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October 6, 2011

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Travis Sanderson, Energy Program
U.S. Fish and Wildlife Service
Wyoming Ecological Services Office – Rawlins
1300 North 3rd Street
P. O. Box 2407
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Re: Chokecherry and Sierra Madre Wind Energy Project
Summary Report for 2011 Nest Surveys

Dear Messrs. Carpenter and Sanderson:

Power Company of Wyoming LLC (PCW) proposes to construct and operate the 2,000 to 3,000 MW Chokecherry and Sierra Madre Wind Energy Project in Carbon County, Wyoming (the Project). The Project involves public lands under the management of the Bureau of Land Management, private lands owned by The Overland Trail Cattle Company LLC (a PCW affiliate) and a small number of State lands. PCW has applied for a wind energy development right-of-way grant for the public lands. The BLM is analyzing the potential impacts of the Project under an environmental impact statement in compliance with its obligations under the National Environmental Policy Act. The draft EIS was issued by BLM on July 22, 2011 (DEIS).

BLM Instruction Memorandum No. 2010-156 (July 9, 2010) provides that if a proposed project has the potential to impact golden eagles or their habitat, an Avian Protection Plan (APP) will be required by the BLM as a condition of the right-of-way grant. The APP is to be developed by the applicant, in coordination with the U.S. Fish and Wildlife Service (FWS) and the BLM, to evaluate options to avoid and minimize the project impacts. The APP may also include measures for bats (an ABPP).

PCW, as the applicant, is developing an ABPP for the Project. In December 2010 PCW submitted to the FWS draft Avian Monitoring Protocols for the Project. A copy of the Protocols was also provided to BLM. The FWS and BLM have verbally provided comments on those protocols which PCW incorporated.

Consistent with the agreed upon Protocols, in May and June of this year PCW engaged SWCA Environmental Consultants to conducted raptor nest surveys within the Project development footprint and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. The selection of a 5-mile turbine buffer was made through consultation with the FWS and the BLM.

Enclosed is a Summary Report for 2011 Nest Surveys for the Chokecherry and Sierra Madre Wind Energy Project. I am also providing GIS files showing the location of each nest located and the helicopter flight paths taken during the survey. In addition to the helicopter flights, ground surveys were completed in some areas where leaves on trees or terrain features made helicopter surveys impractical or unsafe. Follow-up visits were made to all active eagle nests and many buteo nests to confirm fledging of young or abandonment of the nest structure. In summary, 23 active raptor nests and 158 inactive raptor nests were identified within the surveyed area. In addition, all ferruginous hawk nests within the Project area and identified within the BLM's dataset were visited and the condition of the nest documented. No active ferruginous hawk nests were found during the 2011 surveys.

Our findings are consistent with those disclosed in the DEIS. During its 2008-2009 surveys WEST found 24 active raptor nests (DEIS at pg. 3.14-19) and no active ferruginous hawk nests (DEIS at pg. 3.15-11) within the Application Area.

If you should have any questions regarding the enclosed report and data, please let me know.

Sincerely,

Garry L. Miller
Director – Land and Environmental Affairs

cc: Heath Cline, BLM
Jon Kehmeier, SWCA Environmental Consultants
Pam Murdock, BLM

Summary Report for 2011 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

Prepared for:

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Prepared by:

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October 6, 2011

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INTRODUCTION

In May and June 2011, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) development footprint and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM). This buffer was agreed upon since the existing BLM raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts already underway within the Project area, which could also assist in identifying potential nesting raptors. Additionally, BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer. Data from those BLM monitoring efforts will be considered during development of the Avian Protection Plan and Eagle Conservation Plan.

Three types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter survey flight path. All ferruginous hawk (*Buteo regalis*) nests in the Project footprint were visited to assess current condition. Multiple nest monitoring visits were made to all active eagle nests and many of the active *Buteo* nests identified during helicopter and ground surveys. Nest monitoring visits were made until fledging was confirmed or until juveniles were no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by the USFWS.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in a Bell 206B3 helicopter on May 25 and June 10. Surveys on May 25 were completed primarily for the Chokecherry portion of the Project and the North Platte River corridor. Surveys on June 10 were completed for the Sierra Madre portion of the Project area as well as the Atlantic Rim. During the June 10 flight, several of the active nests identified during the May 25 surveys were revisited to assess nest activity and the development stage of the chick(s) on the nest.

Nineteen hours were spent flying the Project area and associated buffer. SWCA biologists used historic nest locations provided by the BLM Rawlins Field Office (RFO) for guidance in surveying existing and undocumented nest locations. Aerial surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and ferruginous hawk, as well as previously documented nest locations for these species and other large *Buteos*, falcons, and accipiters. These habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting large nest structures. While the focus of the nest flights was on the three previously mentioned species, any active raptor nest that was

encountered during the course of the flights was documented. Additionally, all inactive or historic nests in poor condition that were observed during aerial surveying efforts were recorded. Data collected at each nest site included documentation of the nest substrate and location, nest condition, nest status (e.g., active or inactive, number of nestlings, etc.), global positioning system (GPS) location, and photo documentation of the nest when feasible and safe.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipter nests in the Project area. Ground surveys also identified a previously unknown bald eagle nest. Due to an abundance of late season snowpack, areas around the base of Miller Hill were inaccessible until late spring, at which time the groves of quaking aspen (*Populus tremuloides*) had fully leafed out. While locating nests in these groves proved mostly unsuccessful, any raptor activity occurring in these areas would be captured by the four raptor monitoring points located around Miller Hill. Ground surveys also included visits to all historic ferruginous hawk nests in the Project area to evaluate current nest condition and determine when the nest had last been active. All ferruginous hawk nests in the survey area were inactive in 2011 and many of the historic nests identified in the BLM datasets were no longer viable for nesting activities (Appendix A). All ground survey locations were accessed on foot or with trucks and all-terrain vehicles. Data collected during ground surveys were identical to the data recorded during aerial surveys.

In total, 23 active raptor nests were located within the Project area and associated 5-mile buffer (Figure 1). The species composition of the active raptor nests were as follows: eight golden eagle, four bald eagle, six red-tailed hawk (*Buteo jamaicensis*), three prairie falcon (*Falco mexicanus*), one unknown *Buteo* (likely red-tailed hawk), and one American kestrel (*Falco sparverius*). An additional three active non-raptor nests were located during the flights and included one turkey vulture (*Cathartes aura*), one common raven (*Corvus corax*), and one unknown large species. The unknown large species nest was a medium-sized stick nest in a crevice of a cliff band, and was likely either a *Buteo* species or a common raven. All active golden eagle and bald eagle nests were located outside of the wind development footprint although three of the eagle nests (two golden eagle and one bald eagle) were located within 1 mile of potential turbine locations. Most active eagle nests were located east and southeast of the Chokecherry portion of the Project along cliff bands on the Bolten Rim and the North Platte River. One active eagle nest was located on the Sierra Madre portion of the Project. The remaining active eagle nests were located south of Middlewood Hill along Jack Creek and in the south Sage Creek Basin. All of the active golden eagle and bald eagle nests were observed to have one to two nestlings present, while the majority of the other active raptor nests appeared to be in the incubation or brooding stages. Appendix B contains representative photographs of the types of active and inactive nests that were observed during surveys.

NEST MONITORING

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project area between July 5 and August 2. By July 20, four golden eagle and two bald eagle nests were confirmed as fledged or inactive. Additionally, three other *Buteo* and falcon nests were confirmed as fledged or inactive. As of August 2, the final four golden eagle and two bald eagle nests were confirmed as fledged or inactive. Of the remaining active *Buteo* and falcon nests, four were confirmed as fledged or inactive. Two red-tailed hawk nests remained active as of August 2, and two falcon nests were unable to be relocated during ground surveys due to the nests being built into cavities and tight crevasses along cliff bands.

SUMMARY

In addition to the 23 active raptor nests, 158 inactive nests were also located and documented during the nest flights and other nest searching activities. These nests were located across the Project area and associated buffer; however, the vast majority were located along the Bolten Rim and around the perimeter of the Chokecherry plateau. While all nests observed during the nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not able to be located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests marked were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly what species built and/or used the nest.

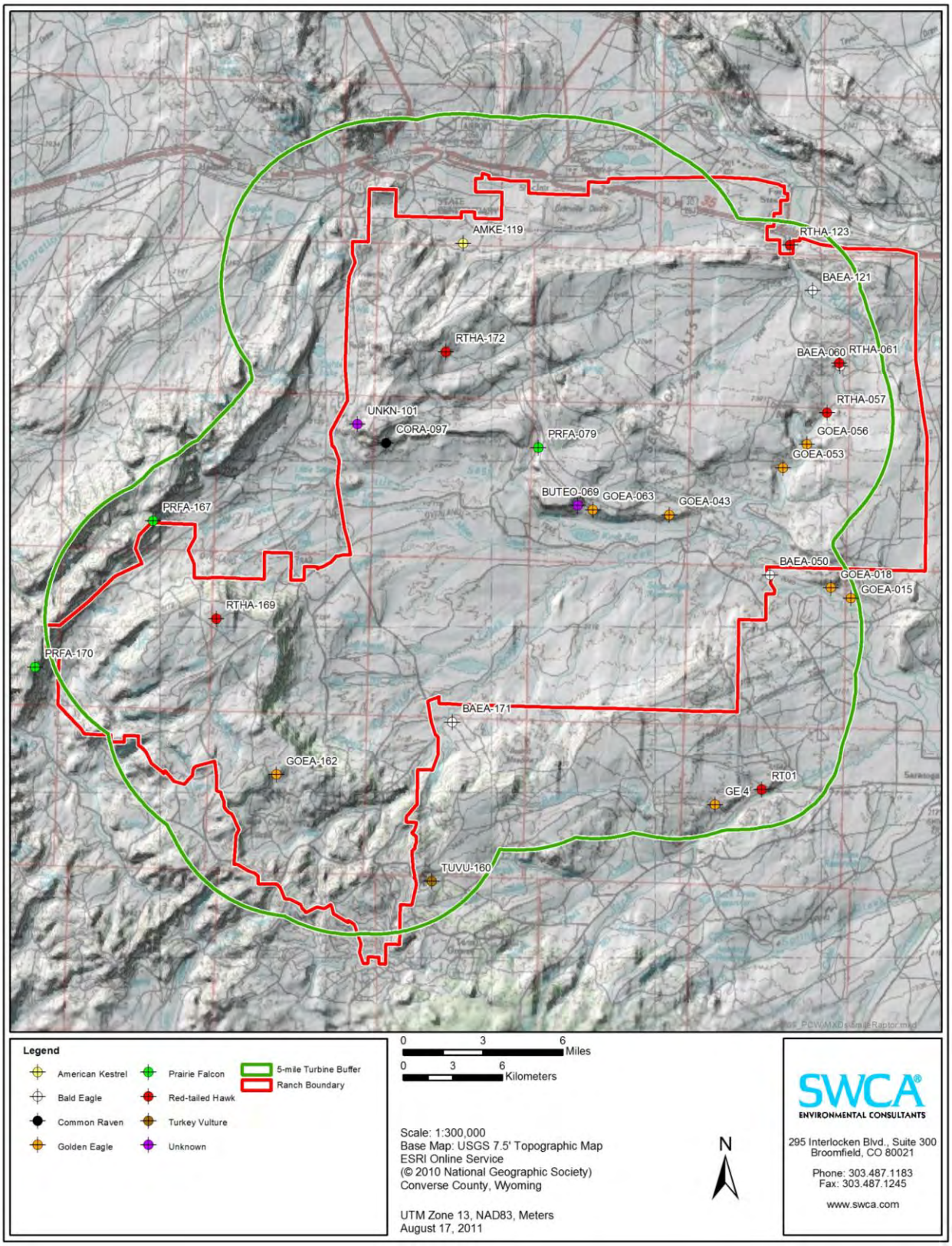

Figure 1. Project area boundary, 5-mile turbine buffer, and all active nests located within the 5-mile turbine buffer in 2011.

APPENDIX A
BLM Ferruginous Hawk Dataset

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BLM FERRUGINOUS HAWK DATASET

In May and June 2011, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) development footprint and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. As part of SWCA's nest survey and monitoring effort, ground surveys were conducted to determine the status and condition of all ferruginous hawk (*Buteo regalis*) nests documented by the Bureau of Land Management (BLM) within the Project footprint. Forty ferruginous hawk nest sites were identified in the Project area from data shared by the BLM, and each of these nest sites was visited during 2011 ground surveys (Figure A-1). Data collected included presence/absence of a nest at each site; a description of the state of the nest (if a nest was detected); a description of the habitat surrounding the site; photographs of the nest and surrounding habitat (photographs are provided in Appendix B); and the presence of other features that could suggest recent ferruginous hawk activity (e.g., feathers, whitewash, fresh nesting materials, etc.). Of the 40 nest sites identified from the BLM data, 15 nest structures in various stages of condition and quality were located, some with almost no structure remaining. Additionally, seven historic sites were observed that may have once supported a nest; however, now only a few deteriorated sticks remain. Few of these nest structures were located at the BLM sites; however, SWCA surveyed at minimum 100 meters (m) around each of the BLM sites for nest structures as they were likely marked during aerial surveys, which can lead to some degree of inaccuracy in each location. Results for each BLM ferruginous hawk nest site are listed below.

FH18851701: No nest was detected at this site, which is located on a rocky hilltop (Appendix B, Photo 14). An historic nest site is located approximately 22 m northwest of the BLM site (Universal Transverse Mercator [UTM] 13T 0334724, 4599927). The nest is in extremely poor condition with only a few sticks on a small rock outcrop (Appendix B, Photo 15). There were no signs of recent ferruginous hawk activity.

FH18870101: This site contains the remnants of an historic nest, mainly consisting of a few deteriorated sticks and a small amount of old whitewash, but no remaining nest structure (Appendix B, Photo 16). No signs of recent ferruginous hawk activity were observed.

FH18870201: This site is located in a drainage with no evidence of active or historic nests within 100 m of the site (Appendix B, Photo 17). No signs of recent ferruginous hawk activity were observed.

FH18870202: No nest was detected at this site. The site is located on a hillslope, and no signs of recent ferruginous hawk activity were present (Appendix B, Photo 18). A nest is located approximately 64 m north of the BLM site (UTM 13T 0320037, 4603851). This nest is located on a hillslope and is in fair condition; however, there were no other signs of recent ferruginous hawk activity (Appendix B, Photo 19).

FH19860301: A nest is located approximately 15 m east of this site (UTM 13T 0327708, 4612200). The nest is in good condition, likely used in the recent past (Appendix B, Photo 20), with a small amount of whitewash observed around the nest. This nest was also recorded during SWCA's flights across the Project area (nest FEHA-153).

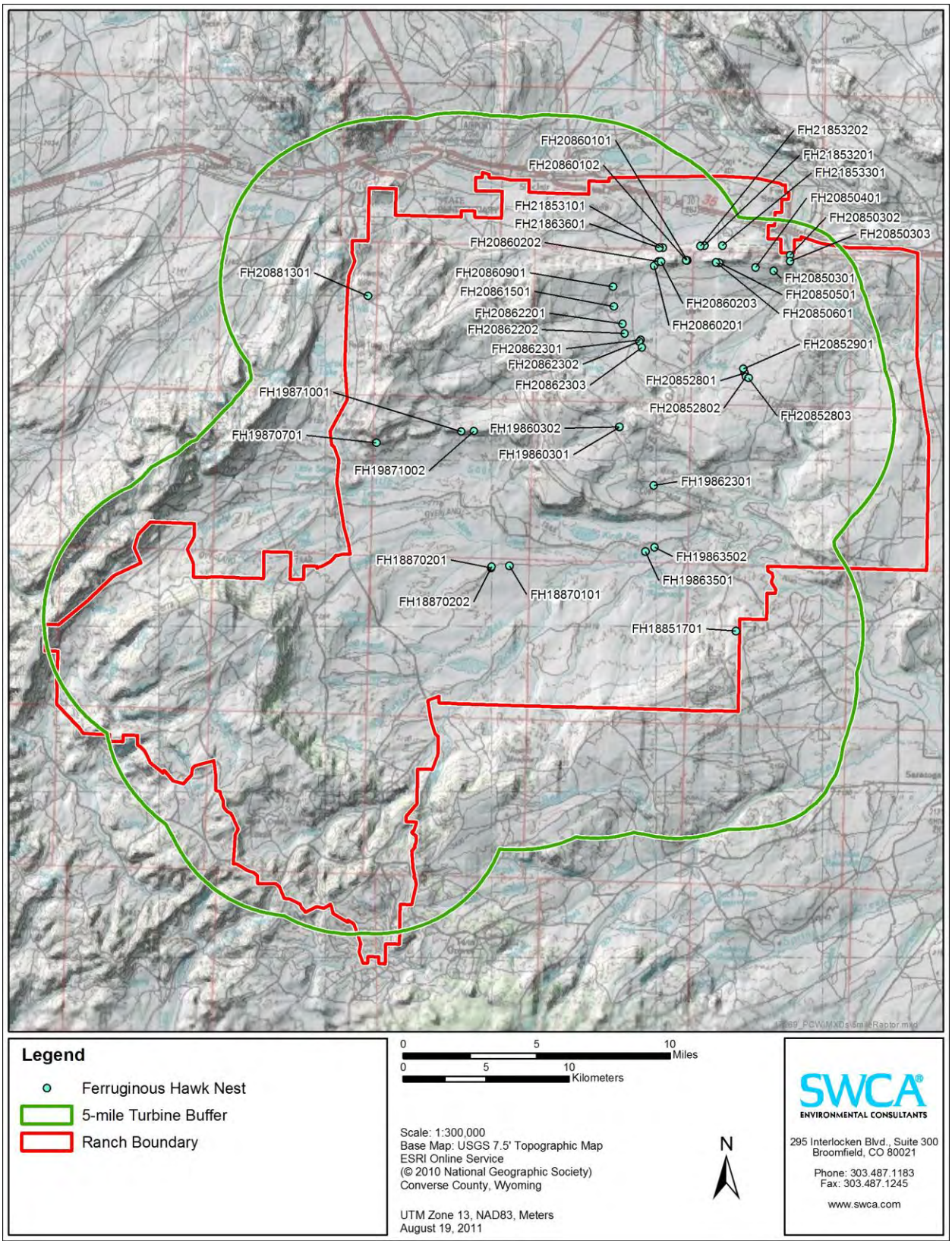

Figure A-1. Project area boundary, 5-mile turbine buffer, and all BLM ferruginous hawk nest sites within the Project area.

FH19860302: No nest was detected at this site. The site is on a rocky hilltop (Appendix B, Photo 21) and is located approximately 35 m north of FH1986031. The area surrounding both of these sites was searched, but no additional nests were detected. No signs of recent ferruginous hawk activity were observed.

FH19862301: No nest was detected at this site. This site is located in sagebrush and bare ground on a hillslope below a cliff band (Appendix B, Photo 22). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH19863501: A nest was detected approximately 20 m north of the BLM site (UTM 13T 0329290, 4604725). The nest is located on a hilltop and is in fair condition, likely having been used in recent years (Appendix B, Photo 23). No other signs of recent ferruginous hawk activity were observed. This nest was also recorded during SWCA's flights across the Project area (nest FEHA-154).

FH19863502: This site contains the remnants of an historic nest, mainly consisting of a few deteriorated sticks, but no remaining nest structure (Appendix B, Photo 24). No signs of recent ferruginous hawk activity were observed.

FH19870701: No nest was detected at this site, which is located partway down a cliff band (Appendix B, Photo 25). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed along the cliff wall.

FH19871001: No nest was detected at this site, which is located at the base of a cliff band above a rock outcrop (Appendix B, Photo 26). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed along the cliff wall.

FH19871002: No nest was detected at this site. The site is located at the base of a cliff band (Appendix B, Photo 27) with signs of recent whitewash along the cliff band. A nest is located approximately 84 m northwest of the BLM site (UTM 13T 0318857, 4612023). The nest is located at the base of the cliff band on a rock outcrop and is in poor condition (Appendix B, Photo 28). No other signs of recent ferruginous hawk activity were observed.

FH20850301: No nest was detected at this site. The site is located in sagebrush and a bare ground drainage at the base of a small hillslope (Appendix B, Photo 29). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed on a perch 70 m to the north.

FH20850302: This site contains a large nest on a rock outcrop near the North Platte River (Appendix B, Photo 30). The nest is in good condition with relatively fresh grass woven into the inner bowl of the nest; the nest was likely used in the recent past. No feathers, whitewash, or other signs of recent ferruginous hawk activity were observed.

FH20850303: A nest was detected approximately 25 m south of the BLM site. The nest is located on a rock outcrop near the North Platte River. The nest is in poor condition and

appeared to be falling off the rock shelf on which it was originally built, which led to the structure being compromised (Appendix B, Photo 31). No signs of recent ferruginous hawk activity were observed.

FH20850401: No nest was detected at this site. The nest site is located on bare ground at the base of a hillslope (Appendix B, Photo 32). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20850501: No nest was detected at this site. The nest site is located in sagebrush and bare ground on a hillslope (Appendix B, Photo 33). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20850601: No nest was detected at this site. The nest site is located in sagebrush and bare ground on a hillslope (Appendix B, Photo 34). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20852801: The remnants of an historic nest are located approximately 16 m west of the BLM nest site at the base of a rock outcrop. The site mainly consists of a few deteriorated sticks, but there is no remaining nest structure (Appendix B, Photo 35). A small amount of old whitewash was observed on the rock outcrop, but there were no signs of recent ferruginous hawk activity.

FH20852802: A nest is located approximately 18 m north of the BLM site (UTM 13T 0335323, 4615247) on a rock outcrop. The nest is in fair to good condition with good structure, but is slightly collapsed (Appendix B, Photo 36). There were no signs of recent ferruginous hawk activity.

FH20852803: No nest was detected at this site, which is located on bare ground in a basin (Appendix B, Photo 37). The remnants of an historic nest are located approximately 95 m east of the BLM site (UTM 13T 0335585, 4615203) on a rock outcrop. The nest is in very poor condition and is mainly a pile of deteriorated sticks (Appendix B, Photo 38). No signs of recent ferruginous hawk activity were observed.

FH20852901: No nest was detected at this site. The site is located on bare ground near saltbush and next to a creek bed (Appendix B, Photo 39). A nest is located approximately 200 m north of the BLM site (UTM 13T 0335189, 4615940) on a rock outcrop. The nest is in fair condition and has potential for reuse in the future (Appendix B, Photo 40). Old whitewash is present at the site, but no other signs of recent ferruginous hawk activity.

FH20860101: No nest was detected at this site, which is located on rocky ground on a hilltop (Appendix B, Photo 41). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860102: No nest was detected at this site, which is located on rocky ground on a hillslope (Appendix B, Photo 42). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860201: No nest was detected at this site, which is located on a rocky hillslope (Appendix B, Photo 43). A nest is located approximately 80 m northeast of the BLM site (UTM 13T 0329868, 4622032) on a small rock outcrop. The nest is in fair to good condition and has potential for reuse in the future (Appendix B, Photo 44). There were no signs of recent ferruginous hawk activity.

FH20860202: No nest was detected at this site, which is located on rocky ground on a hillslope (Appendix B, Photo 45). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860203: No nest was detected at this site, which is located on a rock outcrop on a hilltop (Appendix B, Photo 46). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860901: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 47). There are signs of an historic nest on a rock outcrop located approximately 45 m northeast of the BLM site; however, the site mainly consists of a few deteriorated sticks. This site was also recorded during SWCA's flights across the Project area (nest FEHA-151). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

FH20861501: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 48). There are signs of an historic nest on a rock outcrop located approximately 110 m south of the BLM site; however, the site mainly consists of a few deteriorated sticks. This site was also recorded during SWCA's flights across the Project area (nest FEHA-150). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

FH20862201: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 49). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20862202: No nest was detected at this site, which is located in sagebrush at the bottom of a small hillslope (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20862301: No nest was detected at this site, which is located in sagebrush at the base of a small rock outcrop. There are signs of an historic nest on a rock outcrop located approximately 78 m northwest of the BLM site. The nest is in very poor condition and consists a pile of sticks with no cohesive structure (Appendix B, Photo 50). This site was also recorded during SWCA's flights across the Project area (nest FEHA-149). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

FH20862302: This site contains a large nest beside a rock outcrop. The nest is in good condition with a discernable inner bowl, and was likely used in the recent past (Appendix B, Photo 51). Newer whitewash was observed on the outcrop near the nest, but no other signs of

recent ferruginous hawk activity were observed. This nest was also recorded during SWCA's flights across the project area (nest FEHA-148).

FH20862303: No nest was detected at this site, which is located at the bottom of a small hillslope/rock outcrop (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20881301: No nest was detected at this site, which is located in sagebrush at the bottom of a hillslope (Appendix B, Photo 52). A nest is located approximately 75 m southeast of the BLM site (UTM 13T 0312604, 4620081). The nest is in good condition and built on a small rock outcrop on a hillslope and has potential for reuse in the future (Appendix B, Photo 53). Old whitewash was observed around the nest; however, no other signs of recent ferruginous hawk activity were observed.

FH21853101: No nest was detected at this site, which is located on a rock outcrop on a hilltop (Appendix B, Photo 54). A nest is located approximately 329 m east of the BLM site (UTM 13T 0330639, 4623027). The nest is in good condition and built along the side of a rock outcrop, and likely has been used in the recent past (Appendix B, Photo 55). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21853201: No nest was detected at this site, which is located on the side of a hillslope/rock outcrop. A nest is located approximately 115 m east of the BLM site (UTM 13T 0332949, 4623131). The nest is in fair condition and built along a rock outcrop and has potential for reuse in the future (Appendix B, Photo 56). This site was likely recorded during SWCA's flights across the Project area (nest GOEA-125). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21853202: No nest was detected at this site, which is located along the side of a rock outcrop (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH21853301: No nest was detected at this site, which is located on the side of a hillslope. A nest is located approximately 100 m southwest of the BLM site (UTM 13T 0333852, 4623124). The nest is in poor condition, mostly deteriorated, and built on the top of a rock outcrop (Appendix B, Photo 57). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21863601: No nest was detected at this site, which is located on rocky ground on a hilltop (Appendix B, Photo 58). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

APPENDIX B
Photographs

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Photo 1. Active golden eagle nest GOEA-018. Adult and downy nestling are present.

Photo 2. Active golden eagle nest GOEA-043. One downy nestling is present.

Photo 3. Active golden eagle nest GOEA-053. One downy nestling is present.

Photo 4. Active golden eagle nest GOEA-056. One downy nestling is present and a smaller dummy nest is located just right of the active nest.

Photo 5. Active golden eagle nest GOEA-063. Adult is brooding a downy nestling.

Photo 6. Active golden eagle nest GOEA-162. One downy nestling is present.

Photo 7. Active bald eagle nest BAEA-171. One fully feathered nestling is present.

Photo 8. Inactive stick nest, classified as fair condition.

Photo 9. Inactive stick nest, classified as poor condition.

Photo 10. Inactive stick nest, classified as good condition.

Photo 11. Inactive stick nests. The upper nest is classified as fair to poor condition, the lower nest is classified as good condition.

Photo 12. Inactive stick nest, classified as good condition.

Photo 13. Inactive stick nest, classified as good condition.

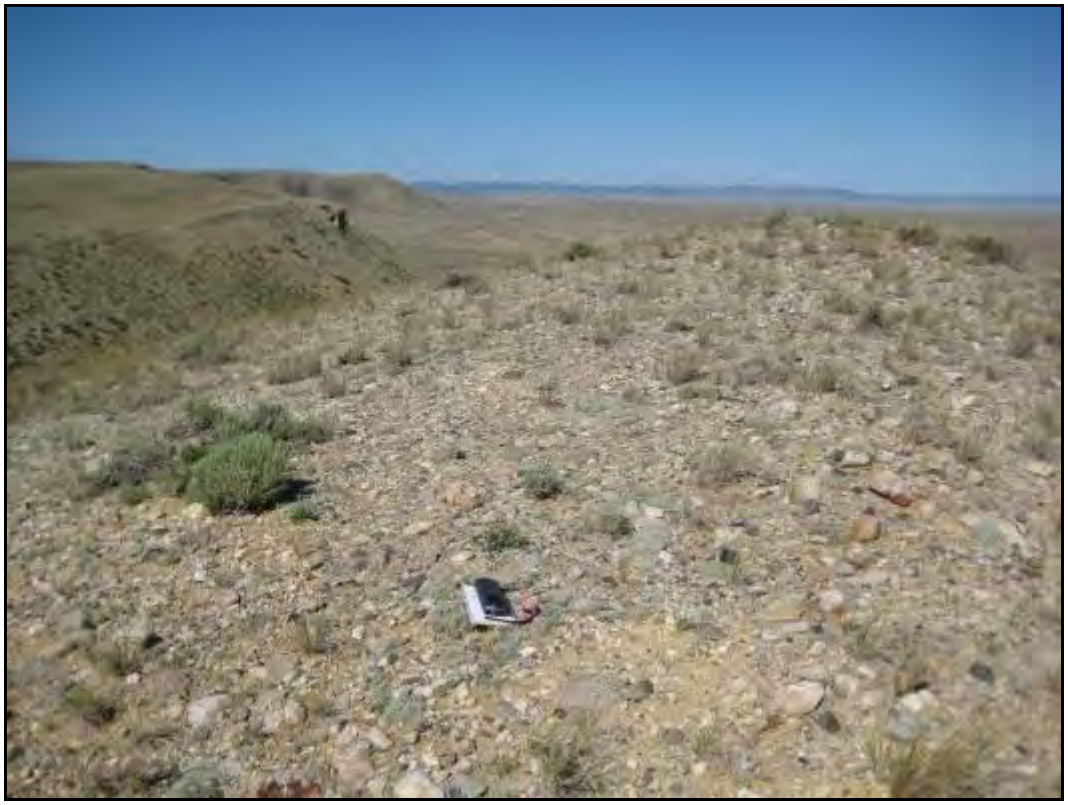

Photo 14. BLM nest site FH18851701. No nest is located at this site.

Photo 15. Remnants of a nest located 22 meters northwest of FH18851701.

Photo 16. BLM nest site FH18870101. Site consists of a small amount of deteriorated sticks, but no remaining nest structure.

Photo 17. BLM nest site FH18870201. No nest is located at or near this site.

Photo 18. BLM nest site FH18870202. No nest is located at this site.

Photo 19. Nest located 64 meters north of FH18870202.

Photo 20. A nest located 15 meters east of BLM nest site FH19860301.

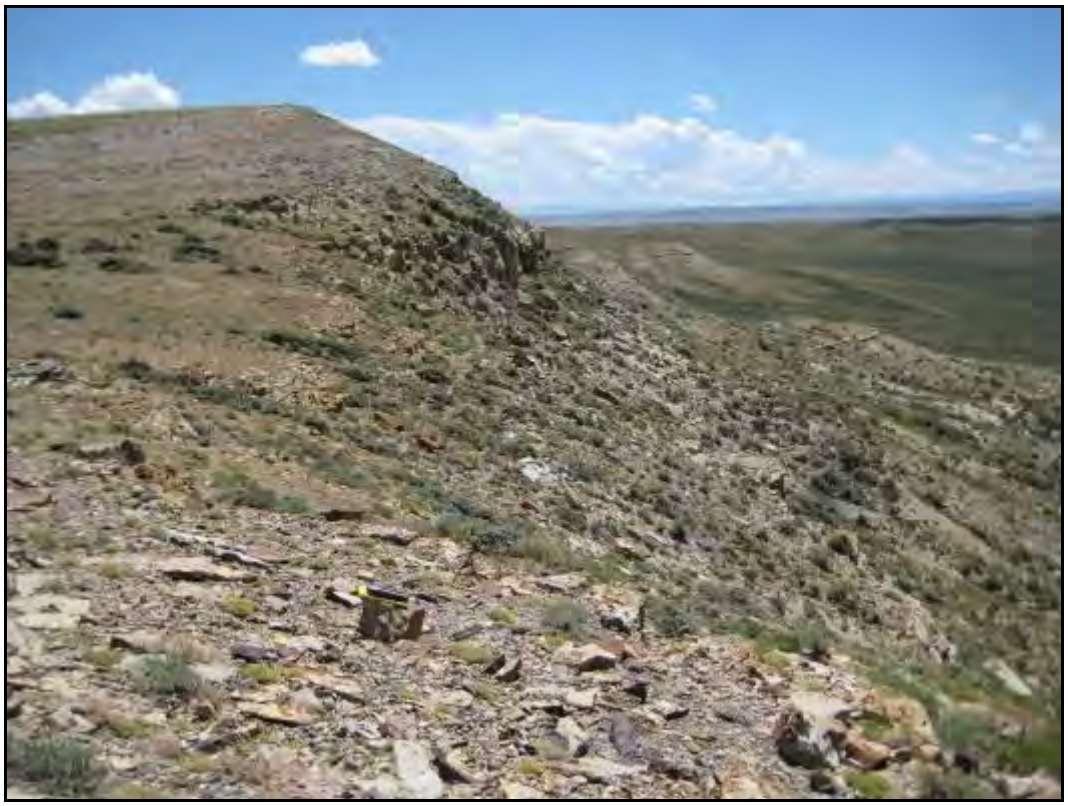

Photo 21. BLM nest site FH19860302. No nest is located at this site.

Photo 22. BLM nest site FH19862301. No nest is located at or near this site.

Photo 23. A nest located 20 meters north of BLM nest site FH19863501.

Photo 24. BLM nest site FH19863502. Site consists of a small amount of deteriorated sticks, but no remaining nest structure.

Photo 25. BLM nest site FH19870701. No nest is located at or near this site.

Photo 26. BLM nest site FH19871001. No nest is located at or near this site.

Photo 27. BLM nest site FH19871002. No nest is located at this site.

Photo 28. Nest located 84 meters northwest of FH19871002.

Photo 29. BLM nest site FH20850301. No nest is located at or near this site.

Photo 30. Nest located at BLM site FH20850302. Nest is in good condition and was likely used in the recent past.

Photo 31. Remnants of a nest located at BLM site FH20850303. Nest is in poor condition and falling off of the rock shelf on which it was built.

Photo 32. BLM nest site FH20850401. No nest is located at or near this site.

Photo 33. BLM nest site FH20850501. No nest is located at or near this site.

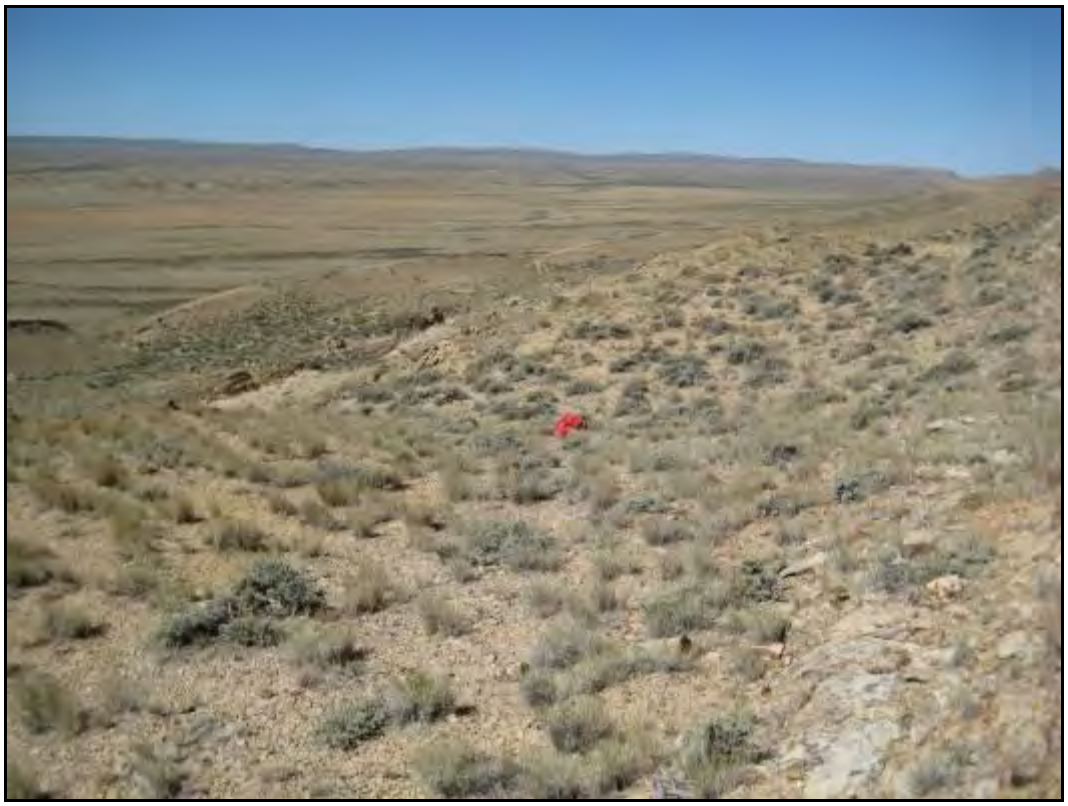

Photo 34. BLM nest site FH20850601. No nest is located at or near this site.

Photo 35. Remnants of a nest located 16 meters west of BLM site FH20852801. Site consists of some deteriorated sticks, but no remaining nest structure.

Photo 36. Nest located 18 meters north of FH20852802.

Photo 37. BLM nest site FH20852803. No nest is located at this site.

Photo 38. Remnants of a nest located 95 meters east of FH20852803.

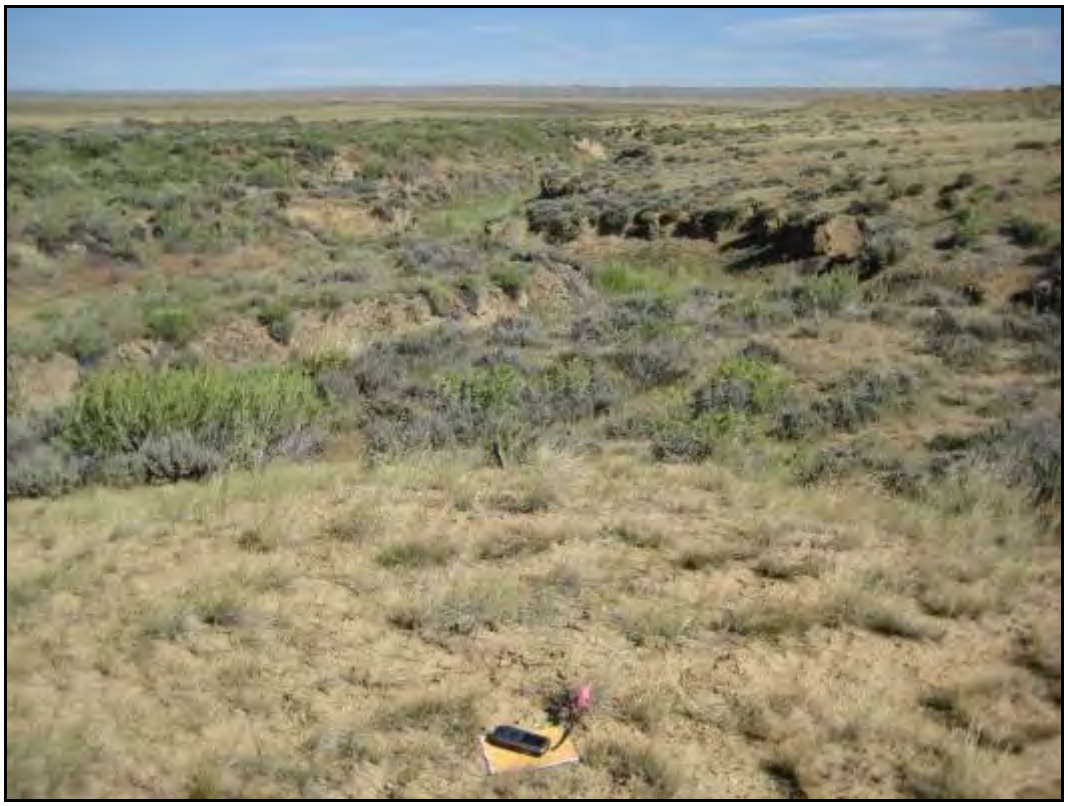

Photo 39. BLM nest site FH20852901. No nest is located at this site.

Photo 40. Nest located 200 meters north of FH20852901.

Photo 41. BLM nest site FH20860101. No nest is located at or near this site.

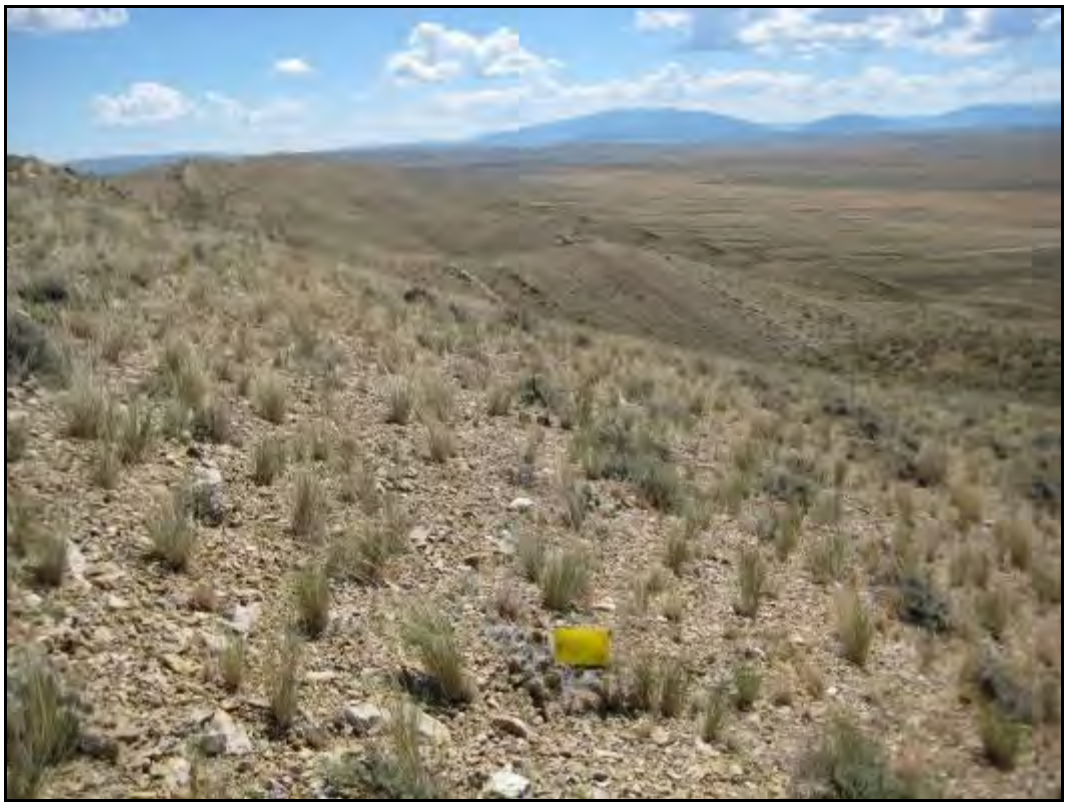

Photo 42. BLM nest site FH20860102. No nest is located at or near this site.

Photo 43. BLM nest site FH20860201. No nest was found at this site.

Photo 44. Nest located 80 meters northeast of FH20860201.

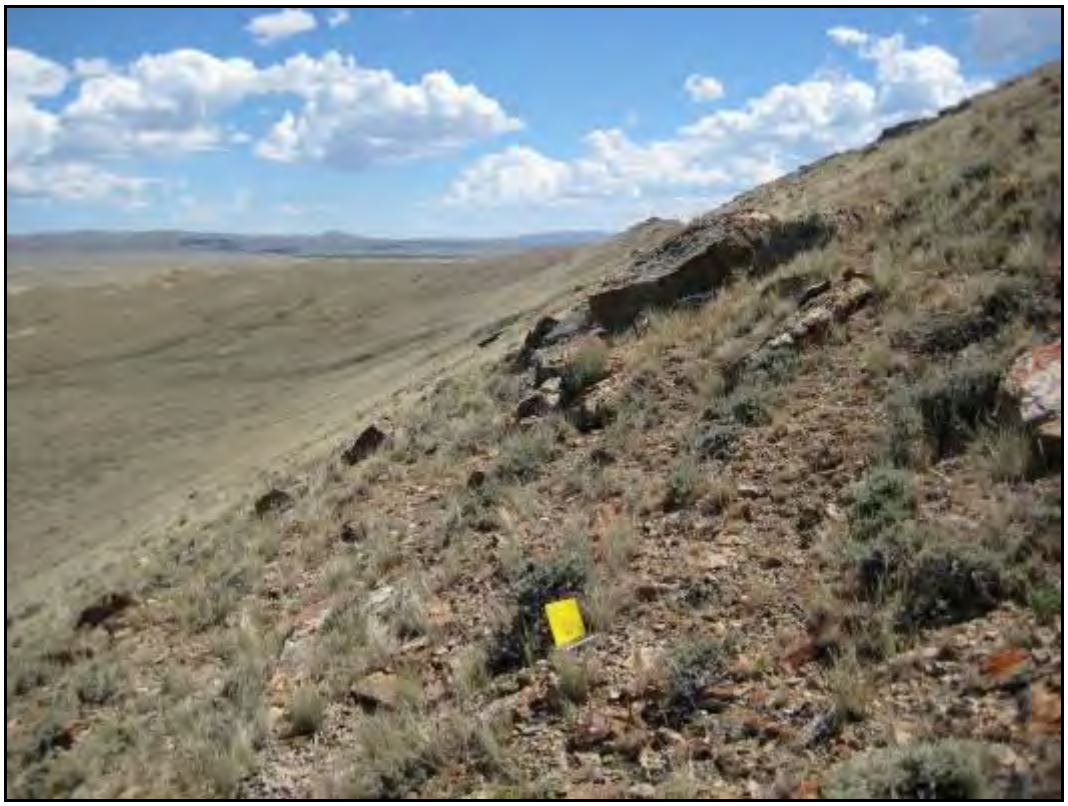

Photo 45. BLM nest site FH20860202. No nest is located at or near this site.

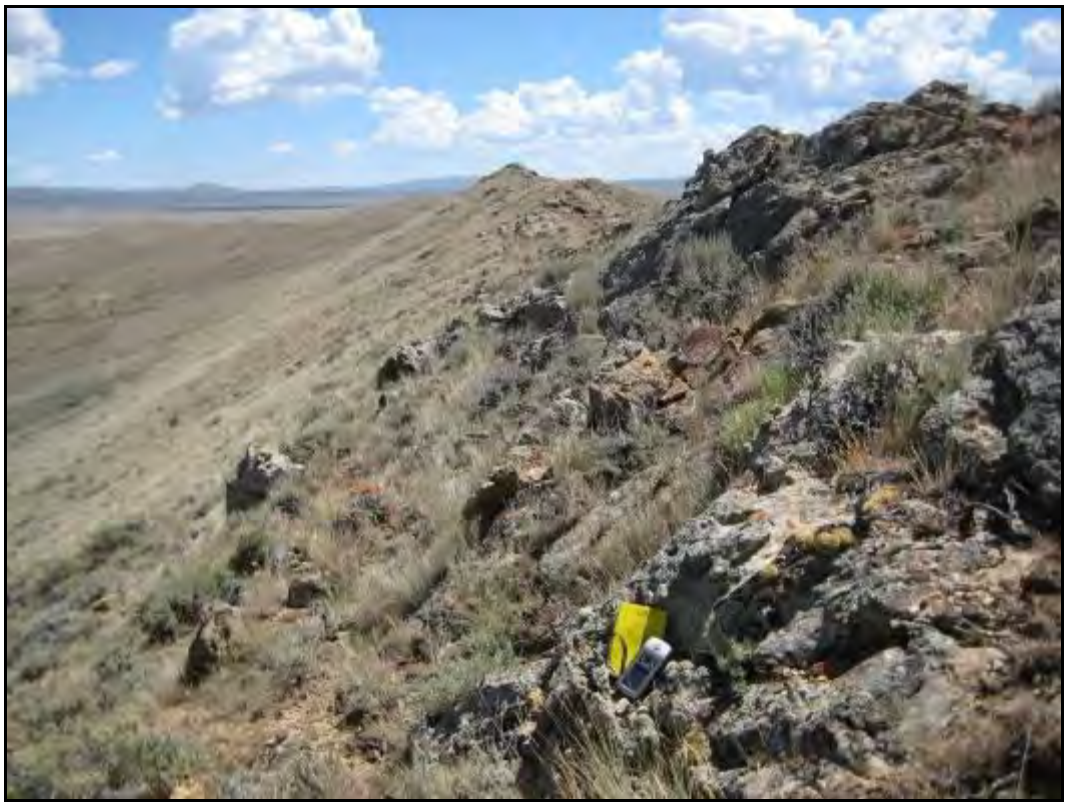

Photo 46. BLM nest site FH20860203. No nest is located at or near this site.

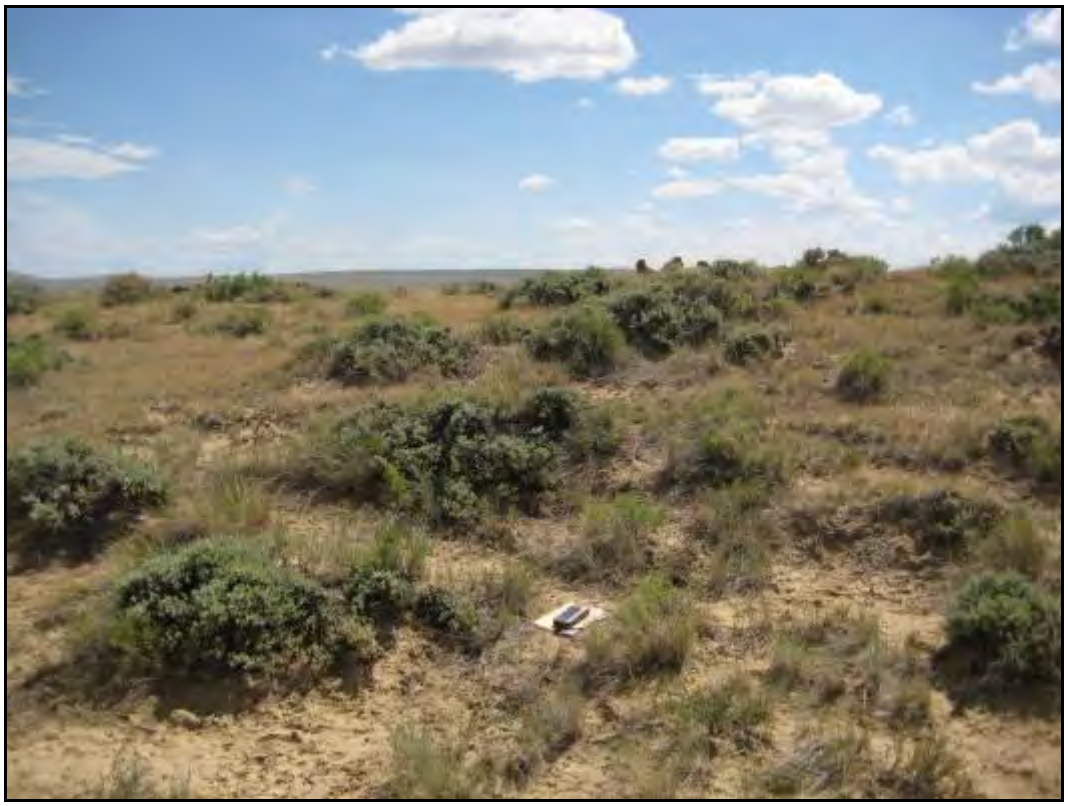

Photo 47. BLM nest site FH20860901. No nest is located at or near this site.

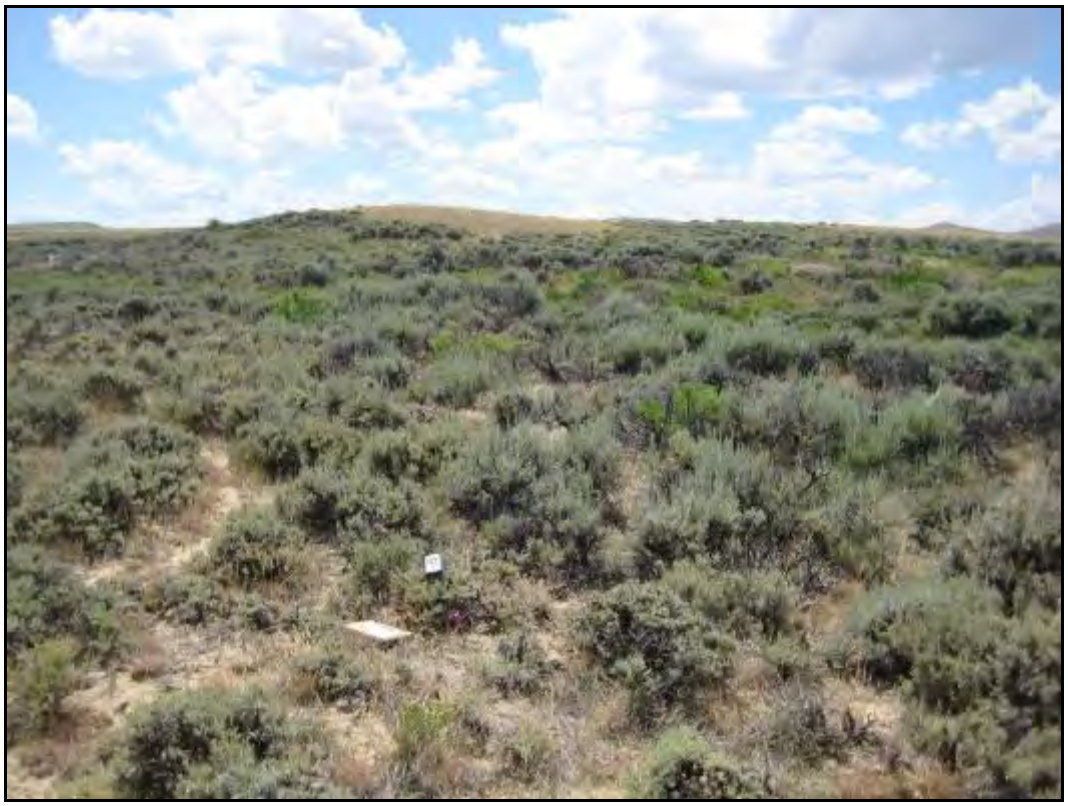

Photo 48. BLM nest site FH20861501. No nest is located at or near this site.

Photo 49. BLM nest site FH20862201. No nest is located at or near this site.

Photo 50. Remnants of a nest located 78 meters northwest of FH20862301. Photo taken during SWCA's nest flights.

Photo 51. Nest located at BLM site FH20862302.

Photo 52. BLM nest site FH20881301. No nest is located at this site.

Photo 53. Nest located 75 meters southeast of FH20881301.

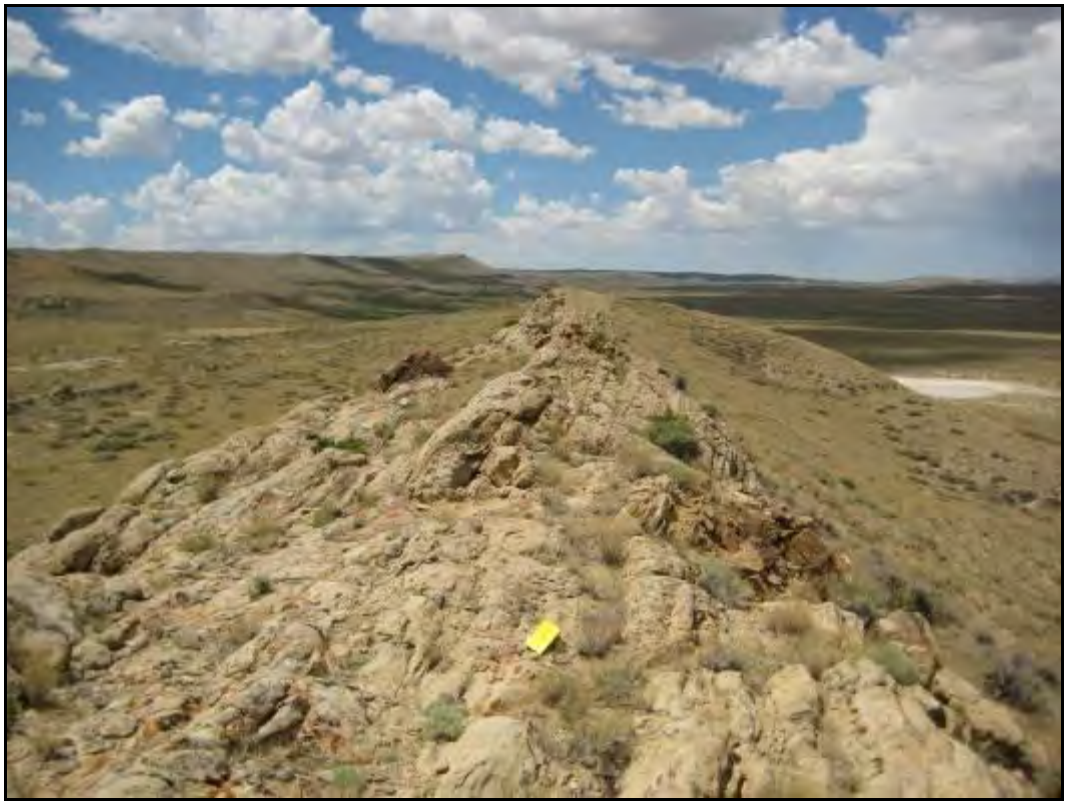

Photo 54. BLM nest site FH21853101. No nest was found at this site.

Photo 55. Nest located 329 meters east of FH21853101.

Photo 56. Nest located 115 meters east of FH21853201.

Photo 57. Remnants of a nest located 100 meters southwest of FH21853301.

Photo 58. BLM nest site FH21863601. No nest is located at or near this site.

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MEMORANDUM

BY ELECTRONIC MAIL

FROM: Garry Miller, Vice President of Land and Environmental Affairs, PCW

TO: Trish Sweanor, Fish & Wildlife Biologist, U.S. Fish & Wildlife Service

CC: Steve Guertin, Regional Director
Noreen Walsh, Deputy Regional Director
Mike Thabault, Assistant Regional Director, Ecological Services
Mark Sattelberg, Field Supervisor Cheyenne
Tyler Abbott, Deputy Field Supervisor Cheyenne
Casey Stemler, Acting Assistant Regional Director, Migratory Bird & State Programs
Kevin Kritz, Biologist, Migratory Birds & State Programs
David Cottingham, Senior Advisor to the Director

DATE: July 6, 2012

RE: Summary of cooperation to date and response to June 25, 2012 data request

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This memorandum responds to your June 25 request for various data relating to the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project). It also summarizes the history of discussions and cooperation to date between the Power Company of Wyoming LLC (PCW) and the U.S. Fish and Wildlife Service (Service) concerning development of a Bird and Bat Conservation Strategy (BBCS)[1] and Eagle Conservation Strategy (ECS) for the CCSM Project. We believe this summary will be useful as our discussions move forward due to the volume of information and technical data that has been exchanged, the loss of "institutional knowledge" regarding the CCSM Project due to the change in Service personnel, and the complex interplay between the Service's policies and procedures, those of the BLMs, and the landscape scale of the CCSM Project FEIS.

PCW has been working closely with the Service for over two years to develop a comprehensive BBCS/ECS that will avoid and minimize the potential for golden eagle take.

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[1] Previously referred to as an Avian Protection Plan (APP).

In 2011, the Service determined that developing an APP is an appropriate option for the CCSM Project.[2] The Service not only approved, but enthusiastically endorsed PCWs monitoring protocols, use of avian radar, and the overall BBCS/ECS development approach.

In 2008 and 2009, BLM's environmental sub-contractor used traditional survey techniques to collect avian use data, which are sufficient for NEPA-level analysis. Beginning in 2010, PCW undertook additional data collection efforts for site-specific avian use with an extensive avian survey program. In March 2011 PCW deployed a sophisticated avian radar system in conjunction with traditional avian survey methods on the Overland Trail ranch to gather specific insights into the habitat that eagles and other raptors either may or may not use. This will inform PCW as to CCSM Project areas that may not be suitable for development/siting turbines. PCW also is gaining valuable insights – such as approximately 93% of all birds and bats fly well above rotor-swept height (blade height).

PCWs avian monitoring program: (1) exceeds USFWS Eagle and Onshore Wind Guidance, State of Wyoming survey recommendations, Federal Advisory Committee guidelines, and BLM survey recommendations and Instructional Memoranda; and (2) provides 100% coverage of probable turbine locations – this is unprecedented pre-construction coverage.

PCWs eagle use data and survey results (there are no eagle nests in the CCSM Project development area) do not support the estimated annual golden eagle fatalities cited in BLMs Final EIS, which largely relied on assigning a risk factor to the entire project site based on limited surveys in high-use areas. PCW would like to meet with the Service's modeling experts to discuss the eagle fatality model developed by SWCA Environmental Consultants (SWCA) for the CCSM Project. This model supports the USFWS initial determination that the CCSM Project is a Category 2 Project for which a BBCS/ECS is appropriate.

Initial Discussions Between PCW and the Service

Beginning mid-2010, PCW contacted the Service and initiated discussions concerning development of a CCSM Project Avian Protection Plan (APP), currently referred to as a BBCS. This was prompted by the newly released Bureau of Land Management (BLM) Instruction Memorandum (IM) 2010-156. The purpose of IM 2010-156 is to provide direction to the BLM for complying with the Bald and Golden Eagle Protection Act (BGEPA) and to identify a process whereby BLM can ensure that authorization of renewable energy projects is consistent with the provisions contained within BGEPA. Under the IM, if the Service determines developing an APP is an appropriate option, the BLM may issue a

[2] Attachment 1, Letter from the Service to BLM dated April 20, 2011.

Record of Decision (ROD) approving the project. The BLM, however, may not authorize a Notice to Proceed until the Service has evaluated the APP and determined that it is adequate.

The parties participating in these initial discussions were PCW, its biological consultant SWCA, BLM, Wyoming Game and Fish Department (WGFD), and the Service. The Service was represented by Mr. Travis Sanderson, the renewable energy coordinator stationed in Rawlins, Wyoming, and Mr. Clark McCreedy and Mr. Scott Covington of the Wyoming Ecological Services Field Office in Cheyenne, Wyoming.

The understanding among PCW, BLM and the Service was that IM 2010-156 applied to golden eagles as opposed to all migratory birds and that BLM and the Service would confer regarding risk to golden eagles for the CCSM Project. Bald eagles were not considered to be at risk by either the BLM or the Service due to extremely low usage, absence of nests, and no identified bald eagle home ranges within the CCSM Project Area. In addition, at that time there was only one known bald eagle fatality at a wind farm in the U.S. Therefore, while the Service encouraged PCW to consider risk to all migratory birds in developing the CCSM Project APP, it was clear that the BLM's decision framework and its concurrence with the Service would only consider risk to golden eagles.[3]

The data available in 2010 consisted of raptor nest data maintained by BLM, and the avian nest and use surveys conducted by WEST Inc. in 2008 and 2009 for the CCSM Project environmental impact statement studies.[4] Upon review of the WEST data, the Service concluded that the data were inadequate to evaluate risk to eagles for purposes of developing an APP and would not produce the type of meaningful results necessary to quantify potential take. Indeed, the Service expressed the view that pre-construction avian surveys for wind projects in general were inadequate and a much more rigorous survey protocol was necessary, especially for golden eagles.

Development of Comprehensive Avian and Bat Monitoring Protocols

The result of numerous meetings, discussions and review of draft protocols was that PCW, working in close collaboration with BLM, WGFD, and especially the Service, developed robust and comprehensive avian survey protocols. The survey protocols called for both traditional ground based observer surveys, such as avian point count surveys, long-watch raptor surveys, and waterbird and breeding bird surveys; helicopter nest surveys; and one of the first ever applications of avian radar technology to survey for large raptors.

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[3] There are no bat species within the CCSM Project Area which fall under the jurisdiction of the Service.

[4] WEST was acting as a subcontractor to the BLM's third party environmental contractor.

The Service specifically requested that PCW conduct yearlong raptor surveys using a Merlin Avian Radar System manufactured by Detect Inc. While the Merlin Radar System had been previously used to monitor bat activity, it had never before been employed to survey for golden eagle activity. According to Mr. Sanderson and Mr. McCreedy, they had asked a number of developers in Wyoming to utilize an avian radar system for pre-construction surveys and all had refused, largely due to the expense - each unit costs nearly $300,000. After in-depth research regarding the potential benefits and limitations of the Merlin Radar System, PCW agreed to purchase the system, as requested by the Service, and to utilize the system in PCWs avian surveys. When making the request and recommendation that PCW invest in the Merlin Radar System, the Service and BLM were well-aware of its limitations. On September 29, 2010, PCW submitted a white paper to BLM and the Service describing that species-specific and group-specific risk assessment would not be possible with the radar data.[5]

The Service Approves PCWs Avian and Bat Monitoring Protocols

In December 2010, PCW submitted its Avian and Bat Monitoring Protocols to the Service for final review.[6] PCWs letter outlined the basis it would use in developing its APP and reflected its understanding as of that date as follows:

> We understand that you will review the adequacy and appropriateness of these Protocols and provide to us your comments, suggestions and recommendations for revising and implementing the Protocols. Upon completion of the Service's review, additional evaluations of bald and golden eagle use of the Project will be made on a site-specific basis using these Protocols. We further understand that data from the 2008 and 2009 point count surveys, data generated from the implementation of these Protocols, and any additional site-specific data provided to PCW by the Service during implementation of these Protocols will be adequate to characterize site-specific eagle activities, develop an Avian Protection Plan, identify impacts from construction and operation of the Project on eagles, and identify avoidance, minimization, and mitigation efforts upon which the Service will evaluate the APP.[7]

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[5] Attachment 2, White paper dated September 29, 2012.

[6] Attachment 3, Letter dated December 21, 2010, from PCW to the Service.

[7] *Id.*

On behalf of the Service, Mr. Sanderson reviewed the December protocols and offered some refinements concerning the long-watch surveys. PCW revised the protocols and resubmitted them to the Service in March 2011.[8]

Subsequently, the Service approved PCWs Avian and Bat Monitoring Protocols. In a March 3, 2011 email, Mr. Sanderson stated "[a]s we have stated all along, we are 100% behind the monitoring protocols . . . ."[9] On May 5, 2011, Mr. Sanderson reiterated the Service's approval of the monitoring protocols and APP/ECS development approach in an email stating "[a]s discussed previously, the Service is entirely on-board with the proposed monitoring protocols . . . ."[10] He also represented that the Service would provide PCW a "letter of endorsement" for the protocols and APP/ECS approach once several small schedule issues related to the timeline that PCW proposed for development of the APP were resolved. Prior to the formal letter being issued, Mr. Sanderson left the Service, as did Mr. McCreedy. Mr. Covington has transferred to a different position within the Service.

PCW Submits its Draft ECS and Requested Data to the Service

After collecting nearly a year's worth of additional data, on January 19, 2012, PCW submitted a draft of its ECS to the Service through Mr. Sanderson.[11] Mr. Sanderson provided the ECS to you, Mr. Tyler Abbot (Wyoming Ecological Field Services) and, we believe, others. On March 7, 2012, PCW submitted the conservation measures section of the ECS to Mr. Sanderson for review by the Service.[12] Shortly thereafter, on March 12, 2012, you, Tyler Abbott and Mr. Sanderson (on the phone), representatives from PCW and SWCA met to discuss the draft of the ECS and data collection efforts. You followed up on the meeting later that day with an e-mail to Mr. Kehmeier asking questions related to ECS data and strategy.[13] Mr. Kehmeier responded to your questions on March 14, 2012.[14]

On March 21, 2012, in response to the Service's request made during the meeting of March 12, 2012, Mr. Kehmeier provided you with raw eagle data for the CCSM Project.[15] Data

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[8] Attachment 4, Submission of revised protocols March 2011 via email dated March 2, 2011 from Mr. Kehmeier to Mr. McCreedy and Mr. Sanderson.

[9] Attachment 5, Email dated March 3, 2011, from Mr. Sanderson to Mr. Kehmeier.

[10] Attachment 6, Email dated May 5, 2011, from Mr. Sanderson to Mr. Kehmeier.

[11] Attachment 7, Submission on January 19, 2012, of first draft of the ECS (hard copy without conservation measures section).

[12] Attachment 8, Submission on March 7, 2012, of conservation measures section.

[13] Attachment 9, Email dated March 12, 2012, from Ms. Sweanor to Mr. Kehmeier.

[14] Attachment 10, Email dated March 14, 2012, from Mr. Kehmeier to Ms. Sweanor and others.

[15] Attachment 11, Email dated March 21, 2012, from Mr. Kehmeier to Mr. Abbott, Ms. Sweanor and Mr. Sanderson.

provided included all eagles observed, location of eagles, and the number of minutes each bird was observed. The dataset also included the number of minutes of total survey time which allows for calculation of use per unit of survey time.

On April 12, 2012, Mr. Kehmeier received a new data request from Mr. Abbott including a request for raw eagle use data, eagle flight path maps and survey locations.[16] The maps and data requested had previously been delivered to the Service on January 19 as part of the draft ECS. However, on April 17 and 18, Mr. Kehmeier resent the maps and data to Mr. Abbott.[17]

Subsequently, on April 30, 2012 you requested via voice mail that Mr. Kehmeier send you eagle flight path maps. These flight path maps had been previously included in the draft ECS, submitted to the Service on January 19, 2012, respectively, and again with the April 17 response. On May 1, 2012 Mr. Kehmeier resent the flight path maps in response to your April 30 request.[18]

On May 7, 2012, Mr. Kehmeier responding to a phone conversation with you resent the eagle data that were initially provided to you on March 21 and again on April 17 and 18.[19] The May 7 submission also included updated information to reflect results of winter 2011/2012 avian surveys.

On May 16, 2012, I met with you, Mr. Kevin Kritz and Mr. Tim Modde (Service Region 6 employees), Mr. Kehmeier, and Mr. Clint King and Mr. Doug Faulkner of SWCA to discuss the status of the ECS. At this meeting, PCW was informed for the first time that it must submit not only an ECS to the Service, but a BBCS as well. The Service informed PCW that it is no longer using APPs for wind projects.

We discussed PCW's extensive efforts to date to collect and analyze avian survey data, to assess risk to eagles, and to prepare an ECS. We further discussed the relationship between the BLMs decision on the CCSM Project and the Service's concurrence on the BBCS/ECS. In accordance with IM 2010-156 the BLM may issue a Record of Decision (ROD) approving the CCSM Project based upon the Service's determination that developing an APP for the CCSM Project is an appropriate option. The BLM, however, may not authorize a Notice to Proceed until the Service has evaluated the APP and determined that it is adequate.

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[16] Attachment 12, Email dated April 12, 2012, from Mr. Abbott to Mr. Kehmeier.
[17] Attachment 13, Emails dated April 17 & 18, 2012, from Mr. Kehmeier to Mr. Abbott and Ms. Sweanor.
[18] Attachment 14, Email dated May 1, 2012, from Mr. Kehmeier to Ms. Sweanor.
[19] Attachment 15, Email dated May 7, 2012, from Mr. Kehmeier to Ms. Sweanor.

Service's Request for Unprocessed Avian Radar Data

We also discussed, at length, the avian radar data, and its appropriate uses and limitations. At the May 16 meeting, you requested the raw radar data. As we discussed, however, there are several factors that are problematic with respect to providing you with the unprocessed avian radar data. First, the data files are enormous comprising several terabytes of information which was gathered 24/7 for over a year. Second, the Service does not have the software required to process the raw data. Finally, Mr. Kehmeier, Mr. King and Mr. Faulkner explained that because of the size of the radar data sets and the inability to differentiate among species or size categories, viewing the raw radar data or radar data presentations in the format you requested would not be informative. We have provided the Service with the results of compiling, processing and analyzing the raw radar data and incorporated this information into the draft ECS. In doing so, SWCA followed accepted scientific procedures for presenting data to the Service.

BBCS/ECS and an Eagle Take Permit

At the May 16 meeting we also discussed the relationship between the ECS and an incidental eagle take permit (ITP) and our understanding of the differing standards associated with the Service's approval of each. We base this understanding on the draft Eagle Conservation Plan Guidance (draft Guidance) issued January 2011 and the February 8, 2011 Eagle Conservation Plan Guidance Questions and Answers.

The draft Guidance provides a means of compliance with BGEPA via three components: (1) "conducting early pre-construction assessments to identify important eagle use areas; (2) avoiding, minimizing, and/or compensating for potential adverse effects to eagles; and, (3) monitoring for impacts to eagles during construction and operation."[20] Thus, the focus or standard with respect to the Service's approval of PCW's ECS is whether PCW through its extensive collection of data using traditional and avian radar surveys has, prior to construction, identified important eagle use areas and fully evaluated options to avoid and minimize Project impacts and thoroughly assessed mitigation measures related to siting, operations and monitoring such that the likely take can be minimized or avoided.

The ECS may be considered a first step towards obtaining an ITP as the ECS can be developed to support the issuance of an ITP. The draft Guidance resulting in an ECS

[20] U.S. Fish & Wildlife Service, Draft Eagle Conservation Plan Guidance at 7 (January 2011).

"describes a means by which to collect and analyze information that could lead to a programmatic permit to authorize unintentional take of eagles at wind energy facilities."[21] In determining whether an ITP would be compatible with the preservation of golden eagles, the Service will look to whether the issuance of such permit would be "consistent with the goal of stable or increasing breeding populations."[22] That term "allow[s] take that is compatible with long-term stability or growth of eagle populations."[23] Thresholds for authorizing take are based on regional eagle populations.[24]

Although PCW intends to apply for an ITP, its initial focus is on the development and approval of the ECS and the standards associated with an ECS.

PCWs Response to the Service's Most Recent Data Request of June 25th

On June 20, 2012, you informed me and Mr. Kehmeier that you were meeting with the Service's Eagle Team the next day and asked if we could supply your office with the eagle model PCW is using to estimate eagle take from PCWs survey data. You also requested GIS information for certain bird habitat layers and offered to provide a list of the habitat features you would like. Mr. Kehmeier responded that he was unable to immediately provide you with the data you requested as he was presenting at an important national seminar on greater sage-grouse. On June 25, 2012, you clarified your June 20 data requests and provided specifics on the information sought.[25]

PCW responds to your June 25 data requests as follows:

1. Request: Data on active nest sites for 2008, 2011 and 2012.
   Response: The raptor nest data sets for 2008 and 2011 were previously provided. Transmitted with this memo we are resending the GIS data for 2008 and 2011 and providing the dataset for 2012.
2. Request: Flight path data for all raptor species.
   Response: We have previously provided flight path data for all eagles. We have not compiled flight path data for raptors other than eagles. Transmitted with this memo

[21] U.S. Fish & Wildlife Service, Draft Eagle Conservation Plan Guidance at 7 (January 2011).
[22] 74 Fed. Reg. 46836, 46837 (September 11, 2009).
[23] 74 Fed. Reg. at 46839.
[24] 74 Fed. Reg. at 46841.
[25] Attachment 16, Email dated June 20, 2012, from Ms. Sweanor to Mr. Kehmeier and Mr. Miller; email dated June 20, 2012, from Mr. Kehmeier to Ms. Sweanor; and email dated June 25, 2012, from Ms. Sweanor to Mr. Kehmeier.

we are resending the flight path GIS data for eagles. We will compile the flight path data for other raptors and include it with the BBCS/ECS submission.

3. Request: Avian survey point locations.
   Response: These data have been previously provided to you and were also included in the draft ECS. Transmitted with this memo we are resending the avian survey point locations in GIS format.
4. Request: Data on vegetation cover.
   Response: The draft ECS includes maps of vegetation cover. We have not previously received a request for the GIS data. Transmitted with this memo are the GIS files for the vegetation cover.
5. Statement: You indicated that you have BLM historical nest sites and prairie dog town data. No response from us is required; however, we do note the following. In 2010 BLM contracted with Smith Environmental and Engineering to investigate and record white-tailed prairie dog (WTPD) town locations and associated burrow density. The data were collected to help in identification of suitable black-footed ferret (BFF) habitat for the Bolten Ranch BFF Complex. We have reviewed this report and have serious concerns regarding its accuracy, the scientific methods employed, and its conclusions. We have undertaken an independent study to examine the report's findings. We will document our field investigations and provide a review of the Smith report with the submittal of the BBCS/ECS. Until our review is complete, we caution the Service in relying upon this BLM supplied data in the Service's assessment of eagle risk for the CCSM Project as our early assessment is that the Smith data are seriously flawed.
6. Request: Data on ungulate crucial winter range.
   Response: The data have not been previously requested from us. Transmitted with this memo are the GIS files showing ungulate crucial winter range.
7. Request: Greater sage-grouse lek locations.
   Response: These data have not been previously requested from us. Transmitted with this memo are the GIS files showing greater sage-grouse leks.
8. Request: Data on ungulate parturition areas.
   Response: There are no ungulate parturition areas with the CCSM Project area.
9. Request: Data regarding grouse (presumably greater sage-grouse) brood rearing habitat data.
   Response: These data have not been previously requested from us. We are uncertain of how to respond to your request as greater sage-grouse brood rearing activity (early and late) can occur throughout portions of the CCSM Project area. We request that you be more specific in your request or clarify the intended use of the data so that we might be responsive to your needs. Without a more specific request we can state that the majority of brood-rearing activity surrounding the CCSM

Project occurs in sage-grouse core areas as defined under Wyoming Executive Order 2011-5.

10. Request: Data on rodent concentrations (e.g., ground squirrels).
    Response: Over the course of our greater sage-grouse and avian studies we record incidental observations of rodents within the CCSM Project area; however, we have not conducted any surveys for rodents other than the surveys recently undertaken to examine the validity of the Smith report. We are therefore unable to provide the data you requested.
11. Request: A GIS layer for the CCSM Project area boundary modified to exclude the Grizzly Wildlife Habitat Management Area as set forth in the final environmental impact statement.
    Response: As we were not privy to the contents of the CCSM Project final environmental impact statement prior to the Notice of Availability, we were previously unaware that the Grizzly WHMA was excluded. Transmitted with this memo is the GIS data layer for the CCSM Project boundary with the Grizzly WHMA omitted.

As to your request for the eagle fatality model developed by SWCA for the CCSM Project, we request a meeting with you and the Service's modeling experts to review the SWCA model as well as the Service's model. We believe it is imperative to understand the model inputs, assumptions, and construction in order to fully comprehend and appreciate the model results. We believe this is best achieved through an in-person meeting with you and the Service's modelers.

Finally, based on the notification PCW received on May 16, 2012, that PCW would need to submit a BBCS in addition to its ECS, we are in the process of finalizing those documents. Because PCW has not received guidance from the Service as to the expected format of the BBCS, PCW intends to include a project description, discussion of survey methodologies and results, and as an appendix an ECS that addresses issues specific to eagles. While you have requested that PCWs BBCS be a concise document, you have also requested that it include all of our survey methods explained in full (even those that involve standard avian protocols) along with a detailed discussion of analysis, results, conservation and mitigation measures, post-construction monitoring plans, and adaptive management procedures. PCW is striving to achieve this challenging balance in the draft BBCS/ECS and expects to provide these to the Service for review by July 16, 2012.

ATTACHMENT 1

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

APR 2 6 2011

In Reply Refer To:
ES-61411/WY11CPA0147

Memorandum

To: Field Manager, Bureau of Land Management, Rawlins Field Office, Rawlins, Wyoming

From: Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, Cheyenne, Wyoming

Subject: Avian Protection Plan Concurrence for the Sierra Madre-Chokecherry Wind Energy Project

Thank you for your letter of December 9, 2011, regarding the proposed Power Company of Wyoming's (PCW) Sierra Madre-Chokecherry Wind Energy Project (Project). The proposed Project is located south/southwest of the city of Rawlins, Carbon County, Wyoming. The Project is a proposed 2,000-MW electrical generating facility consisting of up to 1,000 2-MW wind turbines.

You have requested that the U.S. Fish and Wildlife Service (Service) determine if an Avian Protection Plan (APP) is appropriate for this Project to minimize the potential "take" of eagles. Our response to your request is based on the two-step process identified in the Bureau of Land Management's (Bureau) Instruction Memorandum No. 2010-156 (IM-2010-156), which is:

1) The Service determines that developing an APP is an appropriate option for this Project to avoid and minimize the potential for golden eagle take; therefore, the Bureau's Authorized Officer may issue a Record of Decision approving the project; and

2) The Bureau's Authorized Officer shall not authorize a Notice to Proceed for this Project until the Service has evaluated the APP and determines that it is adequate.

Following the two-step process, we have determined that developing an APP is an appropriate option to avoid and minimize the potential take of eagles (based on the Bureau's IM-2010-156), and migratory birds and bats based on PCW's commitment to meeting the following criteria:

a) Three years of surveys evaluating eagle, migratory bird and bat use of the Project area, as per Service guidance, conducted prior to Project construction; and

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b) Turbine numbers and layout are adjusted to provide effective buffers for eagle and other raptor nest sites as well as areas with high bird and bat utilization, as evidenced by the survey data.

To avoid and minimize impacts to migratory bird species protected by the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703, as well as eagles protected under the Bald and Golden Eagle Protection Act (Eagle Act), 16 U.S.C. 668, the APP will need to address all migratory bird species. The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing unauthorized take, the Service realizes that some birds may be killed even if all reasonable measures to protect them are used. The Service's Office of Law Enforcement (OLE) carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and industries that have taken effective steps to minimize their impacts on migratory birds, and by encouraging others to enact such programs. It is not possible to absolve individuals, companies, or agencies from liability even if they implement avian mortality avoidance or similar conservation measures. However, the OLE focuses its resources on investigating individuals and companies that take migratory birds without regard for their actions or without following an agreement to avoid take.

We advise the Bureau's Authorized Officer to not authorize a "Notice to Proceed" until the completed APP is delivered to the Service for evaluation and the Service determines the APP is adequate as documented in formal correspondence. The Service's determination as to the adequacy of the APP will depend upon the quality of the survey results used to develop the APP, how survey information was used to design a project layout that minimizes impacts, and how conservation measures will be applied during construction and operation.

We suggest that a programmatic APP, containing conservative conservation measures (e.g., no turbines within 4 miles of a golden eagle nest), be developed initially to provide guidance in lieu of area-specific information. This APP should be incorporated into the Project's Environmental Impact Statement (EIS). Any subsequent Project phases that rely upon an Environmental Assessment, which tiers to the EIS, will also form the basis for an individual Plan of Development (POD) APP. We expect that site-specific PODs will have higher levels of information about bird use, and their APP can be tailored to each specific area. We caution that it may not be reasonable to expect that the entire Project area can be developed (e.g., some Project areas may not be suitable for construction and should remain undeveloped).

The Service appreciates the Bureau's efforts to conserve golden eagles, other migratory birds, and bats in Wyoming. If you have questions regarding this letter or the MBTA and the Eagle Act, please contact Travis Sanderson of my staff at the letterhead address or phone (307) 328-4333.

cc: BLM, High Desert District Manager, Rock Springs, WY (J. Ruhs)
BLM, RECO Wildlife Biologist, Rawlins, WY (C. Morton)
BLM, Project Manager, Rawlins, WY (P. Murdoch)
BLM, RECO Project Manager, Cheyenne, WY (T. Engles)
BLM, State RECO Manager, Cheyenne, WY (M. Valle)
USFWS, Regional Energy Coordinator, Lakewood, CO (T. Modde)
USFWS, Branch Chief Energy, Water, Climate, Lakewood, CO (P. Repp)
USFWS, Chief, Branch of Conservation Planning Assistance, Washington, D.C (L. Bright)
WGFD, Non-Game Coordinator, Lander, WY (B. Oakleaf)
WGFD, Statewide Habitat Protection Coordinator, Cheyenne, WY (M. Flanderka)

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ATTACHMENT 2

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Review of Avian Radar Technologies and Comparison with Traditional Survey Methodologies

Prepared for

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September 2010

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Introduction

The Chokecherry and Sierra Madre Wind Energy Project (Project) is being developed by the Power Company of Wyoming LLC.. The Project, located south of Rawlins, Wyoming, includes the construction and operation of 1,000 wind turbines producing between 2,000 and 3,000 megawatts of electricity. The Project will be constructed in "checkerboard" lands - a mixture of federal and private lands where approximately half of the land is private and approximately half is administered by the Bureau of Land Management (BLM), with a small portion being owned by the State of Wyoming.

In July 2008, the BLM published a Notice of Intent to prepare an Environmental Impact Statement (EIS) to analyze the environmental consequences of the Project. Generally, the Project consists of two distinct wind development areas. The northern, Chokecherry development area will contain 50-60% of the 1,000 turbines with the remainder of the turbines in the southern Sierra Madre development area.

Between June 2008 and June 2009, avian use data were collected for much of the wind development area as part of the BLM National Environmental Policy Act (NEPA) process (Johnson et al. 2008). Data were collected using standard point count methods at 19 locations in all months except January and February when much of the Project area was inaccessible due to adverse weather conditions. All sites except for three were visited 31 times during the survey period.

Data collected during the 2008 and 2009 surveys are sufficient to provide estimates of avian use of the Project area as well as to provide initial estimates of the frequency of each species at rotor-swept heights. However, since the surveys were completed, recommendations have been made to utilize avian radar technology to better understand avian use within the Project footprint. These recommendations have been made in part because of perceived biases of traditional survey methodologies related to bird identification, detection, and estimation of height and location.

This document reviews the avian radar technology, evaluates options for the types of radar that might be utilized for survey of the Project footprint, and summarizes the benefits and tradeoffs of using radar versus traditional point count methodologies.

Review of Radar Technology

Since the 1940s, echoes from locations of avian species have been detected in surveillance radar data (Lack and Varley 1945 *in* Gauthreaux and Belser 2003). Radar became a useful tool for studying and quantifying bird movements in the U.S. after the installation of the Weather Surveillance Radar system across the country in 1957 (WSR-57) (Gauthreaux 1970 *in* Gauthreaux and Belser 2003). The WSR-57 system was used for several decades to better understand timing and location of bird migrations.

During the 1980s, the Weather Surveillance Radar system was upgraded to include Doppler (WSR-88D) (Gauthreaux and Belser 2003) to better determine the velocity and detailed movement patterns of weather systems. The U.S. Air Force also began using site-specific radar systems to reduce the number and severity of bird strikes with aircraft (Merritt et al. 2008). These systems were used through the 1980s and 1990s to better understand migration patterns and to reduce risks associated with bird

strikes at airports across the U.S. In the late 1990s, commercial avian radar systems became available (Nohara et al. 2007) and are currently used to monitor avian activities for airports, military installations, energy projects (including wind), and other applications.

How Avian Radar Works

Radar is an acronym for Radio Detection and Ranging. Radar systems work by transmitting a radio beam and listening for the echoes of that beam as it is reflected off of various surfaces. By calculating the time between the transmission and reflection of the radio waves and the relative strength of the reflection, radar systems can determine the distance a target is from the transmission source and the relative size and sometimes shape of the target. Two different types of radar bands (X-band and S-band) are typically used for avian radar systems. X-band radar operates on a 2.5-4 cm wavelength and a frequency of 8-12 GHz. S-band radar operates on an 8-15 cm wavelength and a frequency of 2-4 GHz. Because of the shorter wavelength, X-band radar allows for higher resolution data and better target identification and differentiation.

Types of Avian Radar

Some avian radar systems require manual operation. Manual radar systems require that technicians use two-dimensional (2-D) T-bar marine radar and watch the radar reflections on screen as they are collected. For manual radar applications, a technician counts the number of targets recorded for each pass of the radar and maps flight paths. Manual operation works reasonably well during periods with low avian use. However, during periods of high avian use (i.e., migration), recording frequency does not allow for accurate counts of individual targets or determination of all flight paths. Additionally, because of time required to operate a manual radar unit and record individuals and flight paths, data typically are collected only on one plane (horizontal or vertical) at a time, are not operated continuously, and do not allow for determination of an individual bird's location in all three dimensions.

Advancements in radar and computer technology currently allow for remote monitoring and automatic radar operation with less time required for technicians. Current programming, processing, storage, and analysis capabilities enable more accurate differentiation among different sizes and types of targets. Current avian radar systems also enable data post-processing to remove noise, map flight paths, and enable comparison with environmental correlates to better understand localized bird migration and use patterns. Many currently available avian radar systems simultaneously operate two T-bar marine radar units (one in the X-band and one in the S-band). Use of the two different bands allows for simultaneous operation without signal interference and allows for 3-dimensional (3-D) mapping of bird use patterns where the two bands overlap.

In addition to the technologies described above, fixed-beam vertical profiling radars are becoming commercially available for the purposes of avian and bat species discrimination (an example of one such system is the Vesper system manufactured by DeTect, Inc.). The fixed beam vertical profiling radar system for birds and bats is similar to radar wind profiling systems currently used for weather forecasting and aircraft flight planning (site:http://en.wikipedia.org/wiki/Wind_profiler accessed September 21, 2010). The technology focuses a narrow beam of electromagnetic energy vertically.

When the beam is disrupted by a target, the reflections are detected and recorded by the radar system. The goal of the fixed beam vertical profiling radar system for avian and bat survey purposes is to differentiate bird, bat, and insect targets based on their wingbeat frequencies and size. While promising for future applications in areas with very high bird or bat use, the technology is still in the development stages for avian and bat survey purposes (Edward Zakrajsek, DeTect, Inc., Personal communication with Jon Kehmeier August 4, 2010). Because the technology is still in the development stages and considered experimental, the fixed beam vertical profiling system will not be further reviewed in this document.

Commercial Dual-Band Avian Radar Systems

Two different radar systems will be reviewed in this section. Both systems are manufactured by DeTect, Inc. in Panama City, Florida, an industry leader in avian radar technologies. DeTect manufactures avian and airport radar systems and is one of several commercial distributors of avian radar technology. DeTect's radar systems are currently being used on a number of large wind projects including the Gulf Wind project in southern Texas.

DeTect, Inc. manufactures and provides technical support for the dual band MERLIN© Avian Radar System (MERLIN). The following information was provided by Gary Andrews, General Manager of DeTect, Inc., in an email to Jon Kehmeier dated August 20, 2010. This information was provided in response to queries regarding operating conditions, range of sampling, and off-road capabilities of the MERLIN radar system. Two models (MERLIN XS10200e and MERLIN XS10200 pe-series systems) were evaluated. Each system consists of a continuous scanning horizontal and vertical dual bird radar sensor system with a 200 watt horizontally-operating solid-state S-band, open array radar sensor with Doppler processing and extendable tower and a 10 kW vertically-operating magnetron X-band open array radar on fixed tower with slide-out.

The standard MERLIN XS10200e (Figure 1) includes dual, high clearance, heavy duty off-road axles with torsion bar suspension that are suitable for off-road travel on unimproved roads. The system is mounted on a 23 foot long and 8 foot wide trailer weighing 4800 pounds. All electronics are mounted in an environmentally controlled operator cabin. Cost for purchasing a XS10200e is $295,000. This does not include maintenance, operation, or validation costs which could effectively double or triple the purchase price.

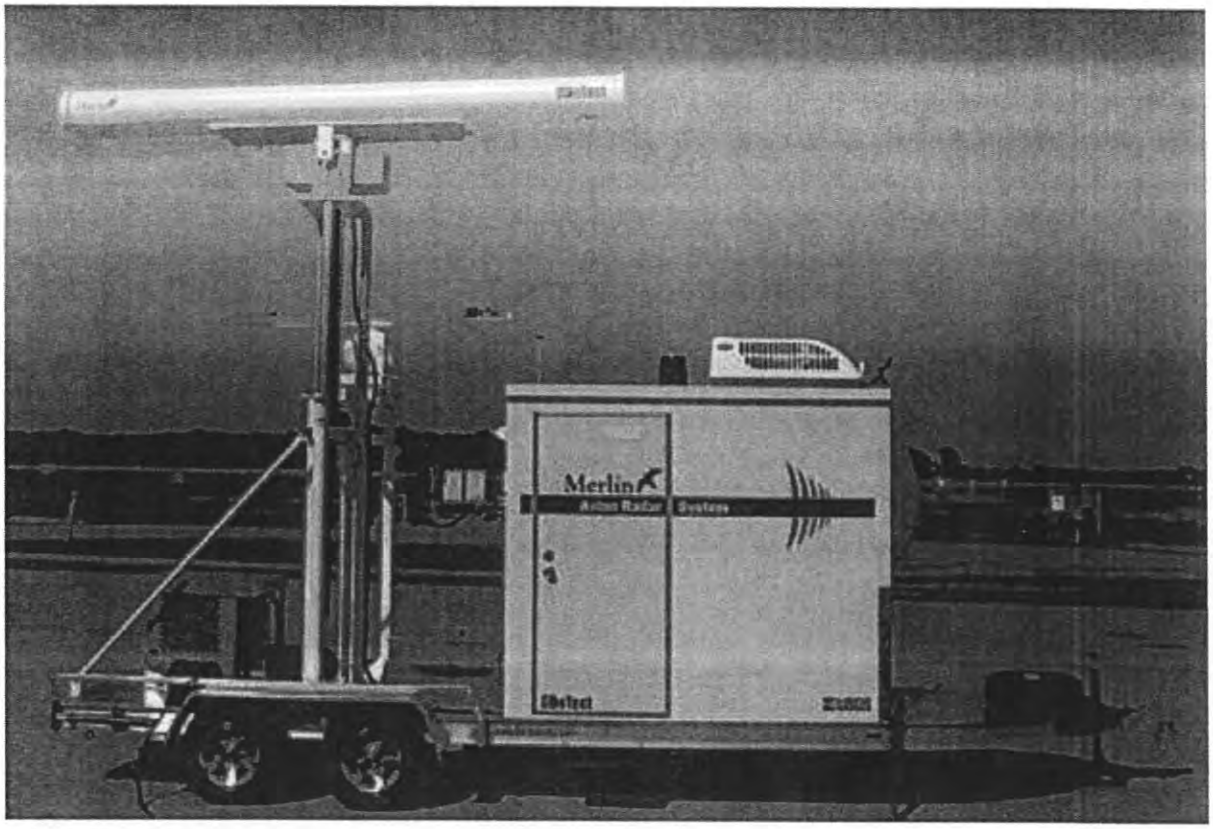


Figure 1. Image of MERLIN XS10200e system. S-band horizontal radar is uppermost T-bar and X-band vertical radar is lower T-bar. The yellow box is a diesel generator power supply and the white cabin is the environmentally controlled operator cabin. Image provided by DeTect, Inc.

The MERLIN XS10200 pe-series (Figure 2) is lighter, narrower, and shorter (16 feet long by 6.5 feet wide) with a single axle. The system is specifically designed for getting into rugged, hilly terrain but still cannot be moved frequently across very rough roads such as those in the Project area because of trailer length, weight, and the sensitivity of the electronics. The pe-series is the functional equivalent to the XS10200e unit but the electronics are mounted in a National Electrical Manufacturers Association (NEMA) outdoor enclosure rather than in an environmentally controlled operator cabin. Cost for purchasing the XS10200-pe is $245,000 and does not include maintenance, operation, or validation costs as discussed above.

Either model of the MERLIN radar system is a fully self-contained, trailer mounted system functional at delivery. All structural components of the system are industrial grade, corrosion resistant marine grade aluminum or stainless steel. The system is mounted on a trailer constructed to U.S DOT standards made of marine grade aluminum with aluminum diamond plate decking. The trailer is constructed with industrial couplers, torsion suspension and electric or hydraulic brakes with heavy-duty off-road high

clearance axle(s). Ancillary support equipment on either model includes a spare tire, lightning protection, ground anchors, tools, and safety equipment.

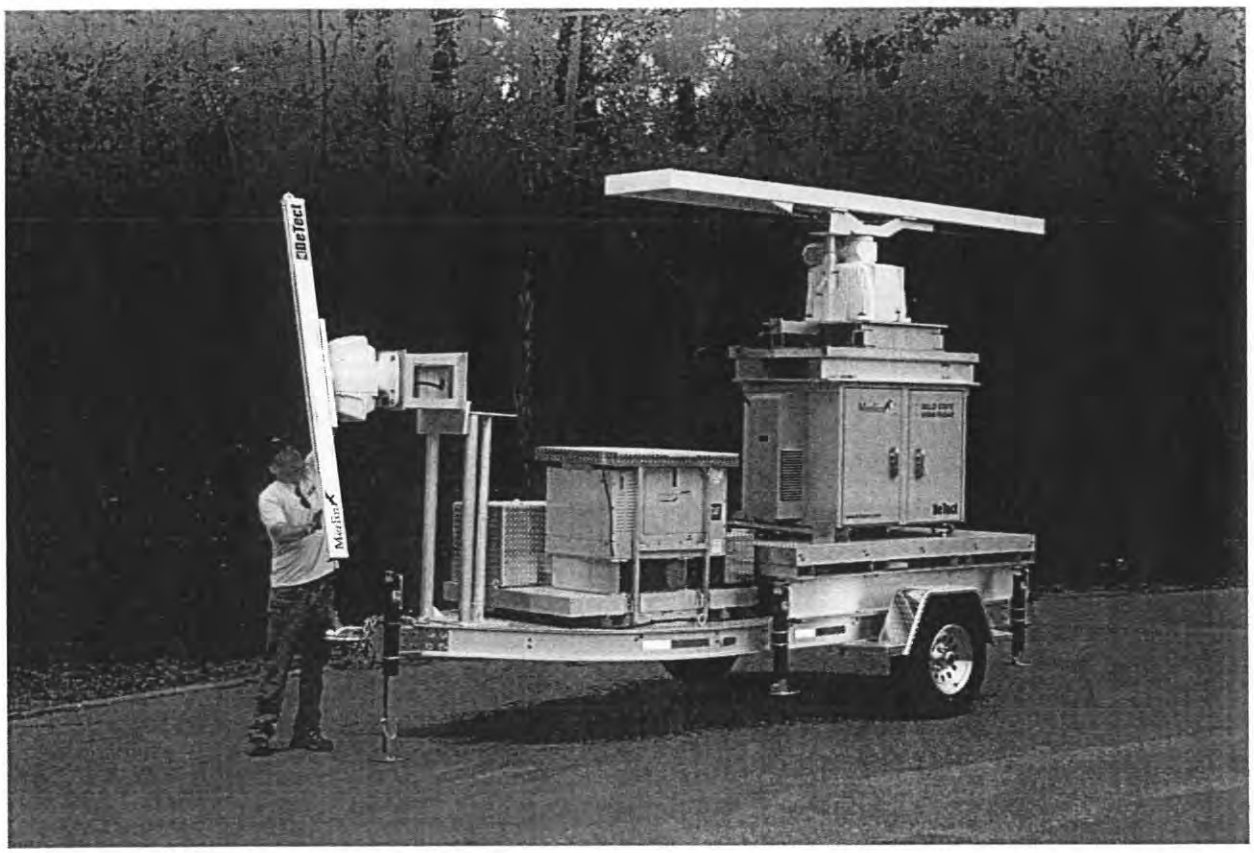


Figure 2. Image of MERLIN XS10200-pe system. S-band horizontal radar is uppermost T-bar and X-band vertical radar is T-bar being handled by the operator. Note the single axle compared to the double axles in Figure 1 and the NEMA enclosure versus the operator cabin. Image provided by DeTect, Inc.

Both models contain a redundant onboard power supply with options for commercial electrical power or diesel generator power. Because of the lack of a commercial electrical connection in the project area, a dual 6 kW diesel power generator system with extended run fuel tank operation would be required. This would include an Uninterruptible Power Supply (UPS) back-up that will function when one of the two generators stops operating. Weekly maintenance is necessary to refill fuel for the generator and maintain and check all systems. The system is designed such that one of the two generators would be functioning at all times resulting in continuous air emissions and noise. Additionally, because of the requirement for diesel generators in the Project area, there would be some possibility for small fuel and fluid spills.

The MERLIN system is designed to require low maintenance and provide reliable use in adverse environments and temperatures (-20 to +130 degrees F). The MERLIN XS10200e system has a redundant environmentally controlled, insulated operator/equipment cabin while the MERLIN XS10200pe has a NEMA enclosure to protect the electronics. The XS10200e system also has weatherproof panel construction and is wind-load tested to 80 mph. Its trailer is covered with an aluminum deck and slip resistant flooring and has an access door with step, window, and keypunch lockset. Within the cabin, the XS10200e has a technician console with fixed radar display and a slide-out keyboard and mouse tray.

When operating, the MERLIN systems have a S-band horizontal survey range of 2-4 miles and a 24-degree above ground level detection and X-band vertical survey range of 0.75-2 miles and a 24-degree survey band width. The combination of the two survey zones provides some overlap and allowance for 3-D mapping of avian and bat activity immediately above the radar system (Figure 3).

Both MERLIN models are delivered with a data processing computer system; a MERLIN radar operating and processing software package, including MERLIN Administrator, Processor, Display, Remote, MerlinChart™, TrackPlot™, and a MERLIN SQL datasystem. This software and analysis package enables analysts to remove much of the clutter and noise from the radar dataset, map the locations and flight pathways, and sort the targets by size. Figure 4 illustrates the data recorded from the horizontal radar. Figure 5 illustrates the data recorded from the vertical radar. Figure 6 illustrates the types of analyses and output files generated by DeTect's analysis software packages. Data from the radar system can be remotely managed using cellular networks, satellite uplinks, high-speed internet, or via direct download from the system.

Each system also contains a MerlinGPS /Compass™Georeference Datum System; and a weather station. Both systems come with installation support, user training, 1-year of data processing and analysis support, a 3-year parts and labor warranty, and a 3-year software upgrade commitment. Depending on manufacturing backlog, current delivery times for either MERLIN model is between 120 and 150 days. DeTect will deliver the selected system to any North American location.

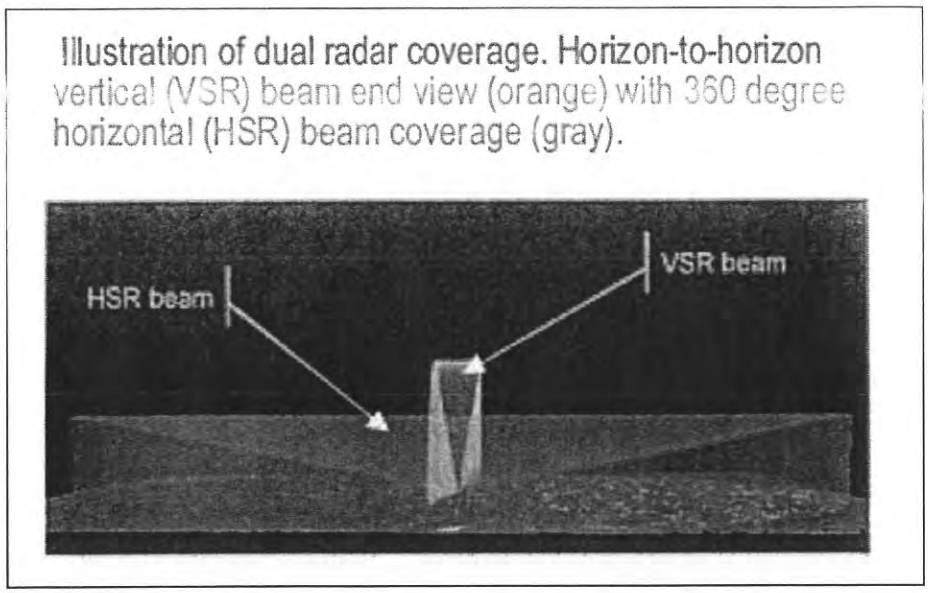


Figure 3. Illustration of surveyed area for both vertical and horizontal radar. Image from DeTect, Inc. Avian Radar System Brochure.

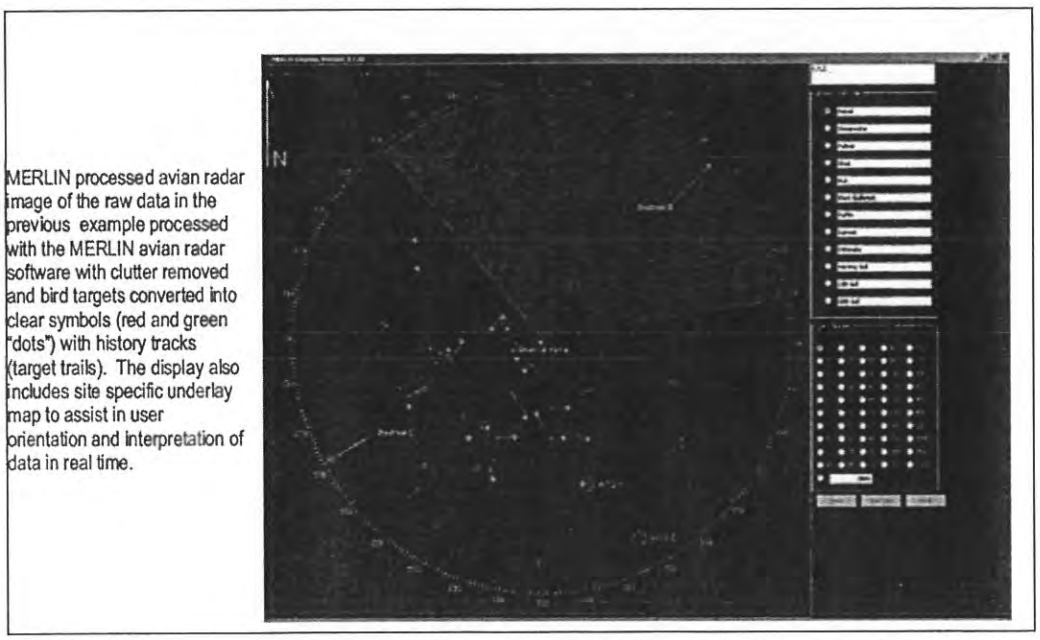
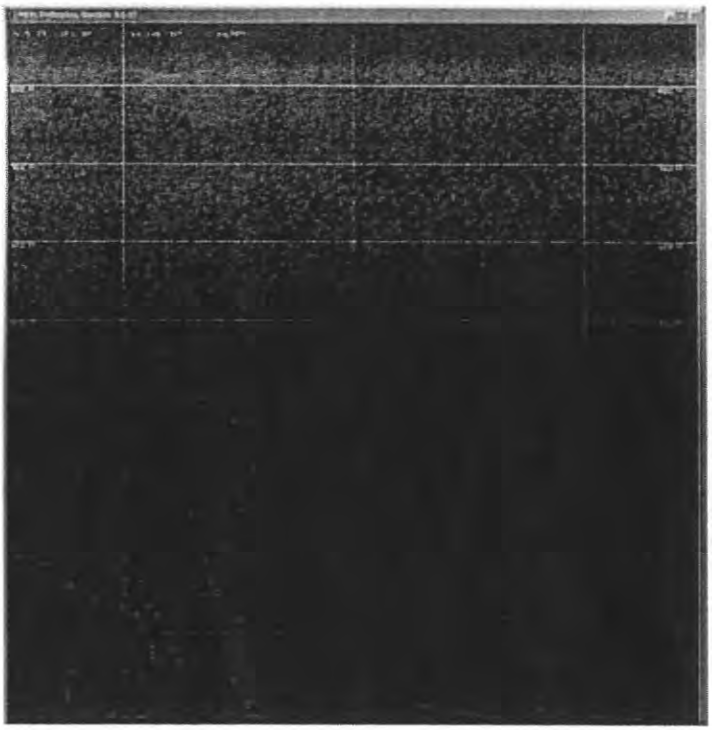
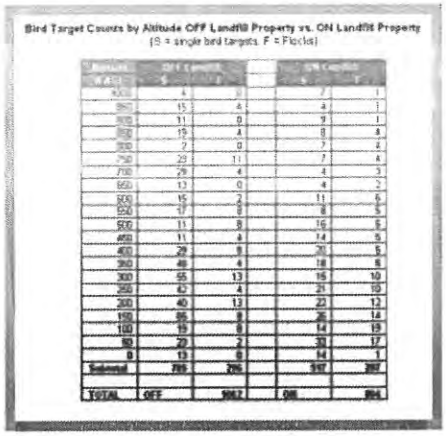


Figure 4. Illustration of survey area and data recorded from horizontal radar application. Image from DeTect, Inc. Avian Radar System Brochure.



MERLIN Avian Radar vertical radar display showing heavy bird migration during the spring of 2004 in upstate New York during survey conducted for the Cornell Lab of Ornithology. Bird targets are red dots with target history trails with z (altitude) in feet up to 4500 ft above ground level and y (distance from radar) in nautical miles (nm) out to 0.75 nm to either side of the radar (the radar position is the bottom center of the screen). The vertical radar beam in this survey was aligned in the predominant migration direction and most of the targets are passing along the length of the beam.

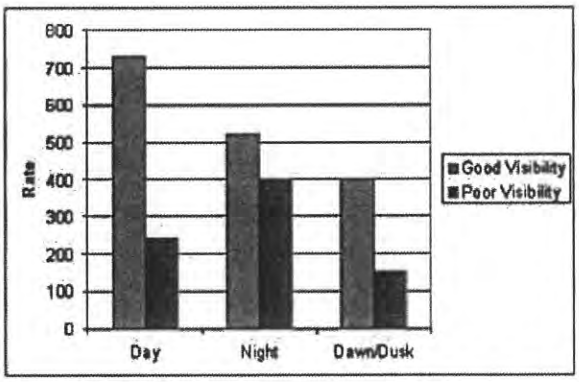
Figure 5. Illustration of survey area and data recorded from vertical radar application. Image from DeTect, Inc. Avian Radar System Brochure.



Bird Target Counts by Altitude OFF Landfill Property vs. ON Landfill Property
(S = single bird targets, F = Flocks)

Altitude	OFF Landfill		ON Landfill	
	S	F	S	F
1000	4	0	7	1
950	15	4	4	1
900	11	0	9	1
850	19	4	8	4
800	2	0	7	4
750	29	11	7	4
700	29	4	4	3
650	13	0	4	2
600	15	2	11	6
550	17	8	8	5
500	11	8	16	6
450	11	4	14	5
400	29	8	20	5
350	48	4	18	6
300	55	13	16	10
250	42	4	21	10
200	40	13	22	12
150	85	8	26	14
100	19	8	14	19
50	23	2	33	17
0	13	0	14	1
Subtotal	789	296	997	287
TOTAL	OFF	1062	ON	894

Tabulated daily count of single birds and flocks for radar sample areas On landfill versus Off landfill; daily analysis used to document effectiveness and compliance of the landfill bird control and habitat management program. (data extracted from vertical radar database of MERLIN XS2530i Avian Radar System at the Waste Management Outer Loop RDF, Louisville, Kentucky).



Summary Chart of Passage Rate of Bird Targets Across 1 km Wide Front by Visibility Conditions (data extracted from vertical radar database of a MERLIN Avian Radar System at proposed wind farm site).

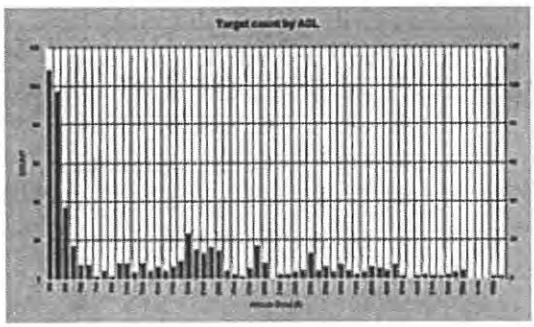
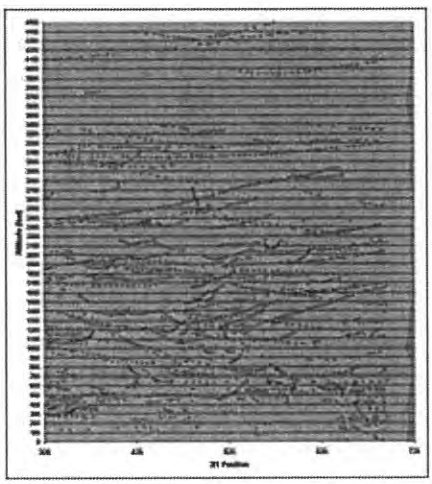


Chart of bird target count by altitude for a 24-hour period generated by MERLINChart® data report software from MERLIN Avian Radar System database (data from USAF Beale AFB, California MERLIN XS2530m system from January 2007).



One hour altitude track plot of vertical radar data for night spring migration over USAF Travis AFB, California (generated by MERLIN TrackPlot® software from MERLIN XS2530m Avian Radar System database).

Figure 6. Illustration of data output and some of the analysis options using DeTect's analysis software and technical support.

Summary of Benefits and Tradeoffs

Radar technology has gained support within the scientific community because it reduces or eliminates observer biases that are inherent to traditional visual observation survey techniques; it monitors and records avian activity 24-hours a day eliminating the need for costly and unreliable nocturnal surveys; it enables assessments of avian and bat activity during low visibility conditions when traditional survey methods are not appropriate; and it samples larger areas (up to a four mile radius from the radar) than traditional survey methodologies.

However, even with the benefits described above, radar technology does not provide all of the data necessary to assess species-specific or group-specific risk. Radar technology is limited in its ability to detect and differentiate some species or groups of birds or bats. Avian radar systems typically classify each target identified according to size (small, medium, large, or flock size). Small targets might correlate with sparrow-sized birds, medium with American kestrel sized birds, large with common raven or red-tailed hawk, and flock size with a Canada goose, golden eagle, or bald eagle. Unfortunately, confusion can even occur within each of these categories. For instance, three sparrows migrating together would appear as a medium target; two crows would appear as a large target; and several large or medium sized birds together would appropriately appear as a flock (as does a single goose, multiple geese in formation, a single or multiple eagles, etc.). Additionally, radar detections are lower when there is noise from landscape features, the ground, vegetation, or weather. Detections will be highest when birds are flying in areas with clear, unobstructed views of the sky and lowest near the ground or in areas with considerable topography.

Because of the detectability and differentiation issues associated with radar systems, substantial calibration of the system is necessary to determine how avian species might correlate with the different targets that are or are not recorded. While traditional surveys have detectability and identification biases, very rarely, if ever, would they result in confusing a Canada goose with a golden eagle. Additionally, they would be much more sensitive to avian use close to the ground where many resident and nesting avian species are expected. Point count surveys are superior to radar surveys for detectability and differentiation purposes. Additionally, field observations recorded as part of point count surveys allow for identification of the behavior of an individual bird and the ability to correlate that behavior to some environmental variable. The knowledge of why an individual is using an area is important to design and implement more effective mitigation and avoidance strategies. Radar data will not provide the important behavioral information that point count observations provide.

Avian radar systems are designed for and recommended for use in areas with high avian or bat use and/or areas with substantial risk for impacts to sensitive or protected species that can be differentiated from other species in the area. In 2008 and 2009, avian and bat data were collected for the Project in support of BLM's ongoing NEPA process (Johnson et al. 2008). The mean raptor use of the Project area was compared to 41 other wind facilities in the western United States for summer surveys and 39 for fall surveys. Results indicate that mean raptor use in the area is low to moderate compared to other wind energy projects in the western United States. This indicates that the Project area does not have high avian or bat use relative to other wind development sites around the country. Additionally, while

golden eagles, ferruginous hawks, and other species of interest do occur in the Project area, a radar system will not enable differentiation between those species and other similar-sized species of lesser concern.

Because of the uncertainty associated with differentiation and detectability of avian species with radar and the observer bias and smaller sample area with traditional survey methods, a combination of the two approaches is necessary when it is determined that radar use is appropriate. This would include survey of areas outside of the radar perimeter. Additionally, frequent validation of the radar data would be required to compare with point count data to determine which species were present, whether they were detected, and how frequently they were differentiated from other species or targets. Validation of the system would require two trained technicians. One technician would identify each species observed, record its approximate height and location, and radio the information back to the second technician. The second technician would match the species-specific location and height to the appropriate target on the radar screen to enable more detailed analysis of that target and allow for possible differentiation of that species from others recorded by the system. The combined radar and point could survey process would result in increased costs compared to traditional survey methods. Increased cost would depend on the level of effort required to calibrate the radar data and to survey points that fall outside the radar survey perimeter.

For the Chokecherry and Sierra Madre Wind Energy Development Project area there is already a year's worth of avian and bat use data for the Project (Johnson et al. 2008) that can be used to characterize general turbine collision risk, community diversity, habitat use, and species distribution. These data are sufficient for project-level collision risk assessment. An additional year of combined radar and traditional point surveys would add to this dataset and assist in identifying high-use areas and site-specific mitigation and avoidance planning through micro-siting of turbines. However, The Chokecherry and Sierra Madre project area is not known to have high avian use as demonstrated by the data collected to date for the EIS analysis and it could be difficult to differentiate sensitive or protected species (golden and bald eagles, other raptors, etc.) from other targets including ravens, geese, or other species. An additional year of count surveys may be sufficient to characterize avian use and perform risk assessments for the Project, although as discussed above, there are also limitations with these techniques.

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Lack, D. and G.C. Varley. 1945. Detection of birds by radar. Nature 156:446.

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ATTACHMENT 3

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Tel 303.298.1000
Fax 303.299.1518

December 21, 2010

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Travis Sanderson
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Wyoming Ecological Services Office – Rawlins
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Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Messrs. McCreedy and Sanderson:

Thank you for meeting with us on December 10, 2010 for a discussion of the Chokecherry and Sierra Madre Wind Energy Project. This letter is to confirm our understanding with respect to the draft Avian Monitoring Protocols for the Project.

As you know, Power Company of Wyoming LLC plans to construct and operate the 2,000 to 3,000 MW Chokecherry and Sierra Madre Wind Energy Project in Carbon County, Wyoming. The Project involves public lands under the management of the Bureau of Land Management, private lands and a small number of State lands. PCW has applied for a wind energy development right-of-way grant for the public lands. The Bureau of Land Management is analyzing the potential impacts of the Project under an environmental impact statement in compliance with its obligations under the National Environmental Policy Act.

As a part of the EIS process, the BLM through a third party environmental contractor conducted avian point count surveys of the Project between June 2008 and June 2009. We understand these data have been provided to the Service. As we have discussed, the Service and PCW believe that additional avian monitoring data will be useful in evaluating potential Project impacts to bald and golden eagles, as well as other migratory bird species. In conjunction with the efforts to collect additional avian monitoring data, receiving early technical advice from the Service with respect to site-specific metrics and methods by which potential Project impacts to bald and golden eagles will be evaluated is critical.

Power Company of Wyoming LLC

Attached as Exhibit A to this letter are draft Avian Monitoring Protocols for the Chokecherry and Sierra Madre Wind Energy Project. Marine radar technology has been identified by the Service and BLM as a desired method to map areas of high avian use. The Protocols; therefore, combine marine radar surveys with standard point count and breeding bird methodologies to determine raptor and other avian use across the Project area. The study design follows recommendations made by the Service, BLM, and Wyoming Game and Fish Department. The marine radar technology will also enable better identification of bat use areas and relative densities of bats in the Project area.

We understand that you will review the adequacy and appropriateness of these Protocols and provide to us your comments, suggestions and recommendations for revising and implementing the Protocols. Upon completion of the Service's review, additional evaluations of bald and golden eagle use of the Project will be made on a site-specific basis using these Protocols. We further understand that data from the 2008 and 2009 point count surveys, data generated from the implementation of these Protocols, and any additional site-specific data provided to PCW by the Service during implementation of these Protocols will be adequate to characterize site-specific eagle activities, develop an Avian Protection Plan, identify impacts from construction and operation of the Project on eagles, and identify avoidance, minimization, and mitigation efforts upon which the Service will evaluate the APP.

We have been informed that the Service is developing and will soon release for public comment guidance for APPs for wind energy projects. PCW's intent is to develop an APP based upon the following:

1. The APP will address conservation measures to avoid, minimize and mitigate direct and indirect impacts of the Project compatible with the Service's management objectives for bald and golden eagles.

2. The eagle use areas upon which impacts from construction and operation of the Project are to be evaluated shall be nests within four miles of the Project site, and breeding territories, communal roosts, and important foraging areas within the Project site.

3. The APP will identify practicable means by which impacts to eagles from the Project may be avoided, minimized, and mitigated, and in particular:

    a. the APP shall include, but shall not be limited to, the avoidance measure of prohibiting the construction of a turbine within 825 feet of an active eagle nest[1];

[1] Bureau of Land Management. 2008. *Record of Decision and Approved Rawlins Resource Management Plan*. pg. 2-53.

Power Company of Wyoming LLC

b. the APP shall include, but shall not be limited to, the minimization measure of implementing the recommendations of the Avian Power Line Interaction Committee[2];
c. the APP may include effective on- or off-site mitigation measures.

4. The APP will identify those adaptive management techniques that PCW will implement if post-construction monitoring demonstrates a statistically meaningful difference between estimated and actual levels of impact from the operation of the Project.

As discussed at our meeting, PCW is prepared to proceed with implementing the Protocols, including the purchase and deployment of a Merlin Avian Radar System, upon receipt of the Service's written concurrence confirming the appropriateness of the Protocols for the Chokecherry and Sierra Madre Wind Energy Project.

Thank you very much for your time and consideration and we look forward to hearing from you.

Sincerely,

Garry L. Miller
Director – Land and Environmental Affairs

cc: Jon Kehmeier, SWCA Environmental Consultants
Roxane Perruso, PCW

[2] Avian Power Line Interaction Committee (APLIC). 2006. *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006.* Edison Electric Institute, APLIC, and the California Energy Commission. Washington, D.C. and Sacramento, CA.

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CONFIDENTIAL AND PROPRIETARY PRELIMINARY REVIEW DRAFT
NOT FOR DISTRIBUTION

EXHIBIT A

PRELIMINARY DRAFT

Avian and Bat Monitoring Protocols for the Chokecherry and Sierra Madre Wind Energy Development Project

Prepared for:

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Denver, CO 80202

Prepared by:

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October 2010

DRAFT

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In accordance with the U.S. Fish and Wildlife Service (USFWS) Wind Turbine Guidelines Advisory Committee *Recommendations on Developing Effective Measures to Mitigate Impacts to Wildlife and Their Habitats Related to Land-Based Wind Energy Facilities* (USFWS 2010), the Wyoming Department of Game and Fish (WGFD) *Wildlife Protection Recommendations for Wind Energy Development in Wyoming* (WGFD 2010), and the Bureau of Land Management (BLM) Rawlins Field Office *Wildlife Survey Protocols for Wind Energy Development*, an analysis of biological surveys conducted for the proposed Chokecherry and Sierra Madre Wind Energy Development Project (Project) has been completed to determine compliance with the recommended protocols of each agency.

As part of the BLM's NEPA process for the Project, WEST, Inc. (WEST) conducted avian point surveys of the Chokecherry and Sierra Madre wind resource areas between June 26, 2008 and June 15, 2009. A portion of these data are analyzed in WEST's report, "*Baseline Avian Use Studies for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Summer and Fall Interim Report, June 26-October 14, 2008*" (Johnson et al. 2008). WEST also prepared a report summarizing bat surveys conducted between July 13 through October 13, 2008 titled, "*Bat Surveys for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Report*" (Solick et al. 2008). SWCA has completed additional analyses of all data collected in 2008 and 2009 to determine compliance with the agency monitoring recommendations.

Between June 2008 and June 2009, avian use data were collected for much of the Project area as part of the BLM National Environmental Policy Act (NEPA) process [Johnson et al. 2008]. Data were collected using standard point count methods at 19 locations in all months except January and February when much of the project area was inaccessible due to adverse weather conditions. All sites except for three were visited 31 times during the survey period.

Data collected during the 2008 and 2009 surveys are sufficient to provide estimates of avian use of the Project area as well as to provide initial estimates of the frequency of each species at rotor-swept heights. Horned lark (*Eremophila alpestris*) was predominantly the most common avian species detected in the 2008 and 2009 surveys, having over 800 individual detections. The next most common species were the common raven (*Corvus corax*) with less than 200 detections, and vesper sparrow (*Pooecetes gramineus*) with less than 150 detections. Golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis),* and common raven were most commonly observed within the rotary height of the turbines.

In their recommendations to the Secretary of Interior, the Wind Turbine Guidelines Advisory Committee (Committee) recommends using standard sampling methods to determine avian use of a project area, the presence of sensitive species and other species of interest, and to provide a baseline for assessing displacement effects and habitat loss. The Committee further recommends that the sampling frequency, type, and duration be sufficient to account for variability of avian use between and within sampling periods. When more precise estimates of density are required for a special status species, other methods, including radar or nocturnal surveys are recommended. However, the Committee does not recommend using these types of special surveys unless high risks for collision are expected for migrating songbirds or special status species.

Similarly, the Bureau of Land Management (BLM) Rawlins Field Office Wildlife Survey Protocols for Wind Energy Development recommends that surveys be sufficient to detect temporal and spatial use patterns within the project area. Special emphasis is placed on surveys for raptors and sensitive avian species. BLM survey protocols recommend weekly, 20-minute point counts to record avian use of a project area. Survey times are recommended to be varied weekly to ensure that avian use during daylight hours is adequately documented. In addition to weekly surveys, marine radar is recommended to avian foraging, dispersal, and migration paths.

Wyoming Game and Fish Department's (WGFD) Wildlife Protections Recommendations for Wind Energy Development in Wyoming recommend sufficient numbers of weekly point count surveys during spring and fall migration periods following similar protocols as specific by BLM with survey periods of twenty minutes at each point. WGFD recommends that four surveys be conducted during winter months to capture overwintering avian species. For raptor species, WGFD recommends nest surveys and weekly day-long surveys during spring and fall migration periods.

Data collected during 2008 and 2009 comply with BLM, WGFD, and Committee wind energy survey recommendations and serve as one of the two years of suggested pre-construction monitoring data. Data collected for purposes of NEPA compliance provide estimates of collision risk and enable determination of avian use of the Project area, the presence of sensitive species and other species of interest, as well as providing a baseline for assessing displacement effects and habitat loss.

To supplement the 2008-2009 dataset and to better identify concentrated avian use areas, an intensive one-year survey will be used to better identify avian use areas in the Project area. A combination of marine radar surveys and standard point count surveys will be used to determine raptor use across the Project area. Marine radar technology has been identified by the BLM and USFWS as a desired method to map areas of high avian use. The study design will follow recommendations made by the USFWS, BLM, and WGFD by combining marine radar surveys with standard point count and breeding bird methodologies. The marine radar technology will also enable better identification of bat use areas and relative densities of bats in the Project area.

A single DeTect Merlin Avian Radar System will be used to map avian use across the Project area. The DeTect Merlin radar system is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10–kilowatt (kW) vertically operating magnetron X-band open array radar. The horizontal radar has a range of 2 to 4 miles in a 360-degree pattern around the unit. The vertical radar has a 24-degree beam width and detects flight paths 0.75 to 2.00 miles above the unit.

Marine radar systems require weekly maintenance and fueling and cannot be moved over extremely rough terrain on a regular basis. Additionally, the system will not differentiate between large raptors such as golden eagles and other large birds including geese, other large raptors, and possibly even ravens and should be used in conjunction with field surveys to validate radar recorded data. However, the radar system, when coupled with point count verification of avian use, will allow for accurate horizontal and vertical mapping of avian use in the wind development area. The marine radar system will also enable mapping of high use areas for bat species.

A combination of raptor and point surveys and breeding bird surveys would be conducted in concert with the marine radar system. The intent of this study design is to provide intensive survey information regarding avian use patterns within the radar survey perimeter for each season. Raptor and point counts and breeding bird surveys will be used to validate the radar data and provide estimates of species-specific use patterns. Point count surveys will record the location, flight path, approximate height, and time of use for any individual observed from the point location. Point count locations will be surveyed for eight hours per day during periods with the highest likelihood for detection of migrating birds and/or large raptors. Timing of survey at each location will be varied to determine patterns of avian use during daylight hours.

In addition to the point count and radar surveys, breeding bird surveys will be completed at 15 locations across the wind development areas. Breeding bird surveys will be conducted following the grid monitoring protocols published by the Rocky Mountain Bird Observatory (RMBO) (Hanni et al. 2010). Grid survey locations will be randomly selected using a generalized random tessellation stratified design to ensure a spatially balanced design stratified by major vegetation and habitat types in the Project area. Data collected as part of the grid monitoring efforts would also be used to validate radar data and better determine avian species use to the extent possible. As part of the breeding bird surveys, waterfowl and water bird use surveys would be conducted three times annually (springs, summer, and fall) to identify migrating and resident species.

Locations for placement of the radar and for conducting point count surveys (Figure 1) and breeding bird surveys were determined using a four-tiered approach:

- Tier 1 – Survey areas should determine avian use within the wind development areas.
- Tier 2 – Survey areas should overlap possible foraging areas for large raptors (winter range areas, prairie dog towns, waterfowl use areas, etc.).
- Tier 3 – Survey areas should be in locations to allow for detection of avian movement into and out of the Project area.
- Tier 4 – Survey areas should capture variability in habitat and topography.

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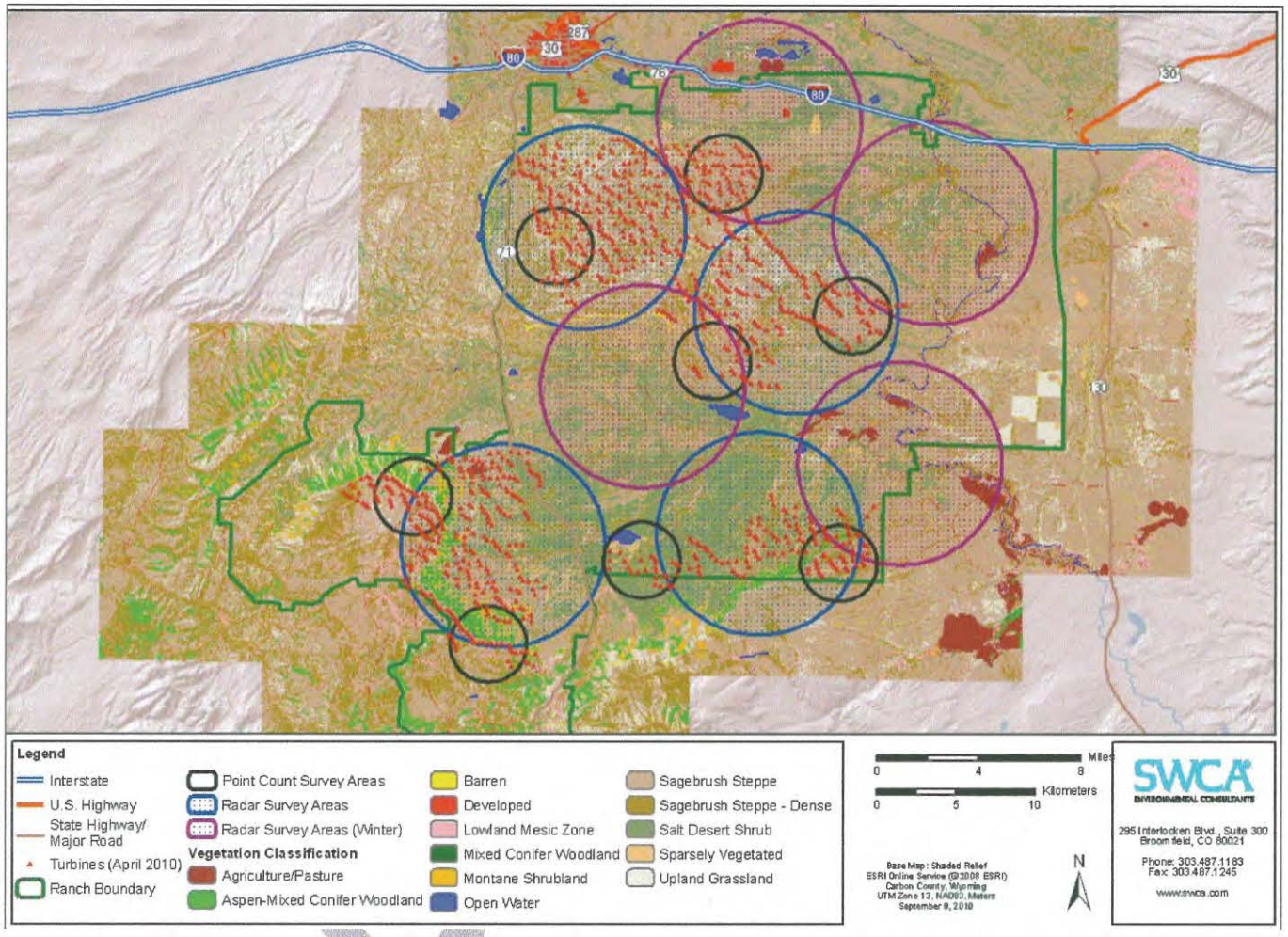

Figure 1. Approximation of area surveyed using avian radar and traditional point count methodologies with respect to possible wind turbine locations. Spring, summer, and fall radar installation locations are the center point of the large blue circles. Proposed point count locations are the center points of the small black circles. Potential winter radar locations are the center points of the large purple circles. Final locations for survey will be determined in coordination with BLM, WGFD, and USFWS.

The radar unit will be placed a 5 locations within the Project area (Figure 1) to cover as many of the turbine locations as possible. Point counts will be completed at nine additional locations to map avian use patterns when radar coverage is not possible. Eight of these point counts will be completed at permanent sampling locations. The ninth point count location will be completed at the radar site to validate the data being collected by the radar unit. This survey date will also be used to service the radar system and will require two technicians. During winter months, the radar will be placed in a location that has high probability of access on a weekly basis. As much of the project area will be covered in snow and large drifts, radar placement in winter will likely be near the Bolton Ranch headquarters, south of I-80 near the North Platte River, on the Bolton Road east of Teton Reservoir, or on the north side of the Chokecherry project area (Figure 1). Winter point count survey locations will also be adjusted as needed to account for winter weather conditions, access issues, and safety concerns.

Based on a four mile radius for radar surveys and a one mile radius for point count surveys, approximately 90-93% of the turbine locations, depending on winter radar placement, will be directly surveyed. It is likely that this percentage is higher than 90-93% for large raptors including bald and golden eagles as many of the point count locations have visibility of several miles. Point count locations outside of the radar survey perimeters have been placed to allow for detection of raptors moving into the project area and between radar surveyed zones.

This protocol assumes that BLM will conduct nest activity and productivity surveys for all known nests in the vicinity of the wind development areas. Incidental observations will be made of nest activity as part of this protocol; however, no formal nest activity or productivity surveys will be completed. Additionally, this protocol assumes that any additional point count surveys beyond the 9 per week specified above would be completed by BLM or USFWS.

The protocols and schedule outlined below will be followed for monitoring and mapping avian and bat use across the wind development area using the marine radar system, point counts, and breeding bird surveys.

1. Fall 2010 – Final radar deployment locations, point count survey locations, and breeding bird survey locations will be identified for all areas of the wind development areas. When possible, point count locations or radar locations will be collocated or closely aligned with the data points surveyed in 2008 and 2009. Radar locations will consider suitable road access for movement of the radar system. Point count locations will be positioned along ridgelines to the extent possible to allow for detection of the highest number of migrating passerines and raptors. Breeding bird survey locations will be determined using a Generalized Random Tessellation Stratified (GRTS) (McDonald 2004; Stevens and Olsen 2004) design with oversampling. This design ensures a spatially balanced random design across all vegetation and habitat types.

2. Winter 2010/2011 – Radar construction, programming, and training. The Draft Avian Protection Plan (APP) will be delivered to USFWS, BLM, and WGFD for review. Among other descriptive sections, the preliminary plan will contain the detailed sampling protocols, preliminary mitigation and avoidance measures, and detailed adaptive management protocols.

3. Spring and Early Summer 2011 – Radar surveys begin in the southern portion of the project area. The radar system will be moved once during the spring migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Breeding bird surveys will be completed at 15 locations across the wind development areas. Surveys for waterfowl and other waterbirds will be conducted once during the spring migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data will be used to identify areas with high avian and bat use. The following schedule will be used for spring and early summer 2011 surveys:

    a. March 1 – May 15, 2011: Radar system will be initialized and debugged prior to main migratory period. Initial installation will occur in an area south of the Bolton Ranch headquarters in the southeastern-most radar survey location identified on Figure 1. This survey location will detect migrating birds in areas adjacent to the Platte River corridor and along the ridgeline north of the Jack Creek road. Weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location south of the Bolton Ranch headquarters.

    b. May 15–July 31, 2011: Radar system will be moved to a location approximately 2 miles east of Miller Hill in the southwestern-most portion of the wind development area (Figure 1). This survey location will detect migrating birds in areas adjacent to and along the ridgeline of Miller Hill as well as in the basin east of Miller Hill. Between May 15 and June 30, weekly point surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location east of Miller Hill. During the month of July, the point count locations will only be visited twice instead of every week in compliance with BLM and WGFD recommendations. Additionally, this time is between migratory periods and typically bird movements are lower because of nesting activities. A point count will be conducted weekly at the radar installation location during this period during routine maintenance activities.

    c. May 25–June 30, 2011: Breeding bird surveys will be completed once at each of 15 locations across the wind development areas to determine relative abundance, species richness, and habitat use patterns. Breeding bird surveys will follow RMBO grid survey protocols (Hanni et al. 2010). Bird flight patterns will be documented to better define risks of wind development activities. All raptors as well as their flight paths and heights will be recorded at all breeding bird locations regardless of whether the raptor falls within the grid survey area.

    d. May 1, 2011: A revised draft APP will be delivered to the agencies for a 30-day review and comment period. The revised draft will contain some preliminary analyses of radar data from early spring migration to allow for more informed discussions of possible mitigation measures.

4. Late Summer – Fall 2011: The radar system will be moved to the Chokecherry portion of the wind development area on August 1, 2011. The radar system will be moved once during the fall migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Waterfowl and wading bird surveys will be conducted once during late summer to detect nesting activity and once during fall migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data collected during spring and early summer will be completed to evaluate bird and bat use and to identify appropriate mitigation measures that could be implemented. The following schedule will be used for late summer and fall 2011 surveys:

    a. August 1: A Final APP will be delivered to the agencies for review and approval. The final APP will contain the mitigation measures that will be applied to remove or minimize risks to avian species. The final APP will also identify the final adaptive management process that will be followed to update the APP and apply additional site-specific mitigation measures as additional data are obtained prior to, during and after construction. An interim report of radar data trends and observations will also be provided with the final APP.

    b. August 1– September 30, 2011: Radar system will installed at the western radar location in the Chokecherry project area radar survey location identified on Figure 1. This survey location will detect migrating birds in the western portion of Chokecherry as well as along the rim of Chokecherry and the basin between Chokecherry and Atlantic Rim. During the month of August, the point count locations will only be visited twice instead of every week. A point count will be conducted weekly at the radar installation location during August as part of routine maintenance activities. During September, weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

    c. October 1–November 15, 2011: Radar system will be moved to a location southwest of the initial Chokecherry installation location (Figure 1). This survey location will detect birds along the southern rim of Chokecherry and the eastern half of the Chokecherry project area. Weekly point count surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location.

5. Winter 2011/2012 (November 16, 2011–March 30, 2012) – The radar system will be deployed in a location near the Bolton Ranch headquarters (Figure 1) or north of the Chokecherry project area to ensure weekly maintenance is possible during winter months. Weekly bird observations will be recorded during routine maintenance activities at the radar location. Weather permitting, monthly counts will be conducted at the point count locations in Figure 1.

6. Spring 2012 – PCW and the agencies will initiate the adaptive management process identified and approved in the final APP to incorporate site-specific mitigation and

avoidance measures into final project designs and the Final Environmental Impact Statement and Record of Decision. A final report documenting the results of the radar and point count efforts will be provided at least two weeks prior to the initiation of the adaptive management process to ensure adequate review time prior to discussions.

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ATTACHMENT 4

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Roxane Perruso

Subject: FW: PCW Revised Avian Monitoring Protocols
Attachments: PCW Draft Avian Monitoring Plan March 2011.docx

From: Jon Kehmeier
Sent: Wednesday, March 02, 2011 05:11 PM
To: Clark_McCreedy@fws.gov; Travis_Sanderson@fws.gov
Cc: garry.miller@tac-denver.com
Subject: PCW Revised Avian Monitoring Protocols

Clark and Travis,

I have attached a copy of revised protocols for Power Company of Wyoming's wind development project. The changes made reflect our better understanding of what the radar system can and cannot do and take into account the Service's recent draft Eagle Conservation Plan guidelines. Please take a look at the new protocols and provide me with any comments or questions that you might have. We are still very interested in getting some feedback from you on the protocols to make sure we have addressed the issues that we have discussed with you over the past months.

Also, the radar system should be delivered in the next 2-3 weeks. We have a call tomorrow morning with DeTect to discuss the delivery logistics. Once we know a bit more I will let you know. After it is up and running we will have you out to take a look at the system.

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Avian and Bat Monitoring Protocols

for the

Chokecherry and Sierra Madre Wind Energy Project

DRAFT

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March 2011

Review of Agency Recommendations

The following protocols have been developed in accordance with the following agency recommendations:

U.S. Fish and Wildlife Service (USFWS)
Wind Turbine Guidelines Advisory Committee *Recommendations on Developing Effective Measures to Mitigate Impacts to Wildlife and Their Habitats Related to Land-Based Wind Energy Facilities* (USFWS 2010)
USFWS Draft Land-Based Wind Energy Guidelines (USFWS 2011a)
Draft Eagle Conservation Plan Guidance (USFWS 2011b)

Wyoming Department of Game and Fish (WGFD)
Wildlife Protection Recommendations for Wind Energy Development in Wyoming (WGFD 2010)

Bureau of Land Management (BLM)
Rawlins Field Office *Wildlife Survey Protocols for Wind Energy Development*,

Generally, UFWS survey recommendations (USFWS 2010, 2011a, and 2011b) include using standard sampling methods to determine avian use of a project area, fatality risk in a project area, the presence of sensitive species and other species of interest, and to provide a baseline for assessing displacement effects and habitat loss. USFWS recommends that sampling frequency, type, and duration be sufficient to account for variability of avian use between and within sampling periods. When more precise estimates of density are required for a special status species, other methods, including radar or nocturnal surveys have been recommended when risks for collision are expected.

Similarly, the Bureau of Land Management (BLM) Rawlins Field Office Wildlife Survey Protocols for Wind Energy Development recommends that surveys be sufficient to detect temporal and spatial use patterns within the project area. Special emphasis is placed on surveys for raptors and sensitive avian species. BLM survey protocols recommend weekly, 20-minute point counts to record avian use of a project area. Survey times are recommended to be varied weekly to ensure that avian use during daylight hours is adequately documented. In addition to weekly surveys, marine radar is recommended to better define avian foraging, dispersal, and migration paths.

Wyoming Game and Fish Department's (WGFD) Wildlife Protections Recommendations for Wind Energy Development in Wyoming recommend sufficient numbers of weekly point count surveys during spring and fall migration periods following similar protocols as specific by BLM with survey periods of twenty minutes at each point. WGFD recommends that four surveys be conducted during winter months to capture overwintering avian species. For raptor species, WGFD recommends nest surveys and weekly day-long surveys during spring and fall migration periods.

Review of Existing Data

In compliance with its obligations under the National Environmental Policy Act of 1969 (NEPA), BLM is preparing an environmental impact statement (EIS) analyzing the potential impacts of the Chokecherry and Sierra Madre Wind Energy Project (Project) on lands and resources within the Project area. Between June 2008 and June 2009, avian use data were collected for much of the Project area as part of the BLM NEPA process [Johnson et al. 2008]. Data were collected using standard point count methods at 19 locations in all months except January and February when much of the Project area was inaccessible due to adverse weather conditions. All sites except for three were visited 31 times during the survey period.

WEST, Inc. (WEST) conducted avian point surveys of the Project area between June 26, 2008 and June 15, 2009. A portion of these data are analyzed in WEST's report, "*Baseline Avian Use Studies for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Summer and Fall Interim Report, June 26-October 14, 2008*" (Johnson et al. 2008). WEST also prepared a report summarizing bat surveys conducted between July 13 through October 13, 2008 titled, "*Bat Surveys for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Report*" (Solick et al. 2008). SWCA has completed additional analyses of all data collected in 2008 and 2009 to determine compliance with various agency monitoring recommendations.

Data collected during the 2008 and 2009 surveys are sufficient to provide estimates of avian use of the Project area as well as to provide initial estimates of the frequency of each species at rotor-swept heights. Horned lark (*Eremophila alpestris*) was predominantly the most common avian species detected in the 2008 and 2009 surveys, having over 800 individual detections. The next most common species were the common raven (*Corvus corax*) with less than 200 detections, and vesper sparrow (*Pooecetes gramineus*) with less than 150 detections. Golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), and common raven were most commonly observed within the rotary height of the turbines.

Data collected during 2008 and 2009 comply with the agency wind energy survey recommendations described in the previous section and serve as one year of suggested pre-construction monitoring data. Data collected for purposes of NEPA compliance provide estimates of collision and fatality risk and enable determination of avian use of the Project area, the presence of sensitive species and other species of interest, as well as providing a baseline for assessing displacement effects and habitat loss.

Project-Specific Protocols

To supplement the 2008-2009 dataset and to better identify concentrated avian use areas for development of a Project-specific Avian Protection Plan (APP) and an Eagle Conservation Plan (ECP), an intensive one-year survey will be used to better identify avian use areas in the Project area. Protocols have been developed following the various agency recommendations discussed above and in coordination with local USFS, BLM, and WGFD biologists. The protocols are consistent with agency recommendations and will provide more detailed site-specific use data than the protocols individually recommended by any of the agencies.

A combination of avian radar, raptor count stations, standard grid sampling, and point count surveys will be used to determine avian use across the Project area with emphasis on large raptors including golden eagles. Avian radar technology has been identified by the BLM and USFWS as a desired method to map areas of high avian use. The sampling design will follow recommendations made by the USFWS, BLM, and WGFD by combining radar surveys with standard point count and breeding bird methodologies. The radar technology will also enable better identification of bat use areas and relative densities of bats in the Project area.

A DeTect Merlin Avian Radar System will be used to map avian use across the Project area. The DeTect Merlin radar system is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10–kilowatt (kW) vertically operating X-band open array radar. The horizontal radar has a range of 2 to 5 miles in a 360-degree pattern around the unit. The vertical radar has a 24-degree beam width and detects flight paths 0.75 to 2.00 miles above the unit.

The avian radar system requires weekly maintenance and fueling and cannot be moved over extremely rough terrain on a regular basis. Additionally, the system will not differentiate between large raptors such as golden eagles and other large birds including geese, other large raptors, and possibly even ravens and; therefore, will be used in conjunction with field surveys to validate radar recorded data. However, the radar system, when coupled with point count verification of avian use, will allow for accurate horizontal and vertical mapping of avian use in the Project area. The radar system will also enable mapping of high use areas for bat species.

A combination of raptor and point surveys and breeding bird grid surveys will be conducted in concert with the radar survey. This design will provide intensive survey information regarding avian use patterns within the radar survey perimeter for each season. Raptor count stations, point counts, and breeding bird surveys will be used to validate the radar data and provide estimates of species-specific use patterns. Raptor stations and point count surveys will record the location, flight path, approximate height, and time of use for any individual observed from the count location. Raptor count locations will be surveyed for 8-12 hours per day during periods with the highest likelihood for detection of migrating birds and/or large raptors. Standard 20-minute point counts will be completed at each raptor count location. Timing of point count surveys at each location will be varied to determine patterns of avian use during daylight hours.

In addition to the raptor, point count, and radar surveys, breeding bird surveys will be completed at 15 locations across the Project area. Breeding bird surveys will be conducted following the grid monitoring protocols published by the Rocky Mountain Bird Observatory (RMBO) (Hanni et al. 2010). Grid survey locations will be randomly selected using a generalized random tessellation stratified design to ensure a spatially balanced design stratified by major vegetation and habitat types in the Project area. Data collected as part of the grid monitoring efforts will also be used to validate radar data and better determine avian species use. As part of the breeding bird surveys, waterfowl and water bird use surveys will be conducted three times annually (springs, summer, and fall) to identify migrating and resident species.

Locations for placement of the radar and for conducting point count surveys (Figure 1) and breeding bird surveys were determined using a four-tiered approach:

- Tier 1 – Survey areas should determine avian use within the Project area.

- Tier 2 – Survey areas should overlap possible foraging areas for large raptors (winter range areas, prairie dog towns, waterfowl use areas, etc.).
- Tier 3 – Survey areas should be in locations to allow for detection of avian movement into and out of the Project area.
- Tier 4 – Survey areas should capture variability in habitat and topography.

Locations of radar placement were refined following attendance at DeTect's radar training courses and during coordination with DeTect's radar placement specialists. Figure 1 reflects the revised radar locations. Final placement of the radar unit and final point locations for survey will be determine in early spring 2011 following radar unit delivery.

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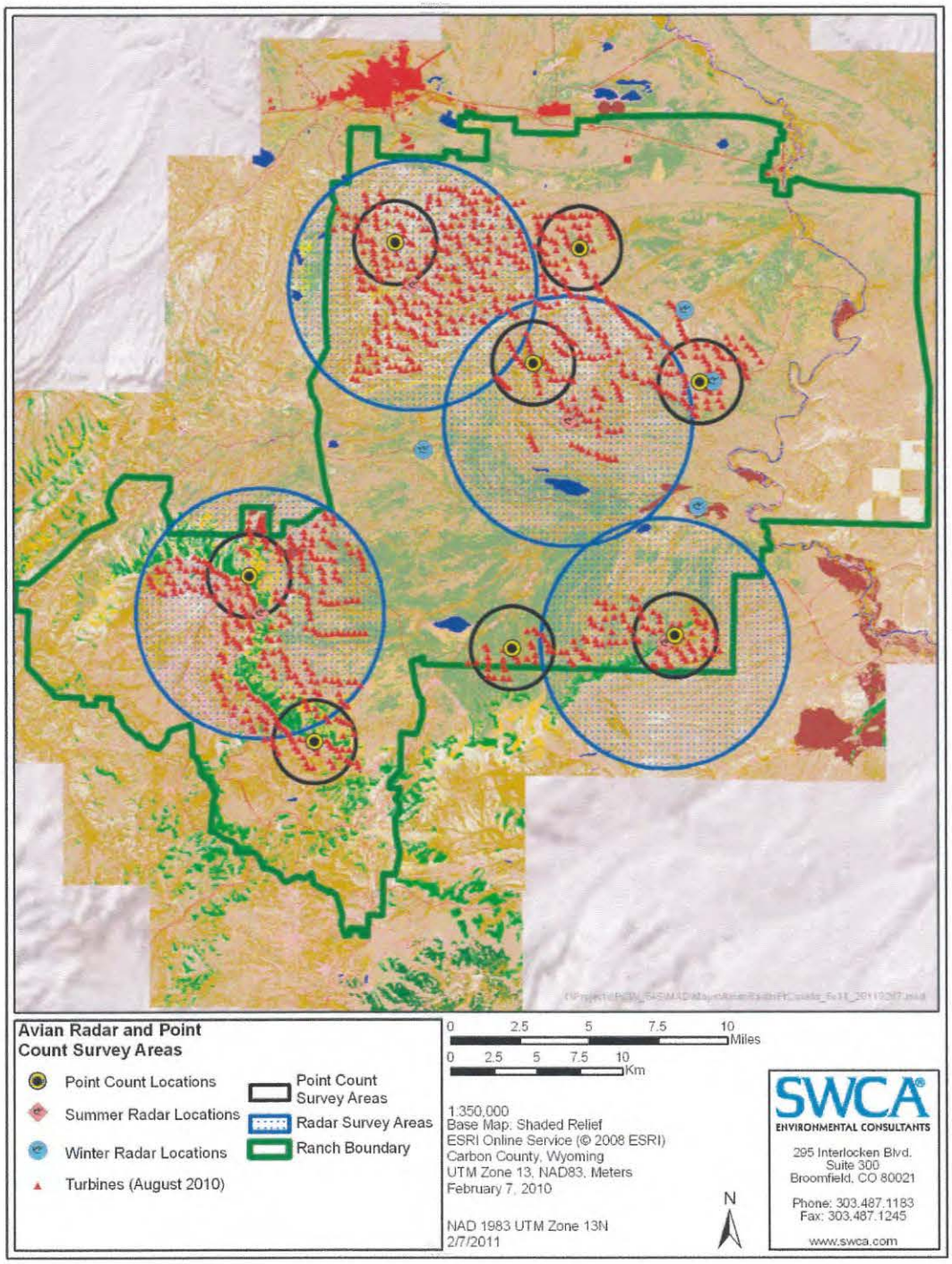

Figure 1. Approximation of area surveyed using avian radar and traditional point count methodologies with respect to possible wind turbine locations. Spring, summer, and fall radar installation locations are the center point of the large blue circles. Proposed point count locations are the center points of the small black circles. Potential winter radar locations are the four blue points. Final locations for survey will be determined in coordination with BLM, WGFD, and USFWS.

The radar unit will be placed at five locations within the Project area (Figure 1). Point counts will be completed at nine additional locations to map avian use patterns where radar coverage is not possible. Eight of these point counts will be completed at permanent sampling locations. The ninth point count location will be completed at the radar site to validate the data being collected by the radar unit. During winter months, the radar will be placed in a location that has high probability of access on a weekly basis. Much of the project area is covered in snow and large drifts during winter; therefore, radar placement in winter will likely be near the Bolton Ranch headquarters, south of I-80 near the North Platte River, on the Bolton Road east of Teton Reservoir, or on the north side of the Chokecherry project area (Figure 1). Winter point count survey locations will also be adjusted as needed to account for winter weather conditions, access issues, and safety concerns.

Based on a four mile radius for radar surveys and a one mile radius for point count surveys, approximately 90-93% of the turbine locations, depending on winter radar placement, will be directly surveyed. It is likely that this percentage is higher than 90-93% for large raptors including bald and golden eagles as many of the point count locations have visibility of several miles and recent radar advancements may allow for detection of large raptors out to 5+ miles. Point count locations outside of the radar survey perimeters have been placed to allow for detection of raptors moving into the Project area and between radar surveyed zones.

Helicopter flights will be completed in mid-April or early May to document eagle nesting activity as well as nesting activity of other raptors that are incidentally observed. Aerial nest activity surveys will be completed in accordance with the recent draft eagle guidance (USFWS 2011b). Following identification of active eagle nests, follow-up productivity surveys will be completed from the ground above/below the nest to determine nesting and fledging success.

The protocols and schedule outlined below will be followed for monitoring and mapping avian and bat use across the Project area using the marine radar system, point counts, and breeding bird surveys.

1. Winter 2010/2011 – Radar construction, programming, and training. The Draft APP/ECP will be delivered to USFWS, BLM, and WGFD for review in late winter/early spring. Among other descriptive sections, the preliminary plan will contain the detailed sampling protocols, preliminary mitigation and avoidance measures, and detailed adaptive management protocols. Monthly reconnaissance surveys will be completed to document eagle use of the Project area during winter months and to help determine best locations for winter 2011/2012 deployment of the radar system.

2. Spring and Early Summer 2011 – Radar surveys will begin in the southern portion of the Project area. The radar system will be moved once during the spring migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Breeding bird surveys will be completed at 15 locations across the Project area. Surveys for waterfowl and other waterbirds will be conducted once during the spring migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data will be

used to identify areas with high avian and bat use. The following schedule will be used for spring and early summer 2011 surveys:

a. March 15 – May 15, 2011: Radar system will be initialized and debugged prior to main migratory period. Initial installation will occur at the southeastern-most radar survey location identified on Figure 1. This survey location will detect migrating birds in areas adjacent to the Platte River corridor and along the ridgeline north of the Jack Creek road. Weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

b. May 15–July 31, 2011: Radar system will be moved to the northeastern survey location (Figure 1). This survey location will detect migrating birds adjacent to and along the Bolten Rim as well as in the basin below the Bolten Rim. Migratory use and raptor soaring locations within and adjacent to the ridgelines in this portion of Chokecherry will also be surveyed using the radar system. Between May 15 and June 30, weekly point surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location. During the month of July, the point count locations will be visited twice instead of every week in compliance with BLM and WGFD recommendations. Additionally, this time is between migratory periods and typically bird movements are lower because of nesting activities. A point count will be conducted weekly at the radar installation location during this period during routine maintenance activities.

c. May 25–June 30, 2011: Breeding bird surveys will be completed once at each of 15 locations across the Project area to determine relative abundance, species richness, and habitat use patterns. Breeding bird surveys will follow RMBO grid survey protocols (Hanni et al. 2010). Bird flight patterns will be documented to better define risks of wind development activities. All raptors as well as their flight paths and heights will be recorded at all breeding bird locations regardless of whether the raptor falls within the grid survey area.

d. May 1, 2011: An agency meeting will be scheduled to discuss preliminary analyses of radar data from early spring migration to allow for more informed use of the radar and survey data that will be used in the APP/ECP.

3. Late Summer – Fall 2011: The radar system will be moved once during the fall migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Waterfowl and wading bird surveys will be conducted once during late summer to detect nesting activity and once during fall migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data collected during spring and early summer will be completed to evaluate bird and bat use and to identify appropriate mitigation measures that could be implemented. The following schedule will be used for late summer and fall 2011 surveys:

a. August 1: A revised APP/ECP will be delivered to the agencies for review and approval. The revised APPECP will contain the mitigation measures that will be applied to remove or minimize risks to avian species. The revised APP/ECP will also identify the adaptive management process that will be followed to update the APP/ECP and apply additional site-specific mitigation measures as additional data are obtained prior to, during and after construction. An interim report of radar data trends and observations will also be provided with the revised APP/ECP.

b. August 1– September 30, 2011: Radar system will be installed at the western radar location in the Chokecherry project area radar survey location identified on Figure 1. This survey location will detect migrating birds in the western portion of Chokecherry as well as along the rim of Chokecherry and the basin between Chokecherry and Atlantic Rim. During the month of August, the point count locations will be visited twice instead of every week. A point count will be conducted weekly at the radar installation location during August as part of routine maintenance activities. During September, weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

c. October 1–November 15, 2011: Radar system will be moved to a location along the rim of Miller Hill in the southwestern portion of the project area (Figure 1). This survey location will detect birds in the Miller Hill area and below the Miller Hill rim in the Sage Creek Basin. Weekly point count surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location.

4. Winter 2011/2012 (November 16, 2011–March 30, 2012) – A final APP/ECP will be delivered to the agencies for review. The final APP/ECP will identify the avoidance, minimization, and mitigation measures to reduce threats to eagles and other avian species. The radar system will be deployed in a suitable location to ensure weekly maintenance is possible during winter months. Weekly bird observations will be recorded during routine maintenance activities at the radar location. Weather permitting, monthly counts will be conducted at the point count locations in Figure 1.

5. Spring 2012 – PCW and the agencies will initiate the adaptive management process identified and approved in the final APP to incorporate site-specific mitigation and avoidance measures into final project designs and the Final Environmental Impact Statement and Record of Decision. A final report documenting the results of the radar and point count efforts will be provided at least two weeks prior to the initiation of the adaptive management process to ensure adequate review time prior to discussions.

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ATTACHMENT 5

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Roxane Perruso

Subject: FW: PCW Revised Avian Monitoring Protocols

From: Travis_Sanderson@fws.gov [mailto:Travis_Sanderson@fws.gov]
Sent: Thursday, March 03, 2011 08:24 AM
To: Jon Kehmeier
Cc: Clark_McCreedy@fws.gov; Travis_Sanderson@fws.gov; garry.miller@tac-denver.com
Subject: Re: PCW Revised Avian Monitoring Protocols

Jon,
We are currently drafting a response to the first set of protocols. We will review the latest version, particularly the changes that you mentioned. I understand you are in town on March 8 for a meeting, I would like to take that opportunity to discuss some things. As we have stated all along, we are 100% behind the monitoring protocols, but we will need to discuss the proposed timeline, specifically the development of the APP. As an office we are still trying to wrap our heads around what an APP will consist of, but it appears your projected timeline may be a little ambitious. But we can definitely discuss in person next week. I hope all is well, and look forward to meeting with you next week.

Travis Sanderson
U.S. Fish and Wildlife Service
Fish and Wildlife Biologist
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-----"Jon Kehmeier" <jkehmeier@swca.com> wrote: -----

To: <Clark_McCreedy@fws.gov>, <Travis_Sanderson@fws.gov>
From: "Jon Kehmeier" <jkehmeier@swca.com>
Date: 03/02/2011 05:10PM
cc: <garry.miller@tac-denver.com>
Subject: PCW Revised Avian Monitoring Protocols

Clark and Travis,

I have attached a copy of revised protocols for Power Company of Wyoming's wind development project. The changes made reflect our better understanding of what the radar system can and cannot do and take into account the Service's recent draft Eagle Conservation Plan guidelines. Please take a look at the new protocols and provide me with any comments or questions that you might have. We are still very interested in getting some feedback from you on the protocols to make sure we have addressed the issues that we have discussed with you over the past months.

Also, the radar system should be delivered in the next 2-3 weeks. We have a call tomorrow morning with DeTect to discuss the delivery logistics. Once we know a bit more I will let you know. After it is up and running we will have you out to take a look at the system.

Jon Kehmeier

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ATTACHMENT 6

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Roxane Perruso

Subject: FW: PCW Revised Draft Avian Monitoring Plan

From: Travis_Sanderson@fws.gov [mailto:Travis_Sanderson@fws.gov]
Sent: Thursday, May 05, 2011 04:10 PM
To: Jon Kehmeier
Cc: Garry.Miller@tac-denver.com; Scott_Covington@fws.gov
Subject: Re: PCW Revised Draft Avian Monitoring Plan

John,
couple of questions regarding the revised draft monitoring plan: at the 3/18/11 (I believe this was the right meeting?) we discussed concerns that the Service had regarding the time line. It was brought to my attention during the office review that our suggestions might not have been incorporated. We voiced concerns about finalizing an APP/ECP after only 1 year of radar surveys (in the spring of 2012). I know that WEST conducted surveys during 2008-2009, but these surveys did not provide information regarding avian utilization of the project area. In past meetings we have discussed that WEST's surveys will account for 1 year of the recommended 3 years of pre-construction surveys, but we have strongly suggested that PCW conduct an additional 2 years as well. This is consistent with the recent correspondence that was sent the BLM regarding the appropriateness of an APP for this project. Below I have outlined the time line that we discussed at the March 18, 2011 meeting for your consideration:

Spring 2011 - Draft Preliminary APP/ECP containing preliminary mitigation measures. This document would primarily be a detailed outline.
Spring 2012 - Draft Final APP/ECP. This document would incorporate an entire year's worth of data, thus will more adequately dictate mitigation and avoidance measures.
Spring/summer 2012 - Final APP/ECP. A finalized document that takes into account two complete years worth of intensive radar and field observations.

Based on the notes from our last meeting this is the time line that was discussed, though PCW never formally committed to it. Unless I am mistaken, this time line fits well within the EIS process and would not result in delays to the project due to monitoring efforts or finalizing documents. As discussed previously, the Service is entirely on-board with the proposed monitoring protocols, I would just like to clarify the issue regarding the duration of monitoring and time line of APP/ECP development. I would like to send a letter of endorsement from our office that does not address any of these concerns. Please email or give me a call tomorrow to discuss. I will be out in the morning conducting sage grouse surveys, but will be in the office late morning and all afternoon. Thanks.

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ATTACHMENT 7

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Chokecherry and Sierra Madre Wind Energy Project

Programmatic Eagle Conservation Strategy

Prepared for

Power Company of Wyoming LLC

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Suite 2400
Denver, CO 80202

Prepared by

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January 2012

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1.0 INTRODUCTION

Power Company of Wyoming LLC (PCW) is developing the Chokecherry and Sierra Madre Wind Energy Project (Project), a 1,000-turbine project located south of Rawlins in Carbon County, Wyoming (Figure 1). The Project will be situated on approximately 156,140 acres of the 320,270-acre Overland Trail Ranch (Ranch). Because the Project spans an approximately 50/50 combination of private land and federal land managed by Bureau of Land Management (BLM), the Project is being reviewed in an Environmental Impact Statement (EIS) pursuant to Section 102 (2)(C) of the National Environmental Policy Act of 1969 (NEPA). In July 2008, the BLM Rawlins Field Office (RFO) published a Notice of Intent to prepare an EIS to analyze the environmental consequences of the Project (BLM 2008a). The Project EIS is using a programmatic approach for the Project. A Final EIS and Record of Decision (ROD) will be issued to authorize the construction of the Project. However, subsequent to the issuance of the ROD, PCW will submit three detailed Plans of Development (PODs) for each of three stages of Project development that will be subject to additional site-specific NEPA analysis prior to issuance of right-of-way grants and a construction notice-to-proceed.

In July 2010, BLM issued Instructional Memorandum (IM) 2010-156, which required the development of a project-specific Avian Protection Plan (APP) for renewable energy projects with the potential to impact golden eagles (*Aquila chrysaetos*) or their habitats (BLM 2010). IM 2010-156 requires that prior to issuance of the Project ROD, the U.S. Fish and Wildlife Service (Service) must concur that measures identified in the APP are sufficient to avoid or minimize take of golden eagles. On April 20, 2011, the Service sent a letter to BLM stating that an APP for the Project is appropriate to avoid and minimize potential take of eagles and other avian species. In the letter, the Service recommended that, because the final locations of Project turbines and infrastructure are not yet known, a programmatic APP be developed for purposes of the BLM's programmatic NEPA process and site-specific APPs be developed for each stage of construction. This Eagle Conservation Strategy (ECS) meets the recommendations to develop a programmatic APP made by the Service in the April 20 letter and meets the requirements of IM 2010-156

The intent of this document is to provide a programmatic framework within which a final Project design will be developed to avoid and minimize risk to eagles and make scientifically-based siting decisions that will reduce project impacts. This Programmatic ECS describes conservation measures and avoidance, minimization, and mitigation measures that will be applied to address risks to golden eagles and bald eagles (*Haliaeetus leucocephalus*) that will result from Project implementation. While this Programmatic ECS identifies avoidance areas for placement of turbines to minimize risk to eagles, it does not describe the specific locations of other conservation measures and activities, how many of these activities will be required, or site-specific and turbine-specific risks to eagles. Rather, per the recommendations made in the April 20, 2011 letter from the Service, these measures will be described in detailed ECS documents for each of the construction stages for the Project and once the final Project design is completed.

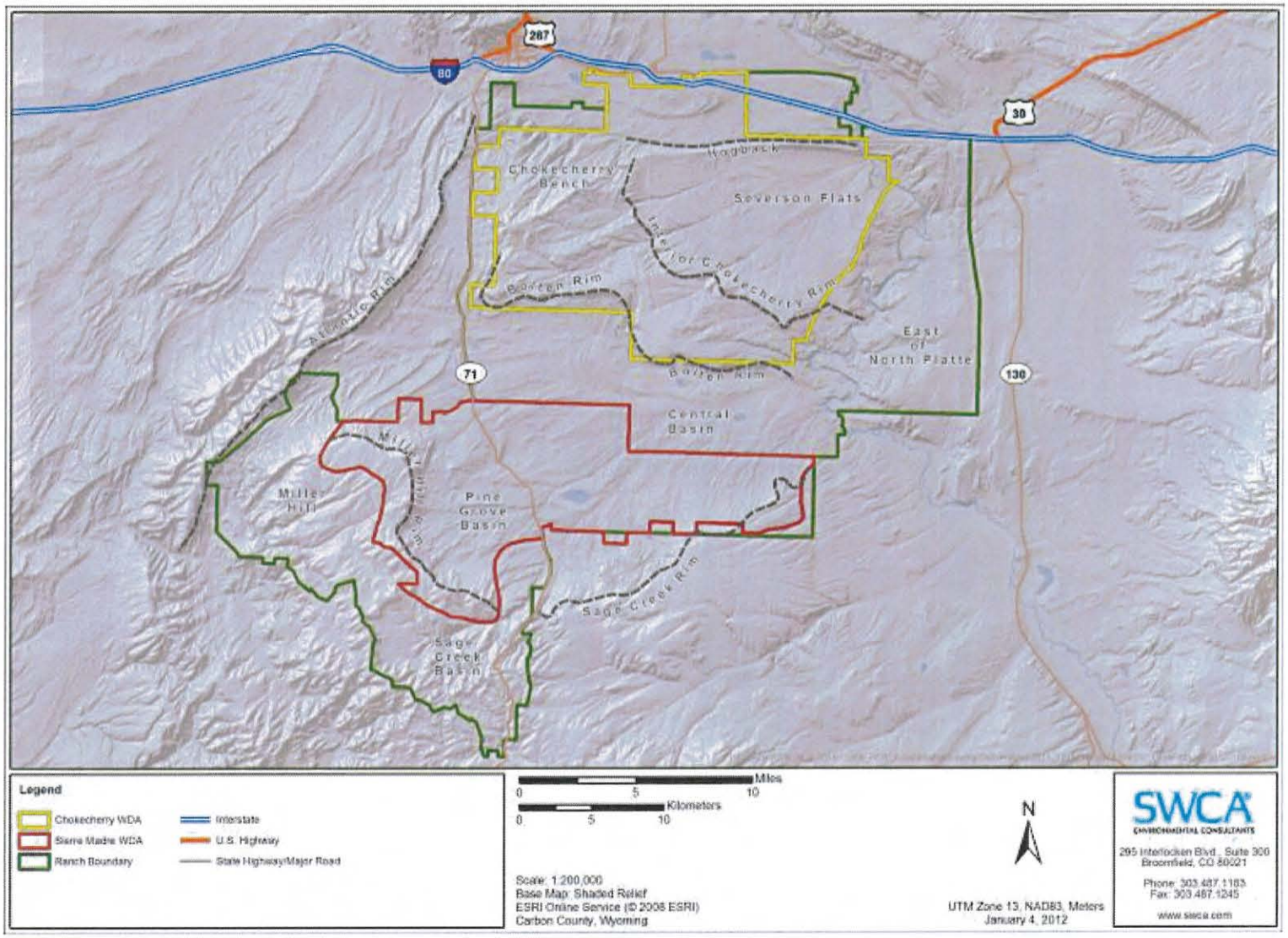

Figure 1. The Overland Trail Ranch, Chokecherry and Sierra Madre Wind Development Areas, and significant land features occurring in the Project area.

Following the issuance of IM 2010-156, PCW initiated a collaborative process with the BLM, the Service, and Wyoming Game and Fish Department (WGFD) to identify a process that would be followed to develop an APP and ECS for the Project. During this collaborative process, it was determined that additional data were needed to better identify concentrated avian use areas, particularly for golden eagles. PCW, in coordination with the agencies, developed an intensive survey protocol to identify high-use areas that might occur in the immediate vicinity of the Project. The comprehensive survey protocols integrated a number of the survey recommendations made by the Service, BLM, and WGFD.

Protocols developed for the Project exceed the recommendations made in the Draft Eagle Guidance, WGFD's Wildlife Protection Recommendations for Wind Energy Development in Wyoming (WGFD 2010), and the BLM RFO Wildlife Survey Protocols for Wind Energy Development (BLM 2008b). The implementation of these protocols adds to data collected in 2008 and 2009 for purposes of a pre-construction site assessment and for use in BLM's Draft EIS (DEIS) analysis. PCW's robust protocols considered the recommendations made in the following documents.

Service Survey Recommendations

Wind Turbine Guidelines Advisory Committee, *Recommendations on Developing Effective Measures to Mitigate Impacts to Wildlife and Their Habitats Related to Land-Based Wind Energy Facilities* (Service 2010).

U.S. Fish and Wildlife Service Interim Guidance for Wind Energy Development in Wyoming (Service 2011a).

Draft Eagle Conservation Plan Guidance (Service 2011b).

Avian Survey Requirements for Wind Energy 'Avian Protection Plans' in Wyoming (Service Unknown Year)

WGFD Survey Recommendations

Wildlife Protection Recommendations for Wind Energy Development in Wyoming (WGFD 2010)

BLM Survey Recommendations

Rawlins Field Office *Wildlife Survey Protocols for Wind Energy Development* (BLM Unknown Year).

The following sections describe the survey protocols developed by PCW; the data collected as part of survey efforts; the project siting considerations that will be made as part of this programmatic ECS; the risk reduction measures that will be evaluated and implemented as part of the construction stage-specific ECS documents; and the adaptive management process that will be followed to ensure the success of risk reduction measures.

2.0 ENVIRONMENTAL COMMITMENT

PCW is a wholly owned affiliate of The Anschutz Corporation which also owns and operates the Ranch on which the Project is located. The Overland Trail Cattle Company, LLC (TOTCO) has been part of the Carbon County community and steward of the land and wildlife resources for 15 years. This ECS is intended to clearly state PCW's actions and commitments to avian protection during the design, construction, operation, and decommission stages of the Project. This document in association with applicant-committed conservation measures identified in various plans as well as avoidance and mitigation measures identified in the Project EIS and PCW's POD will promote conservation of eagles and many other wildlife and fish species in the Project area.

PCW will initiate or continue to:

- develop and implement this ECS and each construction stage-specific ECS using the best available science in coordination with state and federal wildlife management agencies;
- continue previously implemented wildlife conservation measures, such as fence marking or removal for greater sage-grouse (*Centrocercus urophasianus*) protection, installation of bird diverters on all guyed meteorological towers, rangeland enhancement projects, and other habitat and species conservation measures;
- adhere to all applicable state and federal laws, regulations, and permit conditions;
- apply an adaptive management approach as new technology, survey/monitoring techniques, and avoidance/minimization/mitigation measures are developed;
- ensure that all Project-related corporate employees, contractors, and subcontractors are familiar with the Corporate Policy to develop the Project in an environmentally responsible manner;
- ensure that Project construction and operation crews are properly trained to document and report Project-related wildlife fatalities and injuries consistent with this ECS and other Project conservation documents; and
- participate with state and federal agencies, and other groups to conduct research on wildlife populations, including potential impacts and effective conservation measures.

PCW's commitment to this policy will promote environmentally responsible wind energy development initiatives that support wildlife populations in the Project area. Adherence to this policy will further promote wind energy as a viable contributor to national energy independence while demonstrating wildlife management and technological advances available to responsibly develop large-scale projects in the interior western United States.

3.0 ENVIRONMENTAL AND PROJECT SETTING

3.1 OWNERSHIP

The Project is sited on the Ranch, which is owned and operated by TOTCO. Much of the Ranch is located within an ownership region described as "checkerboard," in which land section ownership alternates between private lands (mostly owned by TOTCO) and federal lands managed by the BLM (Figure 2). A small portion of Wyoming State Land Board and WGFD-managed lands (collectively state lands) are also within the Ranch boundary. The probable wind development area (WDA) for Chokecherry is entirely within checkerboard ownership. The majority of Sierra Madre WDA is within checkerboard ownership except for the southern portion, which is primarily federal land. The breakdown of land ownership within the Ranch and the likely areas of wind development is summarized in Table 1.

Table 1. Surface Land Ownership within the Overland Trail Ranch and Chokecherry and Sierra Madre Wind Development Areas.

Ownership	Overland Trail Ranch		Chokecherry WDA		Sierra Madre WDA	
	Acres	%	Acres	%	Acres	%
TOTCO	149,875	47	44,610	50	31,730	47
Federal	142,960	45	43,230	49	31,885	48
State	16,330	5	1,255	1	3,350	5
Other*	11,105	3	0	0	80	<1
Total	**320,270**	**100**	**89,095**	**100**	**67,045**	**100**

* "Other" ownership includes Anadarko grazing lease, City of Rawlins lease, and other private inholdings.

3.2 LAND USE

TOTCO is an open range cow-calf operation which produces its own replacement heifers and sells fall-weaned calves. The Ranch also has approximately 2,500 acres of irrigated hay fields which support the cattle operation. According to the RFO Resource Management Plan (RMP) (BLM 2008c), TOTCO manages the Bolten Ranch/Pine Grove Allotment to provide periodic growing season rest from grazing by increasing stocking density and shortening the grazing period. There are two areas of summer and winter ranges on the ranch, and two separate grazing rotations. There is a main cow herd of 2,500 to 3,000 older cows, a herd of 300 to 500 younger cows, and a herd of 300 select older cows. The grazing rotation for these herds allows rest for upland communities in spring and early summer, and late-summer rest for riparian communities. Stocking rates and movement between various pastures within the allotments fluctuate yearly based on forage availability and resource conditions. According to BLM (2004), grazing management in the Bolten Ranch/Pine Grove allotment has been greatly improved by TOTCO since 1997, and its grazing management plan provides for a well-managed grazing program.

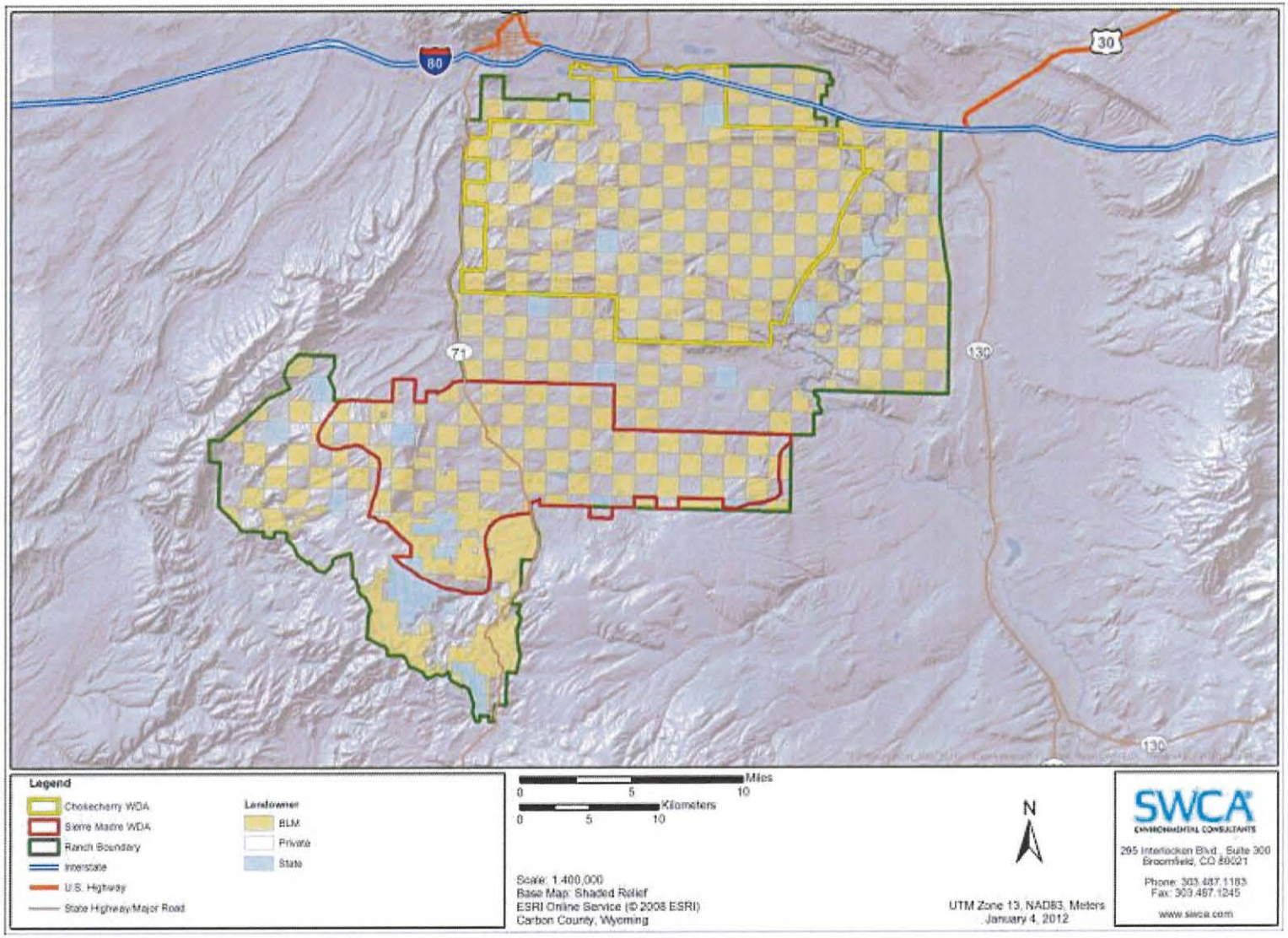

Figure 2. Private, state, and public ownership matrix occurring across the Overland Trail Ranch.

Hunting is permitted only on publicly accessed federal lands within the Ranch boundaries and in defined areas of a special cow elk hunt area east of the Chokecherry WDA. There are no year-round private residences on the Ranch, although there are two private hunting cabins in the northern portion of the Sierra Madre WDA. Primary big game species include mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), pronghorn (*Antilocapra americana*), moose (*Alces alces*), black bear (*Ursa americanus*), and mountain lion (*Puma concolor*). Primary small game species include dusky grouse (*Dendragapus obscures*), greater sage-grouse, and cottontail rabbit (*Sylvilagus* spp.). Twenty hunting units overlap with the Ranch (Table 2). The BLM estimates that approximately 95 percent of the use for the Project area occurs near Sage Creek Basin and Miller Hill between the start of antelope season (late September) and the close of cow elk season (late January) (BLM 2011). Beginning in the winter of 2011–2012, a special hunt license for cow elk in Hunt Unit #130 (Bolten Rim) will be made available to assist in controlling elk populations within this hunt unit.

Table 2. Licenses Granted for Each Big Game Species for Hunt Units Overlapping the Ranch.

Species	Hunt Units	Licenses Granted
Antelope	48, 50, 53, 55, 56, 62, and 108	3,275
Mule Deer	79, 82, 83, 84, and 87	270+ General Licenses
Whitetail Deer	79	25
Elk	12, 21, 108, 111, and 130	775+ General Licenses
Moose	38 and 41	40

Source: WGFD 2009

3.3 ENVIRONMENTAL SETTING

The Project area is characterized by a central basin that transitions to foothills and mesas to the south and southwest, and escarpments and rolling terrain composed of dissected, horizontally layered sedimentary formations to the north and northeast. Elevations range from approximately 6,500 feet above mean sea level at the North Platte River to about 8,500 feet above mean sea level at Miller Hill.

Annual precipitation increases with elevation and ranges from 7 to 19 inches per year, with the majority of precipitation falling between April and May (Western Regional Climate Center [WRCC] 2008). Average monthly high temperatures range from 33.3 to 54.9 degrees Fahrenheit between November and April with the coldest temperatures occurring in January, and 59.6 to 83.3 degrees Fahrenheit between May and October with the hottest temperatures during July (WRCC 2008; Natural Resources Conservation Service [NRCS] 2001). Growing seasons range from 103 to 167 days, beginning in late April and ending in early October (NRCS 2001).

3.3.1 Physiographic Setting

The Project area is dominated by three topographic features (Miller Hill, Chokecherry Plateau, and Sage Creek Rim) separated by a central basin (see Figure 1). To the north, Chokecherry Plateau consists of ridges and rolling hills that generally slope northeasterly

downward to the North Platte River. Approximately 25 miles of the North Platte River flow along the eastern limits of Chokecherry. Most of the northern portion of Chokecherry is defined by a small east-west ridge commonly known as the Hogback (approximately 10 miles) and the southern portion by a well-defined cliff edge commonly referred to as the Bolten Rim (approximately 20 miles). A prominent north-south ridge cut by three ephemeral drainages (Smith Draw, Hugus Draw, and Iron Springs Draw) bisects Chokecherry for approximately 12 miles.

The southwestern portion of the Project area is dominated by a steep-sloped mesa commonly known as Miller Hill. This predominant feature slopes gently toward the south and southwest, with relatively level terrain near the edge of the rim and becoming increasingly undulated towards the southwest.

The southeastern portion of the Project area includes Sage Creek Rim, which has similar features to Miller Hill, although this feature is not as large or high. Only a small portion of the top of the Sage Creek Rim is within the Project area.

The area between these features is a high desert basin transected by Sage Creek and a number of smaller ephemeral tributaries. Much of this basin is outside the WDAs; however, the Project haul road and internal transmission line will traverse the central basin and interconnect the WDAs. Larger waterbodies are interspersed throughout this arid landscape, which include Kindt, Rasmussen, Sage Creek, and Teton reservoirs.

Surface geology in the Project area is predominantly Quaternary alluvium and colluvium, outwash, and eolian deposits derived from Tertiary and Cretaceous claystone, sandstone, and sedimentary rock (Chapman et al. 2004). The Chokecherry WDA is covered primarily by residuum, slopewash, and colluvium landforms, while the majority of the Sierra Madre WDA is covered by residuum landforms (Case et al. 1998).

Soils on the Ranch are developing from a wide variety of parent material derived from sedimentary and igneous origins, which include alluvium and residuum of limestone, sandstone, and shale, and colluvium of granite (NRCS 2004). Subsurface textures are predominantly loamy or sandy soils, while surface textures range from silty clays to coarse sands. Many physiographic features occur throughout the Ranch but dominant features are hills, ridges, escarpments, plateaus, stream terraces, and alluvial fans (NRCS 2004).

3.3.2 Vegetation

Vegetation cover (Figures 3 and 4) is typical of Wyoming Basin and Southern Rockies ecoregions, defined by rolling sagebrush steppe, salt desert shrub basins, and foothill shrublands (Chapman et al. 2004). Rolling sagebrush steppe communities are dominated by various densities of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) at higher elevations, with areas of silver sagebrush (*Artemisia cana*) in the lowlands and black sagebrush (*Artemisia nova*) and low sagebrush (*Artemisia arbuscula*) in exposed, rocky soils.

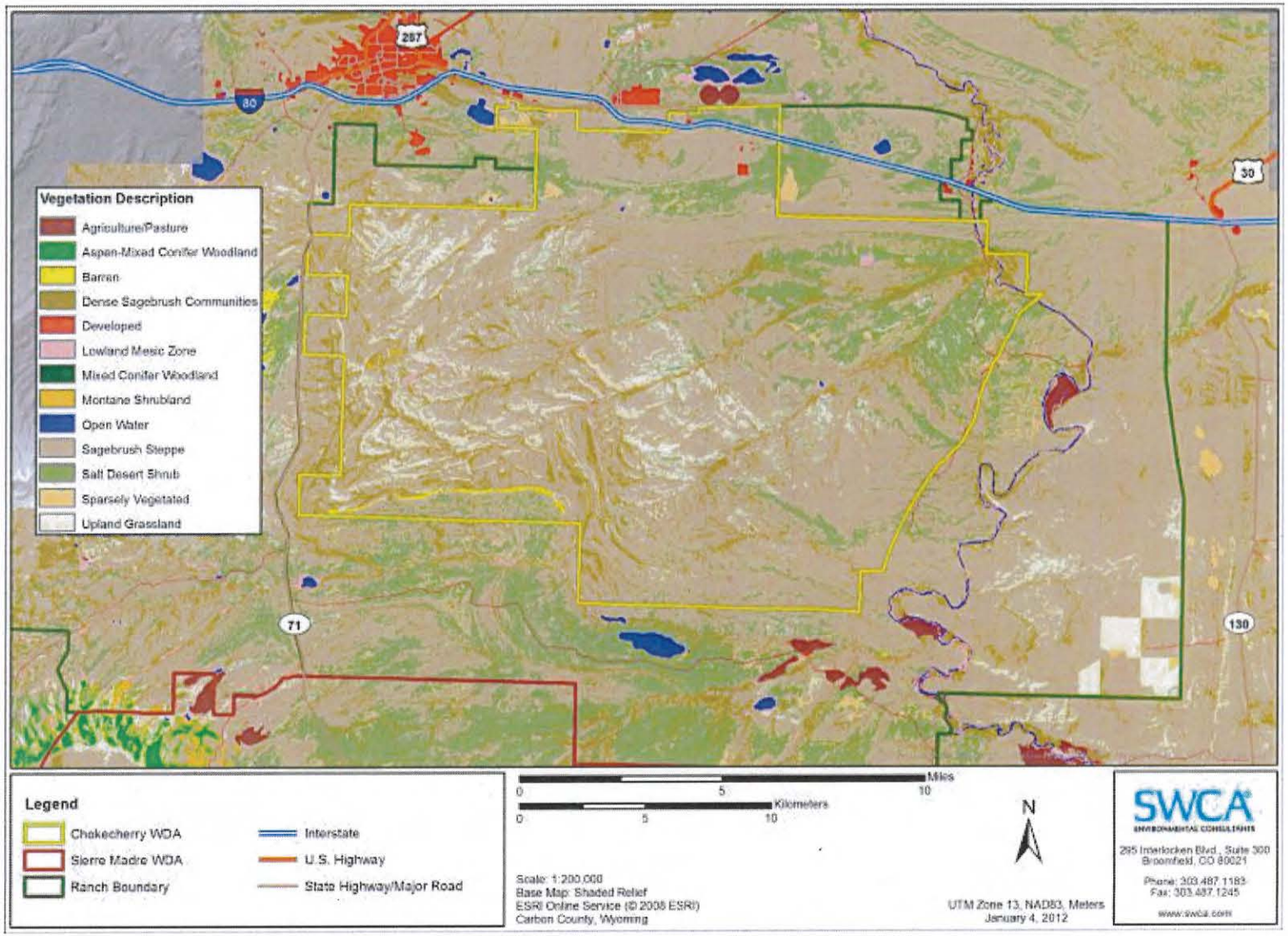

Figure 3. Vegetation communities occurring in the Chokecherry WDA and adjacent landscape.

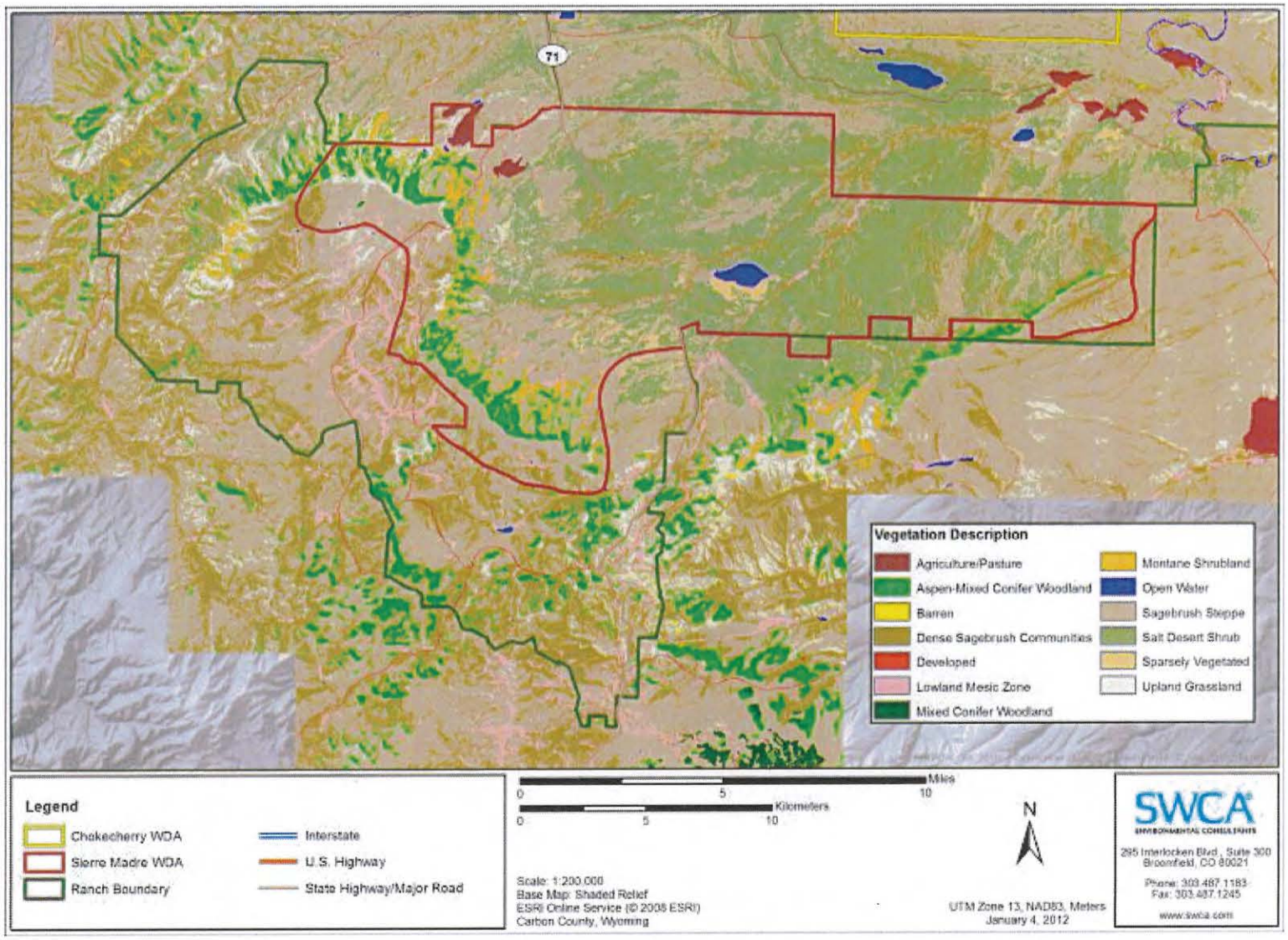

Figure 4. Vegetation communities occurring in the Sierra Madre WDA and adjacent landscape.

Sagebrush steppe communities are interspersed with bunchgrass/rhizomatous grass communities and allied shrubs, and generally have relatively low forb cover. Salt desert shrub basins are characterized by sparse vegetation cover of cushion plant communities with dominant shrub cover of Gardner's saltbush (*Atriplex gardneri*), shadscale (*Atriplex confertifolia*), and black greasewood (*Sarcobatus vermiculatum*). Perennial streams throughout salt desert shrub basins are typically surrounded by basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and riparian communities dominated by willows (*Salix* spp.), sedges (*Carex* spp.), and rushes (*Juncus* spp.). Foothill shrubland communities are dominated by montane deciduous shrubland consisting of mountain big sagebrush, snowberry (*Symphoricarpos* spp.), serviceberry (*Amelanchier* spp.), and mountain mahogany (*Cercocarpus* spp.), surrounded by extended groves of quaking aspen (*Populus tremuloides*), low-growing common juniper (*Juniperus communis*), and patches of limber pine (*Pinus flexilis*).

3.3.3 Water Resources

The surface water resources (Figures 5 and 6) within the Project area include the North Platte River, as well as several perennial streams including Sage Creek, Miller Creek, and Rasmussen Creek in the North Platte drainage and Muddy Creek in the Little Snake drainage. The Project is located within the Upper North Platte basin (Hydrologic Unit Code 10180002) and the Muddy Creek basin (Hydrologic Unit Code 14050004). Within the Upper North Platte basin, Project activities would occur in the Sage Creek, Iron Spring Draw, and Sugar Creek watersheds. Within the Muddy Creek Basin, Project activities would occur in the Upper Muddy Creek watershed. Waters impacted by Project activities include Sage Creek, Little Sage Creek, Hugus Draw, Smith Draw, and Iron Spring Draw in the Upper North Platte basin and McKinney Creek, Grove Creek, and Stony Creek in the Muddy Creek basin. In addition, several ephemeral streams and a few isolated springs are located throughout. There are also numerous stock ponds and some larger irrigation reservoirs including Teton, Kindt, Rasmussen, and Sage Creek reservoirs.

3.3.4 Prey Base

Vegetation cover in the vicinity of the Project is typical of Wyoming Basin and Southern Rockies ecoregions, defined by rolling sagebrush steppe, salt desert shrub basins, and foothill shrublands (see Section 3.3.2) (Chapman et al. 2004). These ecoregions include habitat that support a variety of wildlife that provide a sufficient prey base for foraging and scavenging activities for raptors and eagles. Big game species in the area include mule deer, elk, and pronghorn, and seasonal ranges, designated by WGFD, have been identified across the area (Sawyer et al. 2008).

Chokecherry WDA provides winter habitat and crucial winter habitat for mule deer, while the Sierra Madre WDA provides spring/summer/fall habitat for mule deer and pronghorn and winter habitat for elk and pronghorn (Figures 7 and 8). The area supports big game year round, which provides foraging opportunities on newborns and scavenging opportunities on afterbirth and carcasses.

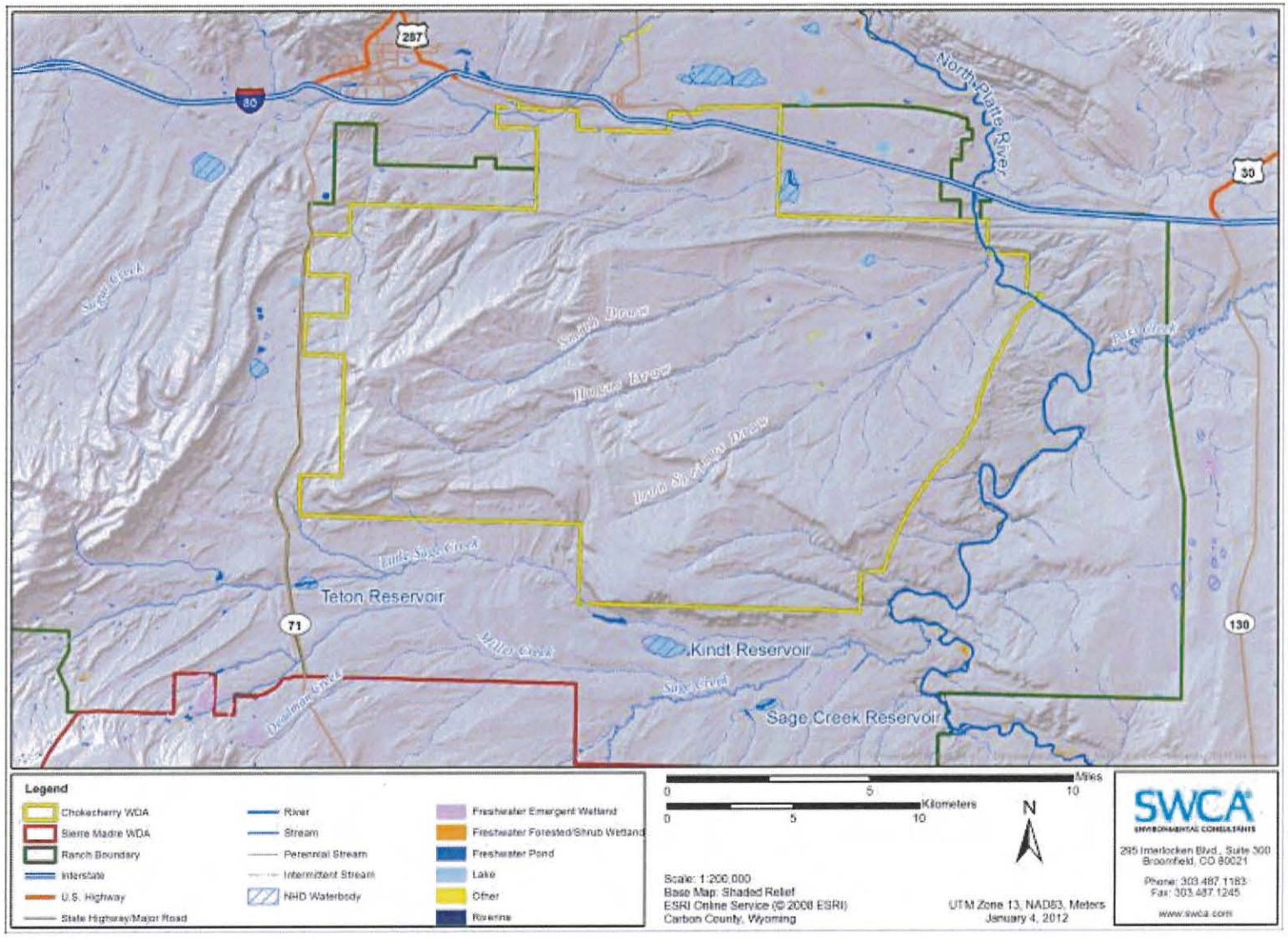

Figure 5. Perennial and ephemeral water bodies and wetland resources in the Chokecherry WDA and vicinity.

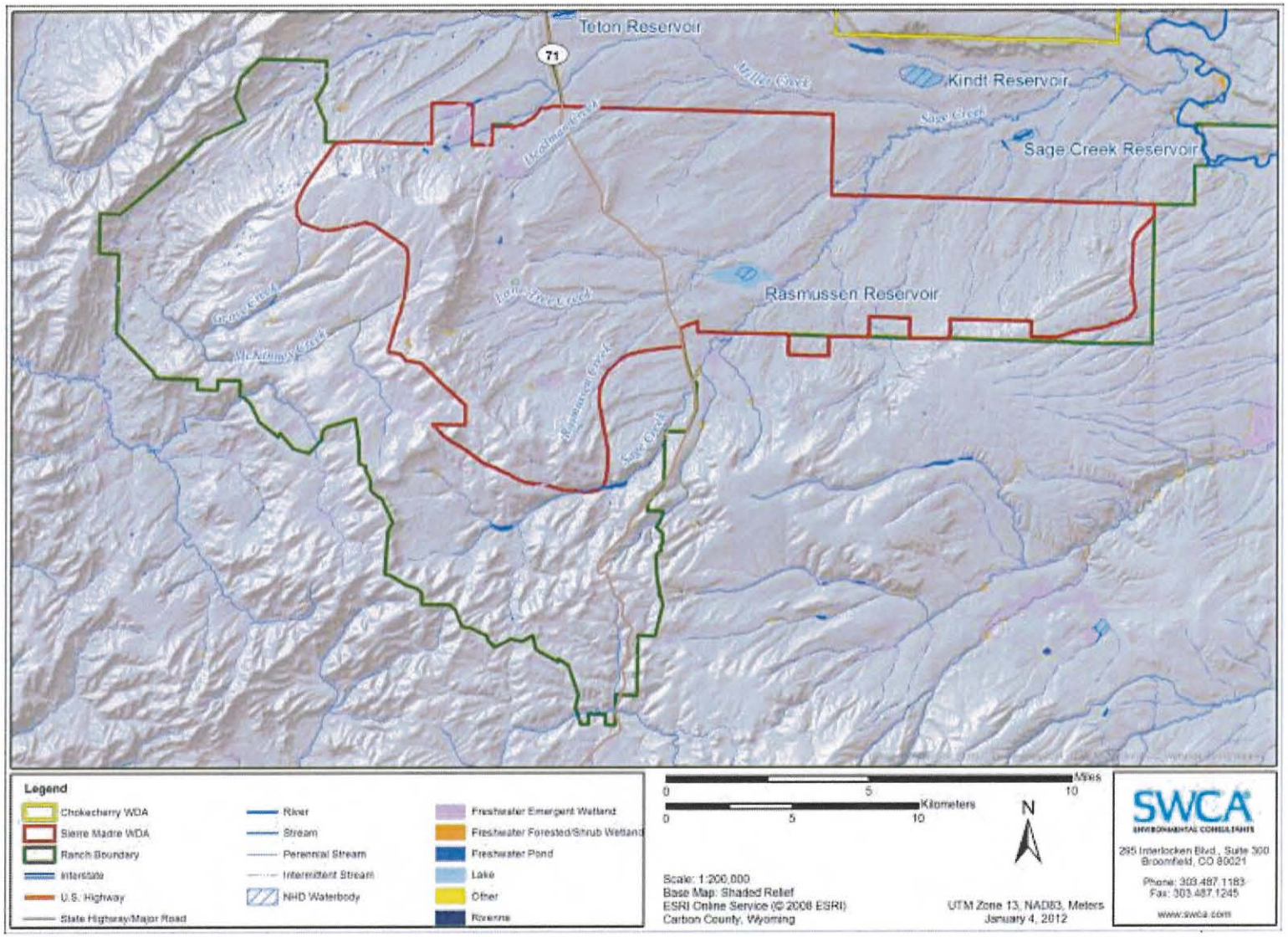

Figure 6. Perennial and ephemeral water bodies and wetland resources in the Sierra Madre WDA and vicinity.

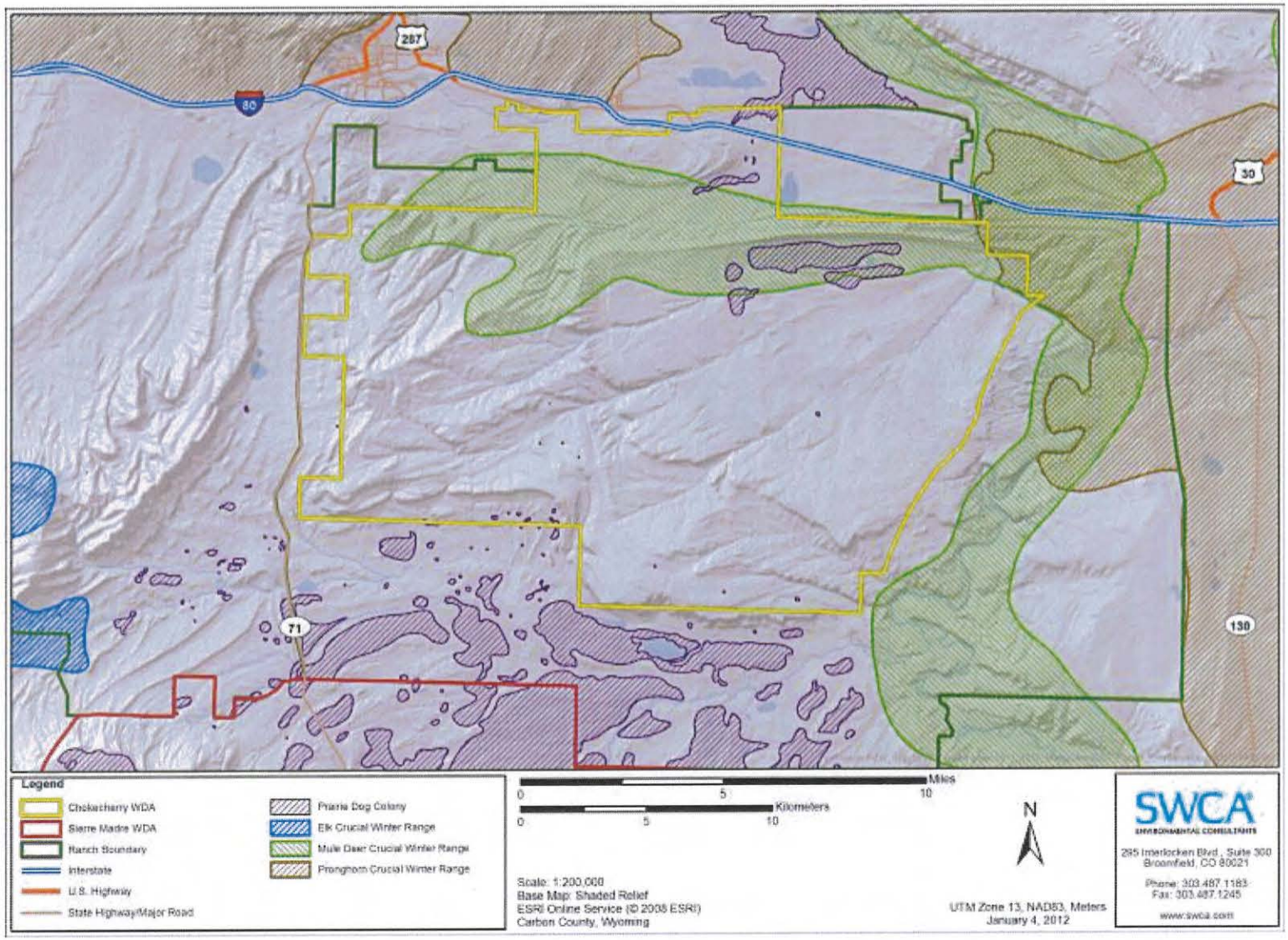

Figure 7. Delineated white-tailed prairie dog colonies and crucial winter ranges for elk, mule deer, and pronghorn occurring in the Chokecherry WDA and adjacent landscape.

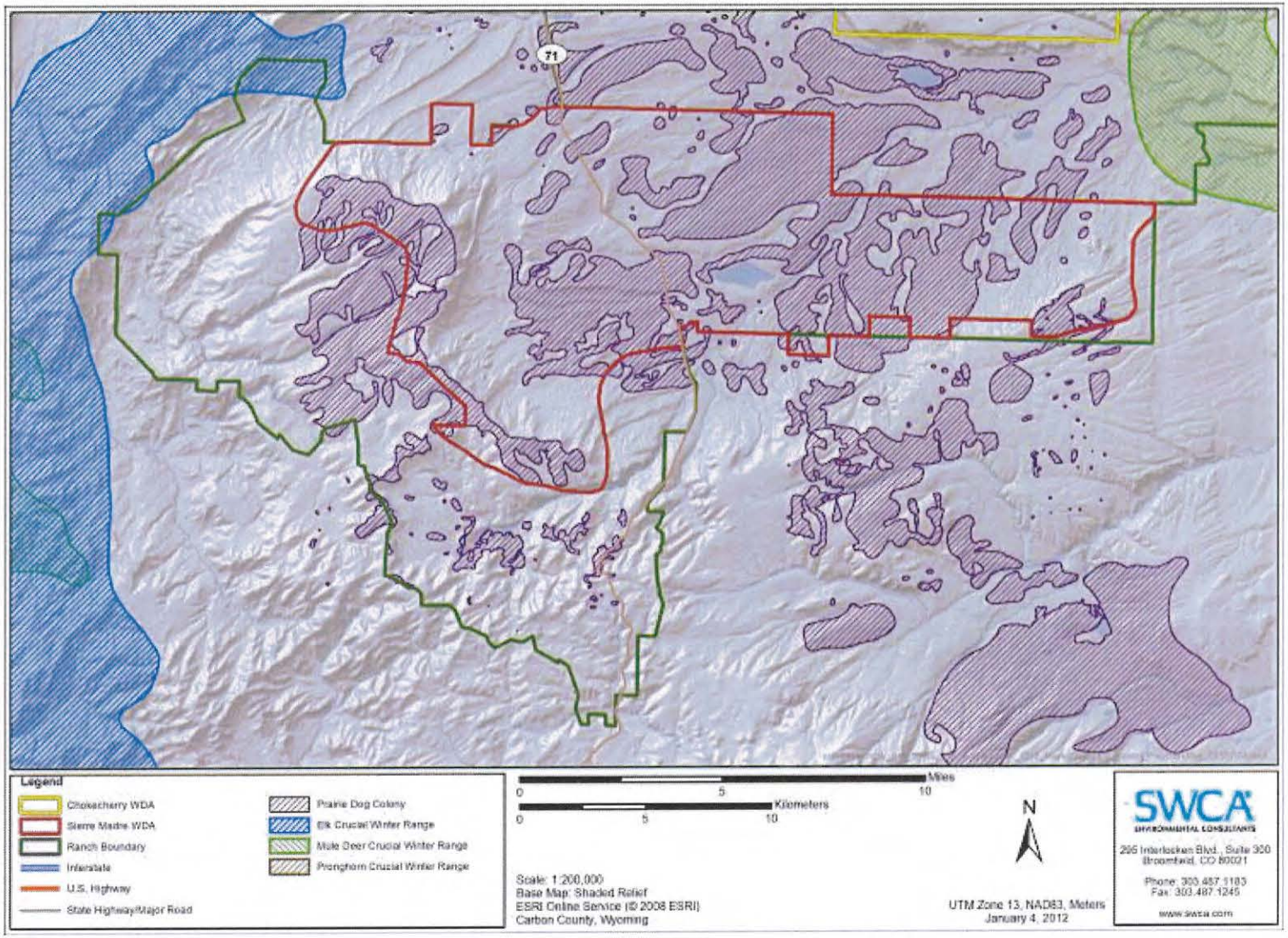

Figure 8. Delineated white-tailed prairie dog colonies and crucial winter ranges for elk, mule deer, and pronghorn occurring in the Sierra Madre WDA and adjacent landscape.

Small game, furbearer species, gamebirds, and waterbirds may provide additional foraging and scavenging opportunities for raptors and eagles. Greater sage-grouse inhabit the Project area and vicinity during all seasons with several active and inactive leks in both the Chokecherry and Sierra Madre WDAs. Highest quality habitat occurs in Wyoming designated core areas outside of the WDAs.

A variety of waterbird species actively use reservoirs and other waterbodies for foraging, breeding, and shelter. Four irrigation reservoirs in the Central Basin provide habitat for migrating and breeding waterfowl and waterbirds with Kindt and Rasmussen reservoirs having the greatest densities and diversity of species (Figures 5 and 6). Inhabited white-tailed prairie dog (*Cynomys leucurus*) communities are scattered throughout the Project area and vicinity, especially in the sagebrush steppe and saltbush scrub across the Central Basin and the mountain sagebrush mosaics atop Miller Hill in the Sierra Madre WDA (Figures 7 and 8).

4.0 SURVEY EFFORTS

Baseline surveys to collect site-specific information on avian, bat, and special status species occurrence were conducted by Western EcoSystems Technology, Inc. (WEST) in 2008 and 2009. After this year one of pre-construction surveys, the Service published a draft version of their Eagle Conservation Plan Guidance on February 18, 2011 (Service 2011b). Upon review of the draft Eagle Conservation Plan Guidance, PCW developed revised survey protocols in coordination with the Service, BLM, and WGFD to address the draft guidance for year two of pre-construction surveys. These final protocols were agreed to by the Service, BLM, and WGFD prior to beginning the second year of pre-construction surveys, which began in 2011. Year two survey protocols were designed to build upon the information gathered during year one surveys and to identify concentrated avian use areas for development of the risk reduction measures and approaches described in this ECS. Collectively, the year one and year two data will be used to characterize site-specific activities of eagles and other avian species, and to develop avoidance, minimization, and mitigation measures that will be used to reduce potential impacts of Project construction and operation. These data fully meet and exceed the recommendations provided by the Service and other coordinating agencies for conducting pre-construction surveys for avian species.

4.1 YEAR ONE SURVEYS

Year one surveys were conducted between June 26, 2008, and June 16, 2009 for the purposes of analyzing project impacts in the BLM's NEPA process. Data collected were analyzed in WEST's report, *Baseline Avian Use Studies for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Summer and Fall Interim Report, June 26-October 14, 2008* (Johnson et al. 2008).

Data collection efforts in 2008 and 2009 included the following.

- Baseline avian use surveys were conducted approximately bi-weekly except during winter when survey efforts were less frequent.
- Aerial surveys were used to locate and map active and inactive raptor nests within 1 mile of the Project area during May 2008.
- An acoustic bat study was conducted at six locations in the Chokecherry and Sierra Madre areas to determine the spatial and temporal variation of bat use.

The data collected by WEST are quantitative and generally reported as percent composition, and as mean number of birds/plot/20-minute survey. These data are suitable for use as an index of abundance with the assumption that the detection probability remained relatively constant among survey periods and point stations but do not provide adequate information to complete site-specific collision risk assessments for eagles.

The fifteen most common species detected during all year one surveys are displayed in Figure 9. Of 2,005 individual bird observations, horned lark (*Eremophila alpestris*) dominated the avifauna composition with 805 observations, representing 40.15% of the total birds recorded during all surveys from 2008 through 2009. Common raven (*Corvus corax*) was the second most prevalent species (175 observations; 8.73%), followed by vesper sparrow (*Pooecetes*

gramineus; 121 observations; 6.03%); however, the number of individuals for these two species shows a dramatic drop from the number of observed horned larks. Golden eagle (69 observations; 3.44%), American kestrel (*Falco sparverius*; 43 observations; 2.14%), northern harrier (*Circus cyaneus*; 42 individuals; 2.09%), and red-tailed hawk (*Buteo jamaicensis*; 27 observations; 1.35%) represent the most common raptor species observed during the survey period, however their numbers are far lower than the three most recorded species.

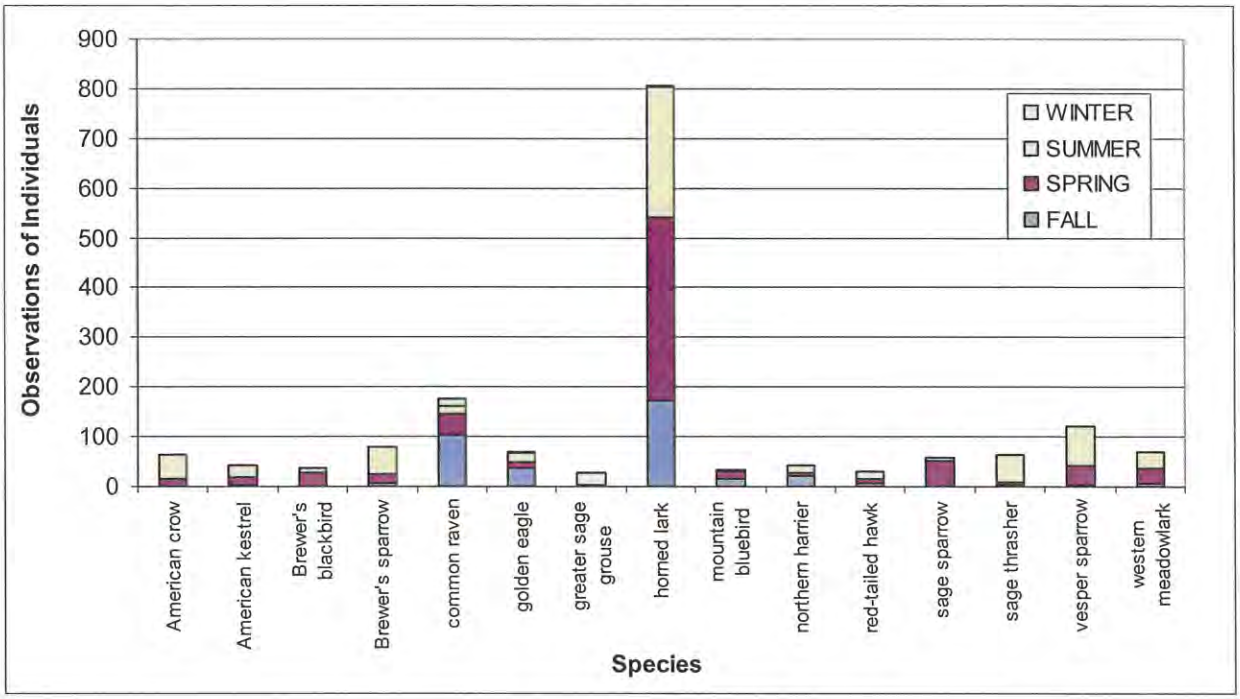

Figure 9. Species commonly detected (90% of total individuals) in the Sierra Madre and Chokecherry Project areas by WEST during all seasons 2008–2009.

Other raptors observed during WEST's 2008 to 2009 surveys include bald eagle (2 observations; 0.10%), Cooper's hawk (*Accipiter cooperii*; 2 observations; 0.10%), ferruginous hawk (*Buteo regalis*; 5 observations; 0.25%), osprey (*Pandion haliaetus*; 1 observation; 0.05%), prairie falcon (*Falco mexicanus*; 6 observations; 0.30%), rough legged-hawk (*Buteo lagopus*; 11 observations; 0.55%), sharp-shinned hawk (*Accipiter striatus*; 2 observations; 0.10%), and Swainson's hawk (*Buteo swainsoni*; 9 observations; 0.45%).

Data collected during 2008 and 2009 comply with Service, WGFD, and BLM wind energy survey recommendations, and serve as one year of suggested pre-construction survey data. Year one data are useful for generally describing use patterns in the Project area for the purposes of developing year two survey protocols. Year one data fulfill the Service's avian survey recommendations for the development of wind energy APPs in Wyoming in that they identify important bird habitats, document raptor and migratory community composition, and identify raptor nest locations.

4.2 YEAR TWO SURVEYS

In coordination with the Service, BLM, and WGFD, PCW developed an intensive avian survey program that meets and exceeds recommendations for wind energy development (BLM 2008b; Service 2010, 2011a, 2011b; WGFD 2010). Year two protocols are consistent with agency recommendations and provide more detailed site-specific use data than the protocols individually recommended by any of the agencies. Year two data also provide the information that will be necessary to calculate site-specific exposure rates and collision risk in the construction stage-specific ECS documents. Analysis of the year two survey data is presented in Section 5 of this document.

Year two data collection included a combination of a DeTect Avian Radar System (radar), long-watch raptor surveys, raptor nest surveys, migratory bird point count surveys, and breeding bird grid surveys. Avian radar technology was identified by the BLM and the Service as a desired method to map areas of high avian use. The sampling design followed recommendations made by the agencies by combining the radar with standard long-watch raptor survey and relevant data from other survey methods. Initial surveys to establish winter eagle use were initiated by SWCA on January 18, 2011, and full-scale avian surveys were conducted from April 4 through November 16, 2011. Monthly winter surveys are being conducted from December 2011 through March 2012. The radar began collecting data in the Project area on March 14, 2011, and will continue to collect data through March 2012.

PCW and the agencies designed the 2011–2012 avian survey protocols to create a rigorous sampling of the WDAs. In total, the radar scanning area and the 15 survey locations included in the avian survey program create coverage over approximately 96% of the probable turbine footprint (Figures 10 and 11), with considerable overlap existing between the radar and avian survey locations. This extensive coverage creates an opportunity to more accurately understand and quantify avian behavior occurring within the Project area, which ultimately will assist PCW in minimizing impacts for all avian species.

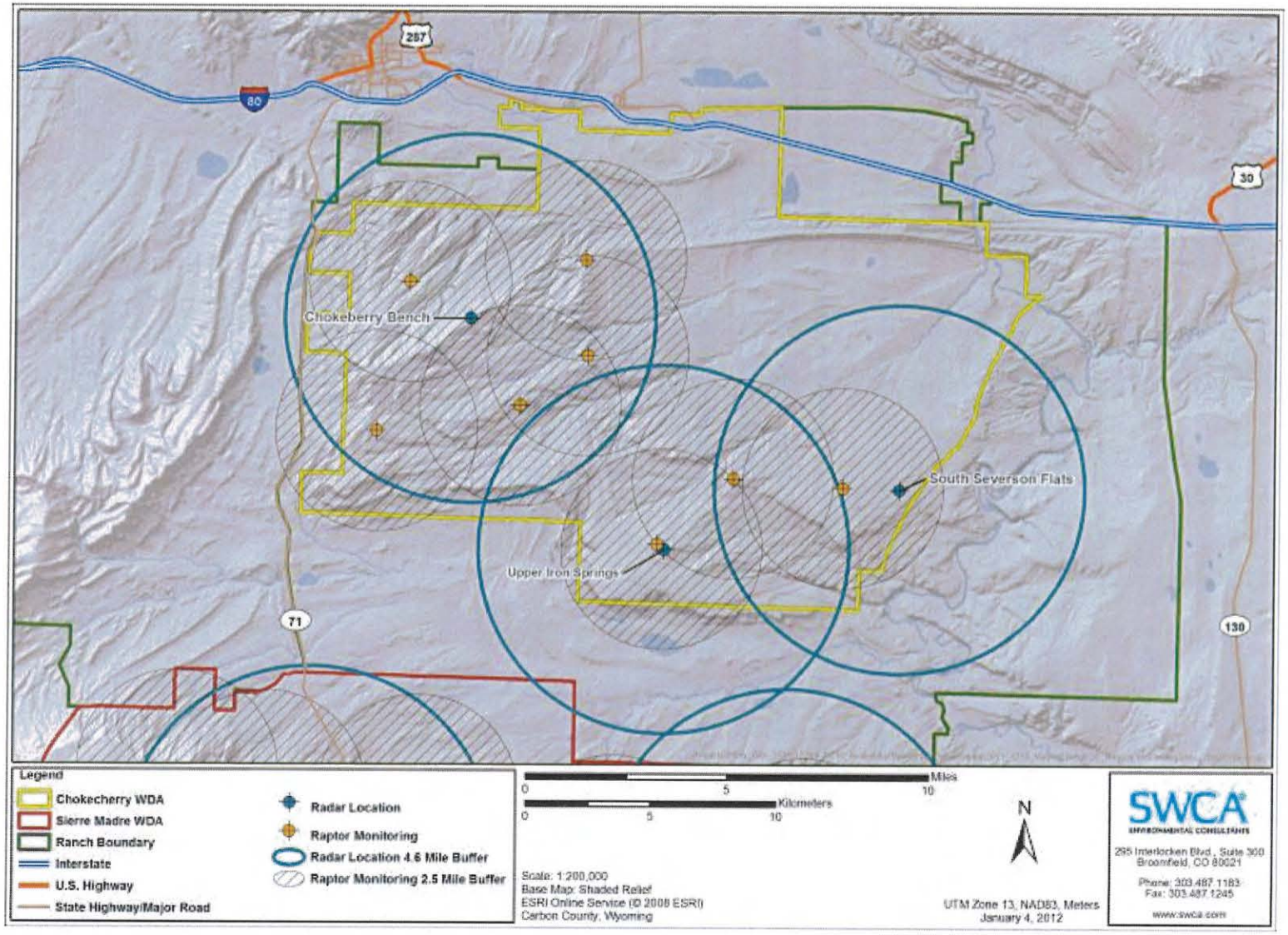

Figure 10. Radar and long-watch raptor survey sites and survey coverage areas in the Chokecherry WDA.

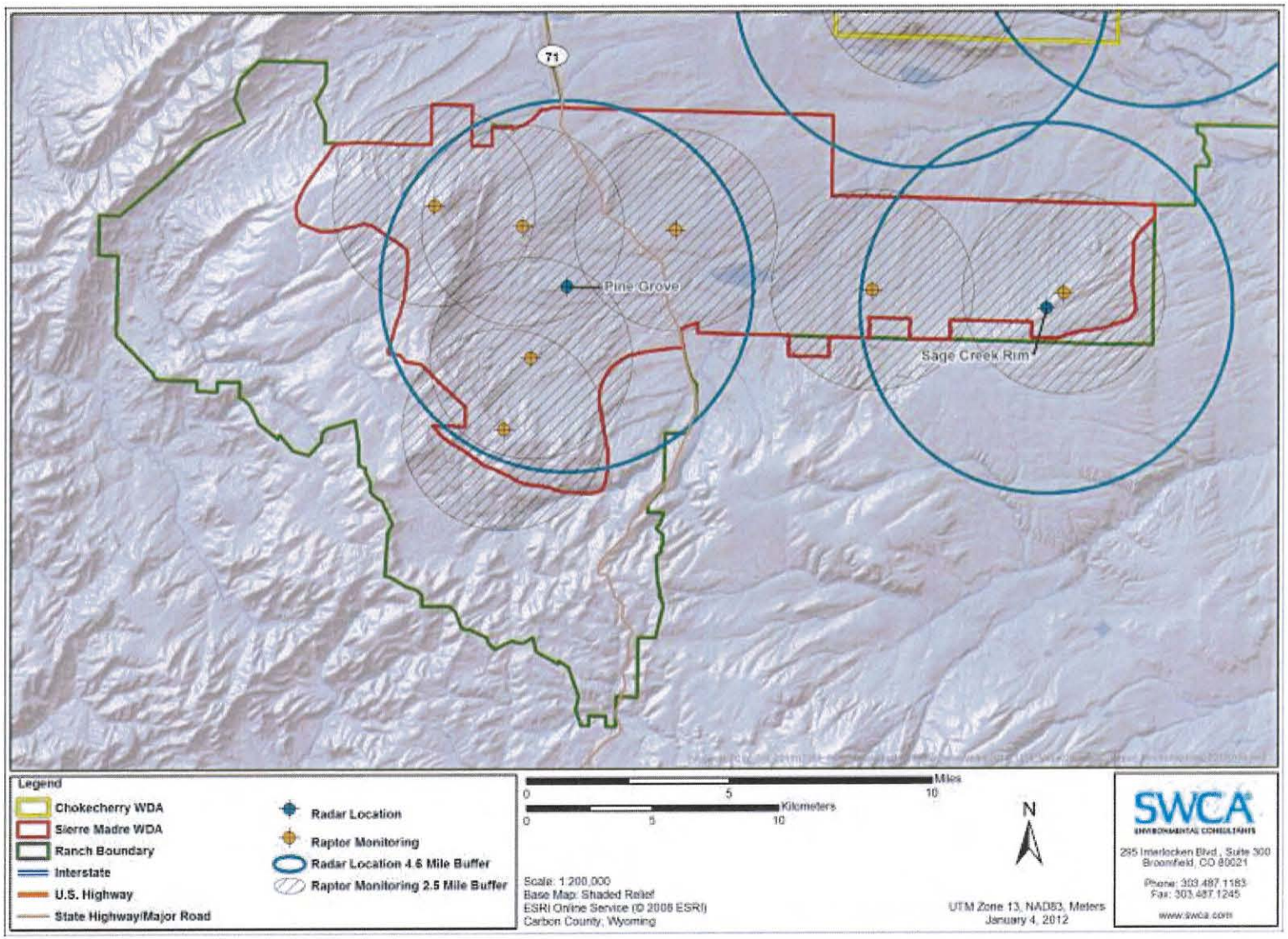

Figure 11. Radar and long-watch raptor survey sites and survey coverage areas in the Sierra Madre WDA.

4.2.1 Avian Radar Protocols

A DeTect Merlin Avian Radar System is being used to map avian use across the Project area. The radar is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10-kilowatt (kW) vertically operating X-band open array radar. The horizontal scanning radar (HSR) has a range of 2.0 miles for passerines and up 4.6 miles for raptors and other large targets in a 360-degree pattern around the unit. The HSR is able to show how targets are using the topography of the Project area by collecting accurate positional data for each target as it moves through the radar scanning area. The vertical scanning radar (VSR) has a 24-degree beam width and detects flight paths to 0.75 mile for passerines and up to 2.00 miles for raptors and other large targets above the unit. The HSR does not collect elevational data for biological targets (targets); however, the elevation of targets may be collected if they pass through the footprint of the VSR. These data are critical for determining the relative percentage of targets passing through the rotor swept zone (RSZ) versus those flying above and below RSZ. The radar runs continuously, collecting data for movements of birds and bats throughout the day and night. The data collected can illustrate the relative numbers of birds and bats passing through the scanning area, as well as the relative size of each target.

Final locations of radar placement were determined following attendance of DeTect's radar training courses and during coordination with DeTect's radar specialists. Service staff attended DeTect radar training with SWCA biologists to better understand the capabilities of the technology and to assist with the siting of the radar in the most appropriate locations (Figures 10 and 11). In each of the WDAs, sites were selected such that the radar would cover the majority of the probable turbine footprint and topographic and habitat features of interest. It was determined that five sites would be sufficient to create maximum coverage of the avian use areas and WDAs.

Placement of the radar at each site was determined based on probable turbine footprint, topographic features of interest, and road access. The radar was microsited at each location to ensure that data were being collected as efficiently and accurately as possible. This entailed placing the radar such that it was able to achieve full scanning potential while reducing the amount of interference received from any rolling terrain surrounding the system.

Of the five radar sites selected for the Project area, three sites were placed in the Chokecherry WDA, and two sites were placed in the Sierra Madre WDA (Figures 10 and 11). The Chokecherry Bench radar location is the westernmost site in the Chokecherry WDA, located approximately 2.9 miles east of Chokecherry Knob. This site was placed along a ridge that runs northeast to southwest with a viewshed into the basins north and south of the ridge. This location enabled the radar to scan down into both basins, as well as to document any potential raptor activity occurring along the ridgeline. The Upper Iron Springs radar location is located in the south-central portion of the Chokecherry WDA. This site was placed on top of the Chokecherry Plateau approximately 1 mile north of the Bolten Rim. This enabled the radar to scan areas on top of the plateau, as well as to document any potential raptor activity occurring along the Bolten Rim and over the Sage Creek Basin. The South Severson Flats radar site is the easternmost site in the Chokecherry WDA. This site was placed on Severson Flats approximately 1.9 miles west of the North Platte River, which enabled the radar to scan the easternmost areas of the probable turbine footprint, as well as document potential raptor

activity occurring over the North Platte River and along the easternmost section of the Bolten Rim.

In the Sierra Madre WDA, the Pine Grove radar site is located in the western portion near the Pine Grove Basin. The site was placed in the basin approximately 2.7 miles east of Miller Hill and 4.0 miles west of Rasmussen Reservoir, which enabled the radar to scan the majority of the basin below Miller Hill, as well as the probable turbine footprint area on top of Miller Hill. The Sage Creek Rim radar site is located in the easternmost section of the Sierra Madre WDA. This site was placed on top of the plateau in the southeast corner of the Project area approximately 0.9 mile north of the First Cottonwood Draw. This enabled the radar to scan the top of the plateau, as well as the basin below the plateau.

Radar validation surveys were completed once a week during the spring, summer, and fall seasons. These surveys involved communication between a biologist at the radar and one in the field with the intent of adding species-specific tags to certain targets being tracked by the radar. Adding species-specific tags to the radar data helps to add resolution to the dataset, and creates more opportunity for creating distinctions between size classes, and possibly species within the radar data.

4.2.2 Long-watch Raptor Survey Protocols

Fifteen avian survey sites were located throughout the Project area to complement the radar data collection efforts as well as to provide survey coverage of the majority of the proposed turbine locations (Figures 10 and 11). Avian survey sites were placed on promenades in the field to ensure proper viewshed of the surrounding terrain and topographic features of interest. Eight avian survey sites were placed in the Chokecherry WDA, and seven avian survey sites were placed in the Sierra Madre WDA. In the Chokecherry WDA, all of the sites are located on top of the plateau as the entirety of the probable turbine footprint occurs on the plateau. In the Sierra Madre WDA, three of the sites are located on Miller Hill and the Cottonwood Draw Plateau, and four of the sites are located in the basins below both of these topographic uplifts, which reflect the spread of the probable turbine layout between the topographic features.

Long-watch raptor surveys were completed bi-weekly at each site per guidance from the Service. Spring and fall surveys were conducted from April 4 through July 1 and August 15 through November 16, 2011, respectively. Summer surveys were conducted from July 10 through August 12, 2011. Winter surveys occur at each site once per month from December 2011 through March 2012. Each raptor survey is conducted for approximately eight hours with varied start and end times to create coverage of morning and evening hours throughout the season. The data collected for each raptor observed during the long-watch surveys include species, number of individuals, elevation, flight behavior, direction of flight, and general demographic data pertaining to each individual raptor. Additionally, the flight path of each raptor observed is mapped on topographic maps in the field.

4.2.3 Migratory Bird Survey Protocols

Migratory bird point count surveys are completed in conjunction with the long-watch raptor surveys, and therefore the number of sites as well as the weekly scheduling is identical to the raptor surveys. At each site, the daily timing of point count surveys varied to determine

patterns of avian use across all daylight hours. All birds detected within a 200-meter (m) radius were recorded during the point count surveys. The data collected during these counts include species, number of individuals, distance from observer, behavior, and general demographic data.

4.2.4 Breeding Bird Survey Protocols

Breeding bird grid surveys were completed at 15 locations across the Project area; these locations were not the same as the 15 raptor and migratory bird locations. Grid surveys were conducted following the survey protocols published by the Rocky Mountain Bird Observatory (RMBO) (Hanni et al. 2010). Grid survey locations were randomly selected using a generalized random tessellation stratified design to ensure spatially balanced sampling stratified within each WDA and across major vegetation and habitat types in the Project area. Grid surveys were conducted within five hours of sunrise and began on June 7 and were completed on June 30, a timeframe which was intended to capture breeding bird activity occurring in the Project area. Grid surveys were completed one time at each of the 15 sites located throughout the Project area. At each of the 15 sites, 16 survey points were established with each point spaced 250 m apart to create a 1-square-kilometer survey grid. Surveys started at sunrise and continued until approximately 10 A.M. with each grid point being surveyed for six minutes. Data collected for these counts are similar to the migratory bird count data; however, vegetation data were also collected for each survey point to assist in the analysis of breeding bird habitats.

4.2.5 Raptor Nest Survey Protocols

Raptor nest surveys occurred from the end of May through the beginning of August 2011. Aerial nest surveys were conducted by helicopter on May 25 and June 10 to document eagle nesting activity as well as nesting activity of other raptors. Aerial nest activity surveys were completed following the protocols developed in coordination with the Service, BLM, and WGFD. In total, approximately 19 hours were spent flying the Project area and an associated 5-mile turbine buffer.

A 5-mile nest survey buffer around the probable turbine footprint was determined in coordination with the Service and other agencies following an evaluation of inter-nest distance for eagle nests within 10 miles of the Project area (Service 2011b). The BLM RFO has compiled locations of eagle and other raptor nests across the RFO since the 1980s. The BLM raptor nest dataset was used for inter-nest distance calculations. Because the BLM's dataset was collected over several decades, many of the nests recorded in the dataset have been inactive for several decades, are part of a known territory with multiple nests, or have been recorded several times in the dataset. To develop more conservative estimates of inter-nest distance, presumed eagle nesting territories were used rather than individual nests recorded in the BLM dataset. Use of nest territories would result in a greater inter-nest distance value and a greater nest survey perimeter than if individual nests were used. Nests that were not part of an obvious territory (i.e., several nests clustered along the same cliff face within 0.5 mile of one another, nests that were separated from one another by a major topographical feature) were considered individual territories for calculation purposes. Use of the nest territory dataset resulted in an average inter-nest distance of 1.62 miles. The average

inter-nest distance was doubled to 3.24 miles to identify the minimum survey buffer surrounding the Project. To ensure that eagle nesting activity in the vicinity of the Project was adequately described and to provide a more conservative survey buffer distance, an additional 50% was added to the 3.24-mile minimum buffer resulting in a 4.86-mile survey buffer which was rounded to 5.00 miles for the final survey protocols.

Location, nesting substrate and condition, species, nesting status, and adult activity were recorded for each observed nest. Inactive nests were categorized into five categories based on relative size and nesting substrate: potential golden eagle nest, potential bald eagle nest, potential ferruginous hawk nest, potential *Buteo* nest, and unknown large species nest. The quality of inactive nests was also assessed and placed into categories of good, fair, poor, or non-functional. Good nests were those that could support nesting activity with minimal rebuild or maintenance. Fair nests were those that would require substantial rebuild or maintenance. Poor nests were those that had evidence of nest structure but would nearly require an entire rebuild of the nest. Non-functional nests were those that had only marginal evidence of past nesting (a few sticks on a ledge), had been destroyed, or had completely fallen from the nest substrate. Ground surveys were conducted during July and August to monitor the status of active nests located during the aerial surveys, and to search areas that were inaccessible during aerial surveys. Ground surveys were also used to locate and establish the activity and condition of all historic ferruginous hawk nests in the Project area. Burrowing owl nest surveys were also completed in several sections in the northern portions of the Chokecherry development area at historic nest locations and near the potential internal haul road, operations facility, and substation locations.

4.2.6 Waterbird Survey Protocols

Waterbird surveys were conducted during spring (April 26–May 4), summer (August 23–24), and fall (October 20–21) at each of the four major reservoirs occurring in the Project area (Kindt, Rasmussen, Sage Creek, and Teton reservoirs) (see Figures 5 and 6). Data collected during the waterbird surveys at each reservoir included species, age, sex, and number of individuals. These surveys are being conducted to evaluate waterbird activity in the Project area as well as to assess the potential eagle and raptor prey base associated with each of the reservoirs.

4.2.7 Prey Base Evaluations

Prey base evaluations are ongoing throughout the Project area. These are being conducted to identify areas containing prey densities sufficient for eagle and large raptor foraging activities. Areas of interest include prairie dog colonies, areas with high rabbit or ground squirrel activity, sage-grouse use areas, waterbird use of reservoirs, and livestock and ungulate calving grounds and winter range.

4.2.8 Survey Coverage

As described above, the Project area is 320,270 acres in size. Of this, the WDAs encompass approximately 156,140 acres. The goal of survey site selection was to create coverage over the majority of the area using the full range of the survey techniques employed, including the

radar and long-watch raptor surveys, while maintaining coverage of important avian use areas identified in the Project area.

The radar has the ability to scan out to 4.6 miles for large targets, such as eagles and *Buteos*. When this survey range is expanded across all five radar sites, while excluding for overlap between sites, 198,346 acres are covered by the radar alone. Approximately 87.3% of the probable turbine development area is covered by the radar when overlap between sites is excluded. Additionally, biologists conducting the long-watch surveys are able to reliably detect and identify large raptors, such as eagles and *Buteos*, out to approximately 2.5 miles. When this survey range is expanded across all 15 sites, while excluding for overlap between sites, 145,352 acres are covered by the long-watch surveys alone. Approximately 93.7% of the probable turbine area is covered by the long-watch surveys when overlap between sites is excluded. When both long-watch and radar survey techniques are combined and overlap between all sites is removed, 223,144 acres and 96.3% of the probable turbine area is covered. This is unprecedented survey coverage for a site of this magnitude, and creates the opportunity for the collection of a high-resolution dataset to determine avian use in the Project area.

5.0 CHARACTERIZATION OF USE

A stepwise process was used to characterize eagle use across the Project area. An initial site assessment of avian and eagle use was qualitatively described based on field observations, nest locations, knowledge of the Project area, and incidental observations recorded during all field efforts. Once the initial site assessment was complete, 20-minute point count data collected by WEST and SWCA's long-watch data were used to evaluate general patterns in eagle and raptor exposure rates in the WDAs. Point count data provided general spatial and seasonal trends in data but were not appropriate to identify site-specific use patterns for the purposes of pre-construction planning and identification of appropriate risk reduction measures. An integrated radar and long-watch survey dataset was used to develop kernel density estimates of flight paths to identify areas with highest eagle use in the Project area.

5.1 QUALITATIVE DISCUSSION OF DATA

Observations of avian use from field survey efforts show that eagles and raptors are most commonly observed surrounding nesting locations, foraging and scavenging areas, and topographic features that provide suitable perching, soaring, and kiting opportunities. These areas include the Bolten Rim over the central basin, the interior Chokecherry Rim, the Sage Creek Rim over the Central Basin, and along the North Platte River (Figure 1). Other areas of high activity include along Highway 130, Interstate 80, and the Sage Creek Road where scavenging opportunities are available. These general observations were instructive during detailed analysis to identify seasonal and spatial trends of use as described in the following sections.

5.1.1 Nest Surveys

5.1.1.1 Year One Nest Data

WEST conducted aerial raptor nest surveys within the Chokecherry and Sierra Madre WDAs (as they were identified in the 2008 Notice of Intent for the Project EIS), as well as a 1-mile buffer around each WDA, for a total of approximately 270 square miles (Johnson et al. 2008). These surveys were conducted by helicopter between May 14 and 30, 2008. Surveys were conducted by flying through suitable nesting habitat consisting of cliff bands, rocky areas, and stands of trees and marking any active or inactive nests that were encountered. WEST also documented any nests located during other survey activities conducted in the Project area.

In total, 24 active raptor nests and 110 inactive nests were located during the 2008 aerial surveys. The active nests included three golden eagle, 11 red-tailed hawk, five prairie falcon, and five great horned owl (*Bubo virginianus*). All of the active nests contained either eggs or nestlings. Of the 24 active raptor nests, 12 were located in the Chokecherry WDA with the majority of the nests located along the Bolten Rim of Chokecherry, and only three nests occurring along the north end of the Chokecherry WDA. Most of the prairie falcon nests and all of the golden eagle nests were located around the Chokecherry WDA and associated buffer; one golden eagle nest was located on the Bolten Rim, while the other two were located on cliff bands on the north end of Chokecherry. The remaining 12 nests were located in the Sierra Madre WDA; eight of the nests were located outside of the Sierra Madre WDA in the buffer zone, two nests were on the border of the WDA, and two nests occurred within the

WDA. The vast majority of the red-tailed hawk nests were located in the Sierra Madre WDA and associated buffer; however, no golden or bald eagle nests were detected there.

In addition to the 24 active raptor nests, seven common raven nests and one Canada goose (*Branta canadensis*) nest were located between the WDAs. Two burrowing owls were also observed during other survey activity in the Chokecherry WDA; however, no corresponding nests were detected in the area.

Of the 110 inactive nests located between the WDAs and associated buffers, 55 were located within the Chokecherry WDA and associated buffer, and 55 were located in the Sierra Madre WDA and associated buffer. The inactive nests were fairly evenly split amongst cliff bands and stands of trees and all of them were recorded as being in good condition. As with the active nests that were located, the majority of the inactive nests located in the Chokecherry WDA were along cliff bands and rock outcrops around the edge of the plateau; and the majority of the inactive nests located in the Sierra Madre WDA and associated buffer were located in the stands of trees in the 1-mile buffer surrounding the WDA.

5.1.1.2 Year Two Nest Data

Between May and August 2011, SWCA conducted raptor nest surveys within the Project area and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. In total, 23 active raptor nests were located within the Project area and associated 5-mile buffer (Figures 12 and 13). Additionally, 158 inactive nests were located and documented during the nest flights and other nest searching activities. All of the inactive nests marked were large in size and were considered potential raptor nests, the majority of which were located along the Bolten Rim and around the perimeter of the Chokecherry plateau.

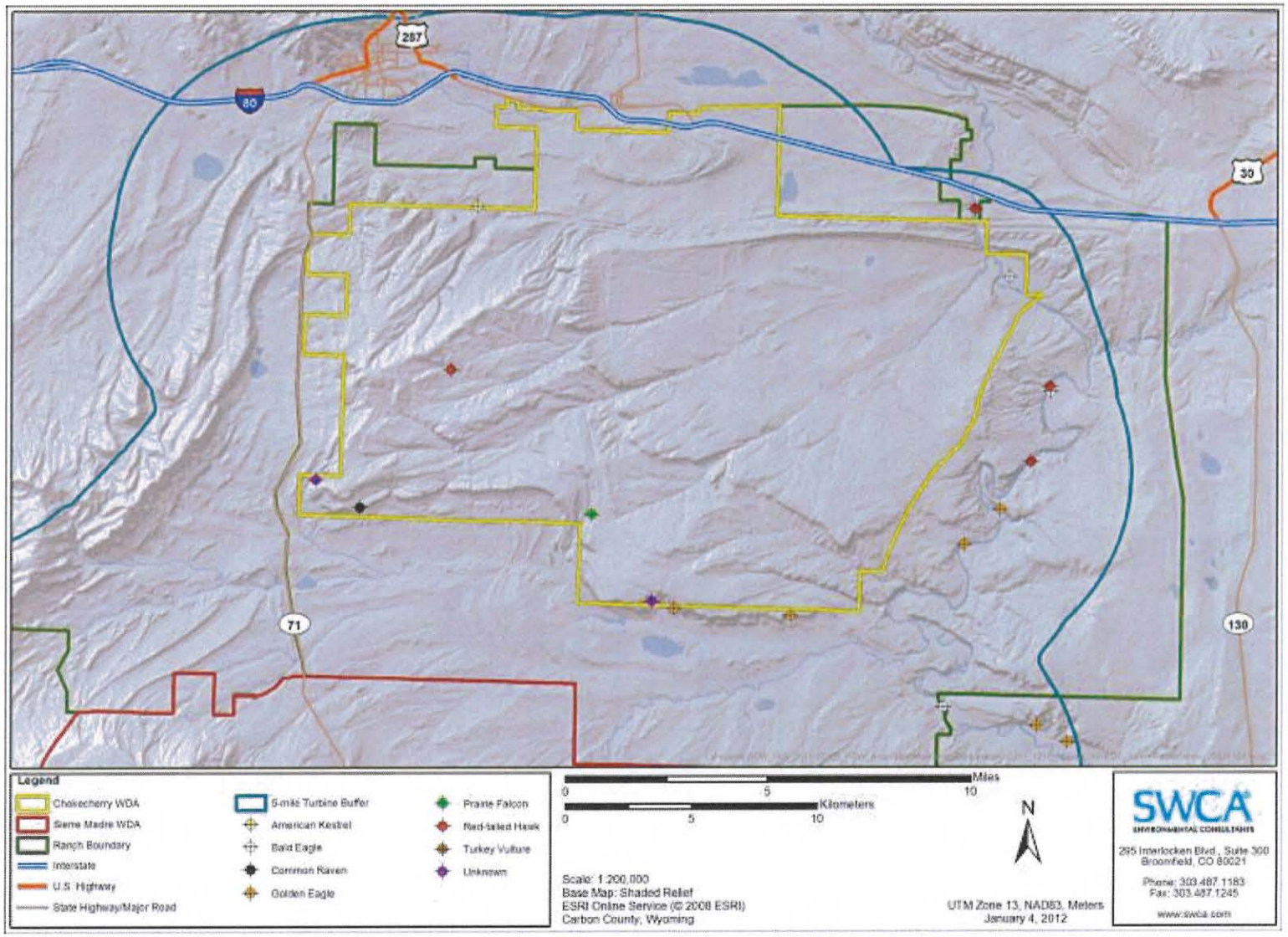

Figure 12. Active nests located in the Chokecherry WDA and associated 5-mile buffer during year two nest survey activities.

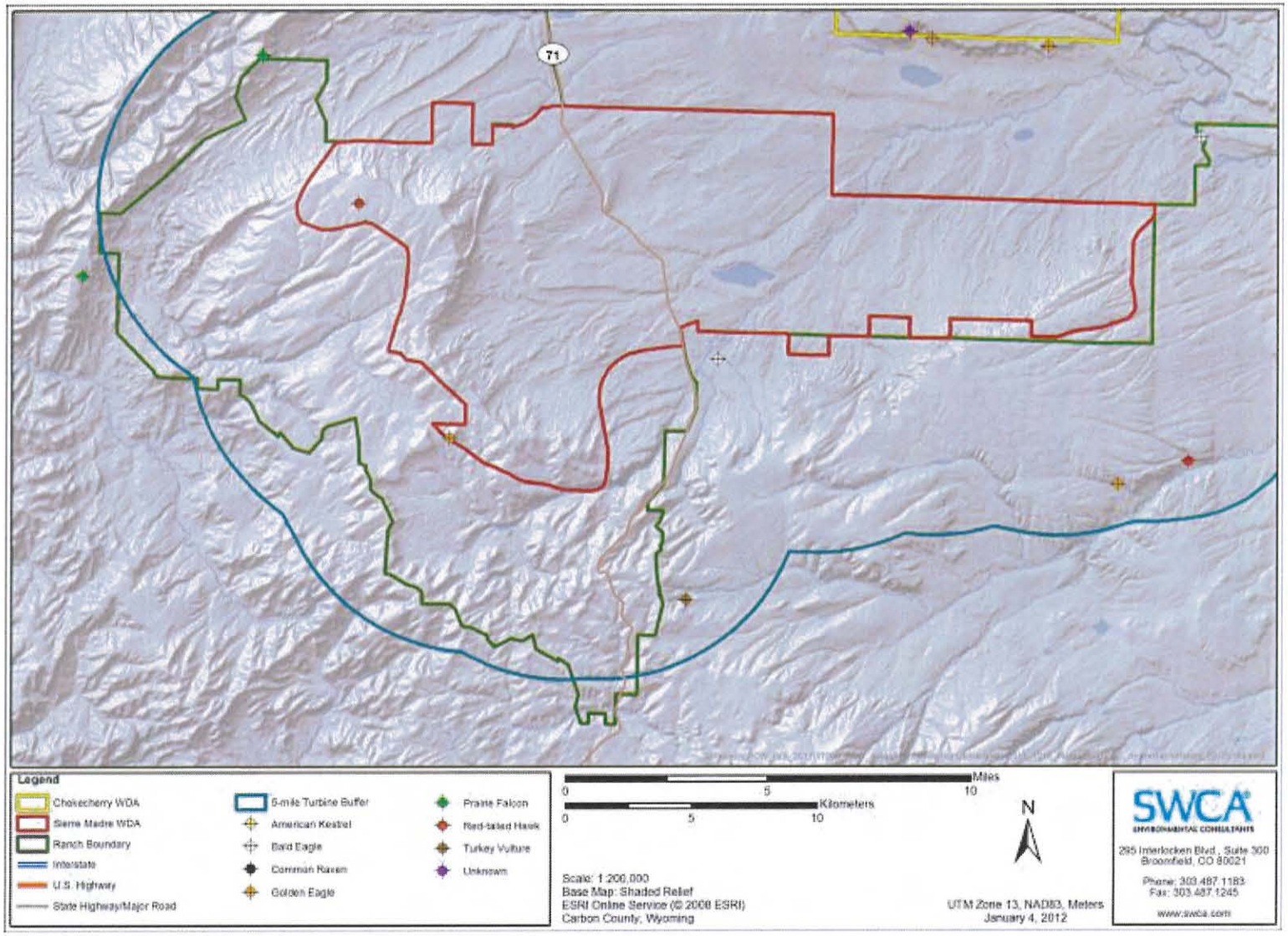

Figure 13. Active nests located in the Sierra Madre WDA and associated 5-mile buffer during year two nest survey activities.

The species composition of the active raptor nests were as follows: eight golden eagle, four bald eagle, six red-tailed hawk, three prairie falcon, one unknown *Buteo* (likely red-tailed hawk), and one American kestrel. Three additional active non-raptor nests were located during the flights and included one turkey vulture (*Cathartes aura*), one common raven, and one unknown large species. The unknown large species nest was a medium-sized stick nest in a crevice of a cliff band, and was likely either a *Buteo* species or a common raven. All active golden eagle and bald eagle nests were located outside of the wind development footprint although three of the eagle nests (two golden eagle and one bald eagle) were located within 1 mile of probable turbine locations. Most active eagle nests were located east and southeast of the Chokecherry portion of the Project along cliff bands on the Bolten Rim and the North Platte River. One active eagle nest was located on the Sierra Madre portion of the Project. The remaining active eagle nests were located south of Middlewood Hill along Jack Creek and in the south Sage Creek Basin. All of the active golden eagle and bald eagle nests were observed to have one to two nestlings present, while the majority of the other active raptor nests appeared to be in the incubation or brooding stages. Multiple follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project area between July 5 and August 2. By August 2, most all of the active nests, including all eagle nests, were confirmed as fledged or inactive. Two red-tailed hawk nests remained active as of August 2, and two falcon nests were unable to be relocated during ground surveys due to the nests being built into cavities and tight crevices along cliff bands.

Forty historic ferruginous hawk nest sites were identified across the Ranch in the BLM nest dataset, and each of these historic sites was visited during 2011 ground surveys. Data collected included presence/absence of a nest at each site; a description of the state of the nest (if a nest was detected); a description of the habitat surrounding the site; photographs of the nest and surrounding habitat; and the presence of other features that could suggest recent ferruginous hawk activity (e.g., feathers, whitewash, fresh nesting materials, etc.). Of the 40 nest sites, 15 nest structures in various stages of condition and quality were located, some with almost no structure remaining. Of these 15 nests located, only two to three appear as though they may have been used recently. Additionally, seven historic sites were observed that may have once supported a nest; however, now only a few deteriorated sticks remain. Few of these nest structures were located at the BLM sites; however, SWCA surveyed at minimum 100 m around each of the BLM sites for nest structures as they were likely marked during aerial surveys, which can lead to some degree of inaccuracy in each location. New coordinates were recorded at each of the located nests for future nest surveys.

During the 2011 aerial surveys, 158 inactive nests were located. There are a number of reasons why the density of inactive nests is relatively high when compared to active nests. One of the primary reasons for this is likely due to land use changes over the past two decades on the Ranch. Until the early 1990s, the Ranch was primarily an extensive sheep rearing operation. As sheep are generally smaller prey and their lambs are a more accessible prey item for eagles, these increased prey densities may have supported more breeding pairs of eagles utilizing the Ranch for nesting and foraging. When the Ranch was transitioned from a sheep to a cattle rearing operation, the decreased prey density opportunities may have led to more competition for the restricted resources, thereby causing fewer pairs of eagles to utilize the Ranch for nesting and foraging. Another consideration regarding the number of inactive

nests is their longevity. Large raptor nests, especially those built on stable and protected cliff bands, have the potential to persist for decades. Of the 158 inactive nests that were located, approximately one-third were classified as fair to poor condition. These nests have a very low likelihood of being rebuilt and used again in the future due to deteriorated structure and support. Breeding pairs also have the potential to build new nests each year even though they may only use the nest once, or they may rotate amongst nests each year. Given the dynamic nature of nest usage and longevity of some nest structures, it is reasonable to conclude that the number of inactive raptor nests in an area is not necessarily predictive of the number of breeding pairs actually supported.

5.2 POINT SURVEY ANALYSIS

To evaluate site-specific eagle use, the Service recommends fixed-radius point counts within a project area with a sampling frequency and duration sufficient to account for variability of eagle use between and within sampling periods (Service 2010, 2011a, 2011b). The recommended approach for estimating eagle exposure rate for a project is based on 30-minute point count surveys of eagles at 800-m radius plots within and adjacent to the project footprint (Service 2011b). All data in the following sections were standardized to make direct comparisons between multiple sampling periods and varied survey protocols.

5.2.1 Year One Data Analysis

WEST conducted 20-minute point surveys between June 26, 2008, and June 16, 2009, to evaluate raptor and eagle use patterns in the Project area. WEST calculated mean use, as represented by the number of observed targets per plot per survey (number of observations/plot/20-minute survey) to be 0.51 raptor/plot/20-minute survey overall (419 total surveys; Table 3). Total eagle use (golden eagle, bald eagle, and unknown eagle) in the Project area was 0.17 eagle/plot/20-minute survey. Seasonal raptor use was 0.80 raptor/plot/20-minute survey in summer, 0.62 raptor/plot/20-minute survey in fall, 0.10 raptor/plot/20-minute survey in winter, and 0.33 raptor/plot/20-minute survey in spring. Seasonal eagle use was 0.18 eagle/plot/20-minute survey in summer, 0.25 eagle/plot/20-minute survey in fall, 0.07 eagle/plot/20-minute survey in winter, and 0.11 eagle/plot/20-minute survey in spring. These data suggest that raptor use in the Project area is greatest in the summer (0.80 raptor/plot/20-minute survey) and largely declines by winter (0.10 raptor/plot/20-minute survey). Eagle use in fall (0.25 eagle/plot/20-minute survey) is higher than any other season, suggesting that the number of eagles may increase in the Project area during the fall migration period.

Table 3. Summary of Observations from Year One Seasonal Raptor Use Surveys in the Original Chokecherry and Sierra Madre Wind Resource Areas (20-minute surveys in 800-m radius plots).

June 26, 2008–June 16, 2009 (800-m radius)				
Season	**Type**	**Surveys**	**Observations**	**Mean Use (per 20-minute survey)**
Summer	Raptors	80	64	0.80
	Eagles	80	14	0.18
Fall	Raptors	159	98	0.62
	Eagles	159	39	0.25
Winter	Raptors	29	3	0.10
	Eagles	29	2	0.07
Spring	Raptors	151	50	0.33
	Eagles	151	16	0.11
Total	**Raptors**	**419**	**215**	**0.51**
	Eagles	**419**	**71**	**0.17**

Year one data were not adequate to make comparisons among the WDAs. Because of changes in the boundaries and locations of the WDAs, many of the year one survey locations for the Sierra Madre WDA fall outside of the current Project areas. The boundaries and locations of the Sierra Madre WDA has been substantially changed to address sensitive wildlife resources, including greater sage-grouse. Nonetheless, a comparison of the data collected during year one surveys is presented in Table 4 although the data collected are not representative of the expected risk in the revised WDA boundary.

Table 4. Summary of Observations from Year One Raptor Use Surveys in the Original Chokecherry and Sierra Madre Wind Resource Areas (20-minute surveys in 800-m radius plots).

June 26, 2008–June 16, 2009 (800-m radius)				
WDA	**Type**	**Surveys**	**Observations**	**Mean use (per 20-min survey)**
Chokecherry	Raptors	280	132	0.47
	Eagles	280	37	0.13
Sierra Madre	Raptors	139	83	0.60
	Eagles	139	34	0.25
Total	**Raptors**	**419**	**215**	**0.51**
	Eagles	**419**	**71**	**0.17**

5.2.2 Year Two Data Analysis

SWCA conducted bi-weekly long-watch raptor surveys at 15 sites between April 4 and November 16, 2011, to evaluate raptor and eagle use patterns in the Project area. Long-watch raptor surveys were conducted at 4,000-m radius plots strategically distributed across the two WDAs. Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage while maintaining observer confidence in species identification. These data do not include winter surveys, which are currently being conducted for the 2011–2012 season.

SWCA calculated mean raptor use, as represented by the number of observed raptors per plot per survey (raptors/plot/long-watch survey) to be 3.46 overall (263 total surveys; Table 5). Total eagle use (golden eagle, bald eagle, and unknown eagle) in the Project area was 1.10 eagles/plot/long-watch survey. Seasonal raptor use was 2.04 raptors/plot/long-watch survey in summer, 3.02 raptors/plot/long-watch survey in fall, and 4.53 raptors/plot/long-watch survey in spring. Seasonal eagle use was 0.45 in summer, 1.29 in fall, and 1.20 in spring. These data suggest that raptor use in the Project area is greatest during the spring and fall migration periods and declines considerably during the summer months. Eagles use follows a similar pattern, with higher use during spring and fall migration and lower use during the summer months.

Table 5. Summary of Observations from Year Two Seasonal Raptor Use Surveys in the Project Area (Long-watch surveys in 4,000-m radius plots).

April 4–November 16, 2011 (4,000–m radius)				
Season	**Type**	**Surveys**	**Observations**	**Mean Use (per long-watch survey)**
Summer	Raptors	47	96	2.04
	Eagles	47	21	0.45
Fall	Raptors	109	329	3.02
	Eagles	109	141	1.29
Winter	Raptors	NA	NA	NA
	Eagles	NA	NA	NA
Spring	Raptors	107	485	4.53
	Eagles	107	128	1.20
Total	**Raptors**	**263**	**910**	**3.46**
	Eagles	**263**	**290**	**1.10**

Raptor use is greater in the Sierra Madre WDA (4.29 raptors/plot/long-watch survey; Table 6) as compared to the Chokecherry WDA (2.77 raptors/plot/long-watch survey), while eagle use in the two WDAs is comparable (1.19 eagles/plot/long-watch survey and 1.03 eagles/plot/long-watch survey, respectively). These data suggest that raptors were observed more frequently in the Sierra Madre WDA as compared to observations made in the Chokecherry WDA. Differences in the relative abundance of raptors in the WDAs may be a result of varying topography and available water and prey resources.

Table 6. Summary of Observations from Year Two Raptor Use Surveys in the Project Area (Long-watch surveys in 4,000-m radius plots).

April 4–November 16, 2011 (4,000-m radius)				
WDA	**Type**	**Surveys**	**Observations**	**Mean use (per daylong survey)**
Chokecherry	Raptors	144	399	2.77
	Eagles	144	149	1.03
Sierra Madre	Raptors	119	511	4.29
	Eagles	119	141	1.19
Total	**Raptors**	**263**	**910**	**3.46**
	Eagles	**263**	**290**	**1.10**

To enable comparison of year one and year two survey datasets, year two data were truncated to observations within 800 m and data from 20-minute survey periods were randomly selected from each daylong survey. Year two raptor use (0.13 raptor/plot/20-minute survey; Table 7) and eagle use (0.018 eagle/plot/20-minute survey) in 2011 were much lower in the Project area when compared to year one data (Table 3). Seasonally, raptors and eagles were more

abundant in spring (0.20 raptor/plot/20-minute survey and 0.033 eagle/plot/20-minute survey) than for any other season, suggesting that raptor and eagle use in the Project area was greater during the spring migration period than for other seasons.

Table 7. Summary of Observations from Year Two Seasonal Raptor Use Surveys in the Project Area (20-minute surveys in 800-m radius plots).

April 4–November 16, 2011 (800-m radius)				
Season	**Type**	**Surveys**	**Observations**	**Mean Use (per 20-minute survey)**
Summer	Raptors	80	12	0.1500
	Eagles	80	1	0.0130
Fall	Raptors	159	7	0.0440
	Eagles	159	1	0.0063
Winter	Raptors	NA	NA	NA
	Eagles	NA	NA	NA
Spring	Raptors	151	30	0.2000
	Eagles	151	5	0.0330
Total	**Raptors**	**390**	**49**	**0.1300**
	Eagles	**390**	**7**	**0.0180**

Although year two raptor and eagle use in each WDA was substantially lower when compared to year one data, raptor and eagle use in the Sierra Madre WDA was higher than that observed in the Chokecherry WDA (Table 8). These data further suggest that raptors and eagles are more frequently observed in the Sierra Madre WDA as compared to the Chokecherry WDA.

Table 8. Summary of Observations from Raptor Use Surveys in the Chokecherry and Sierra Madre Wind Resource Areas by SWCA (20-minute surveys in 800-m radius plots).

April 4–November 16, 2011 (800-m radius)				
WDA	**Type**	**Surveys**	**Observations**	**Mean use (per 20-min survey)**
Chokecherry	Raptors	194	14	0.07
	Eagles	194	2	0.01
Sierra Madre	Raptors	196	35	0.18
	Eagles	196	5	0.03
Total	**Raptors**	**390**	**49**	**0.13**
	Eagles	**390**	**7**	**0.02**

5.2.3 Raptor and Eagle Use in the Project Area

Data from both year one and year two survey efforts were standardized to make direct comparisons between each survey protocol. Mean use was calculated as the observation/plot/minute to determine the number of raptors and/or eagles observed during each survey effort. Year one surveys in 2008 and 2009 resulted in considerably higher estimates of mean raptor and eagle use throughout the Project area as compared to year two survey efforts (Tables 9 and 10). Seasonal mean use patterns were consistently greater in WEST data when compared with SWCA data. According to WEST data, raptor use was highest during summer (0.040 raptor/plot/minute) while eagle use was highest during fall migration (0.012 eagle/plot/minute). Conversely, SWCA data indicate that raptor use was highest during spring migration (0.010 raptor/plot/minute) while eagle use increased during spring and fall migration periods (0.0027 eagle/plot/minute and 0.0028 eagle/plot/minute, respectively) as compared to summer eagle use (0.0018 eagle/plot/minute).

Table 9. Summary of Observations from All Studies of Seasonal Raptor Use Surveys in the Project Area (Mean Use = observations/plot/minute).

Season	Type	WEST (800 m)		SWCA (800 m)		SWCA (4000 m)	
		Total Survey Minutes	Mean Use (per minute)	Total Survey Minutes	Mean Use (per minute)	Total Survey Minutes	Mean Use (per minute)
Summer	Raptors	1,600	0.0400	1,600	0.0075	11,400	0.0084
	Eagles	1,600	0.0088	1,600	0.0006	11,400	0.0018
Fall	Raptors	3,180	0.0310	3,180	0.0022	49,980	0.0066
	Eagles	3,180	0.0120	3,180	0.0003	49,980	0.0028
Winter	Raptors	580	0.0052	NA	NA	NA	NA
	Eagles	580	0.0034	NA	NA	NA	NA
Spring	Raptors	3,020	0.0170	3,020	0.0099	48,220	0.0100
	Eagles	3,020	0.0053	3,020	0.0017	48,220	0.0027
Total	**Raptors**	**8,380**	**0.0260**	**7,800**	**0.0063**	**109,600**	**0.0083**
	Eagles	**8,380**	**0.0085**	**7,800**	**0.0009**	**109,600**	**0.0026**

Table 10. Summary of Observations from Year One and Year Two Raptor and Eagle Survey Efforts in the Project Area (Mean Use = observation/plot/minute).

Season	Type	WEST (800 m)		SWCA (800 m)		SWCA (4000 m)	
		Total Survey Minutes	Mean Use (per minute)	Total Survey Minutes	Mean Use (per minute)	Total Survey Minutes	Mean Use (per minute)
Chokecherry	Raptors	5,600	0.0240	3,880	0.0036	58,360	0.0068
	Eagles	5,600	0.0066	3,880	0.0005	58,360	0.0026
Sierra Madre	Raptors	2,780	0.0300	3,920	0.0089	51,240	0.0100
	Eagles	2,780	0.0120	3,920	0.0013	51,240	0.0028
Total	**Raptors**	**8,380**	**0.0260**	**7,800**	**0.0063**	**109,600**	**0.0083**
	Eagles	**8,380**	**0.0085**	**7,800**	**0.0009**	**109,600**	**0.0026**

Spatial mean use patterns were considerably higher in WEST (year one) data as compared to SWCA (year two) data (Table 10). WEST data indicate that eagle use was greater in the Sierra Madre WDA (0.012 eagle/plot/minute) as compared to the Chokecherry WDA (0.0066 eagle/plot/minute), while raptor use was comparable between the two WDAs (Table 10). Conversely, SWCA data indicate that eagle use did not differ between the Sierra Madre and Chokecherry WDAs (0.0028 eagle/plot/minute and 0.0026 eagle/plot/minute); however, raptors overall were observed more frequently at Sierra Madre WDA survey locations (0.010 raptor/plot/minute) as compared to raptors observed in the Chokecherry WDA (0.0068 raptor/plot/minute). Some of the differences between the Sierra Madre and Chokecherry areas in the WEST dataset might be caused by survey data from plots outside of the current WDAs being used in analysis of potential project impacts.

Overall, the WEST survey effort from 2008 through 2009 and the SWCA 2011 survey effort suggest similar patterns of raptor and eagle use throughout the Project area. However, both survey efforts are markedly different in the number of observations per survey minute (mean use) and the observed temporal and spatial patterns. The SWCA data may provide a more realistic estimation of raptor and eagle use throughout the Project area based on total areal cover of the Project area, total survey minutes, and even distribution of survey periods.

The Service recommends 30-minute point surveys of eagles at 800-m radius plots within and adjacent to the Project footprint for estimating eagle exposure rates (Service 2011). Use of large-plot, long-duration point counts appears to be standard in pre- and post-construction assessment of use of wind energy projects by large species of birds (Hoover and Morrison 1996, Johnson et al. 2000, Smallwood et al. 2009) and 20 to 30 point count plots would represent the maximum number of plots practicable at the recommended frequency for a large capacity (greater than 100 megawatts) wind development (Service 2011). During the WEST survey effort in 2008 and 2009, 16 800-m plots were surveyed with an approximate areal coverage of 7,952 acres, which represents approximately 5% of the Project area. For the second year of survey, PCW developed protocols to provide a more rigorous assessment of avian use within the Project area to meet the objectives of the Eagle Conservation Plan

Guidance (Service 2011b). During the SWCA survey effort in 2011, 15 4,000-m plots were surveyed with an approximate areal coverage of 145,349 acres (excluding overlapping survey areas) resulting in survey coverage over 93% of the Project area. The modified protocol that PCW initiated in 2011 provides a considerably larger areal cover of the Project area, thus representing a more complete and realistic survey of eagle and raptor use.

During the WEST survey effort, 419 20-minute surveys at 16 locations were conducted between June 26, 2008, and June 16, 2009, that resulted in 8,380 survey minutes (Tables 9 and 10). As a result of implementing PCW's protocols, SWCA completed 263 long-watch surveys at 15 locations between April 4 and November 16, 2011, which resulted in 109,600 survey minutes. The likelihood of accurately evaluating spatial and temporal use is increased considerably by increasing the on-the-ground survey time and the areal extent of the survey effort.

In addition, long-watch surveys fundamentally result in a more evenly distributed daily survey period throughout the entire survey year. During the WEST surveys, approximately 70% of the surveys were conducted during time periods of high eagle use (i.e., between 1000 and 1600 hours) (Figure 14). During SWCA's daylong long-watch surveys, approximately 77% of all eagle observations were recorded between 1000 and 1600 hours (Figure 14). WEST estimates of raptor and eagle use are most likely skewed due to the uneven distribution of surveys during diurnal time periods of highest raptor and eagle use. As a result, WEST data are most likely overestimating raptor and eagle use throughout the Project area by having the majority of survey times (70%) starting between 1000 and 1600 hours when 77% of eagle activity occurs. The 20-minute survey protocol estimates overall raptor use at 0.026 raptor/plot/minute and overall eagle use at 0.0085 eagle/plot/minute, while long-watch survey protocol estimates overall raptor use at 0.0083 raptor/plot/minute and overall eagle use at 0.0026 eagle/plot/minute. Long-watch surveys generally capture use throughout the entire day and provide a more powerful temporal and spatial estimation of raptor and eagle use.

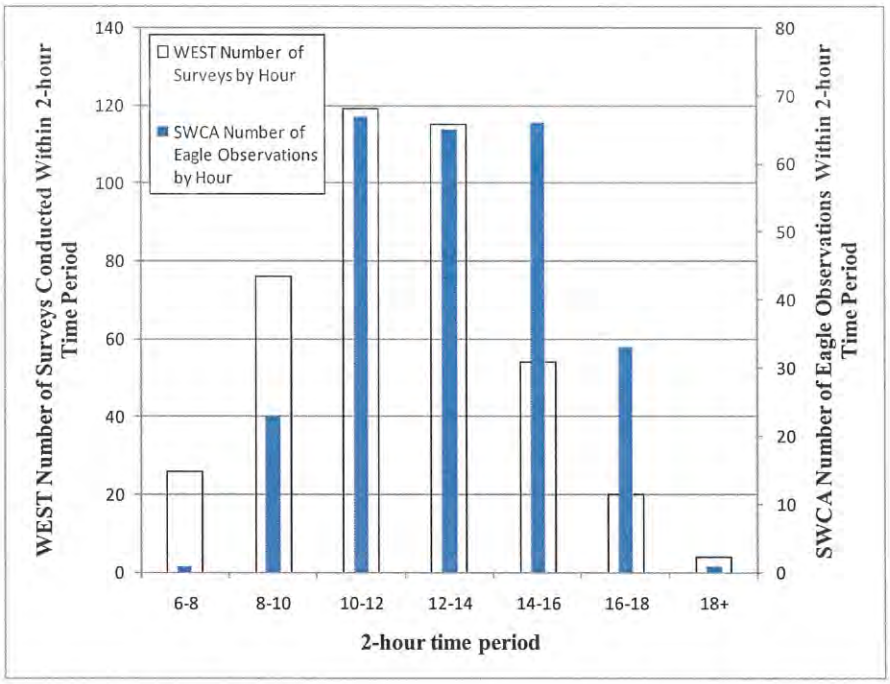

Figure 14. Hourly distribution of 20-minute surveys conducted by WEST and hourly distribution of eagle observations made by SWCA.

5.3 KERNEL DENSITY APPROACH

As described above, data from 20-minute point surveys and long-watch raptor surveys are informative to describe general patterns of spatial and seasonal use. However, the traditional analysis and interpretation of these datasets does not allow for identification of the highest use areas or of patterns of use across the landscape. Identification of high use areas, patterns of use, and seasonal use is important to prioritize the location and timing for implementing risk reduction measures and for identifying priority areas for final project siting.

To identify spatial and seasonal patterns of use and high use areas, long-watch survey data and radar survey data were integrated. Using long-watch survey flight paths and radar validation datasets, a kernel density analysis was completed to identify areas with the highest probability for eagle use. As stated earlier in this document, approximately 96% of the probable turbine construction area has been covered by long-watch or radar datasets. This survey coverage enables a detailed assessment of patterns of spatial and seasonal use across the entire Project area. Winter survey results are not yet available and will be integrated into this ECS once they have been collected and analyzed.

Flight paths from long-watch raptor surveys were integrated with radar data and used in a line/kernel density analysis for the 96% of the probable turbine area that was surveyed. A series of analyses was used to identify eagle use areas from radar data. As the radar does not identify targets to species, substantial analysis and post-processing are required to identify targets having the highest probability of being an eagle or other large raptor.

Each day, PCW's radar system records hundreds of thousands of potential targets and exports these data to a daily Microsoft Access database; the system also stores all records in an on-board SQL database. Each target that is observed is assigned a unique Track ID variable that identifies that target from the first time it is observed by the radar to the last time it is observed. In addition to Track ID, approximately 60 other variables, many of which correspond to the size, shape, and speed of each target, are recorded to the database. The radar makes a full sweep approximately every two seconds meaning that a target that is tracked for 20 seconds has 10 observations per Track ID and hundreds of variables corresponding to its size, shape, speed, etc. The targets recorded into the database can also be displayed into a trackplot image, which is an essential visual layout of target movement across the landscape color coded by directional heading (Figure 15).

During radar validation surveys, as described in Section 4 of this document, trained radar operators and avian observers work together to "tag" Track IDs that are related to an observed species. Over the course of spring, summer, and fall surveys, hundreds of validated targets corresponding to corvids, raptors, eagles, and pelicans/waterfowl were "tagged" in the radar database. These tagged records were used in a discriminant function analysis (DFA) to identify radar targets with the highest probability of being an eagle. The DFA used in this section is one method of discriminating among targets. As additional radar validation data are collected, other methods including classification and regression tree (CART) models will be compared to the DFA method to ensure that final results are as representative as possible.

To complete the DFA, the dataset was split into short-pulse and medium-pulse subsets. Because of the way the radar signals are generated and processed, the properties of variables recorded in the short-pulse zone (approximately 0.75 to 1.00 nautical mile from the radar site) can be different than those in the medium-pulse zone (those targets that fall outside of the short-pulse zone). Separate DFA analyses were completed for the short- and medium-pulse zones.

Initial DFA runs for medium-pulse targets misclassified many targets as American white pelicans. Based on field observations it is known that this species only uses the areas over and between Teton, Kindt, and Sage Creek reservoirs. This area is outside of the turbine development footprint and it was determined that pelican targets could be removed from the DFA to enable better identification of other species. After pelicans were removed from the dataset, the DFA model was able to differentiate eagles from other targets with an accuracy rate of 72%. Among the other targets, the DFA could not differentiate among species. However, for the purposes of developing the ECS, it was determined that additional differentiation among species in the medium-pulse zone was not necessary.

The medium-pulse DFA used a linear, common covariance model with stepwise variable selection. Overall, the DFA resulted in 69 of 102 of eagle targets being predicted correctly (32% misclassification). This is compared to 85 of 112 other targets being correctly identified as "other" (24.2% misclassification). Significant variables in the model were target elongation, compactness, mean chord x, mean chord y, and average target reflectivity. Descriptions for all variables collected by the radar are provided in Appendix A.

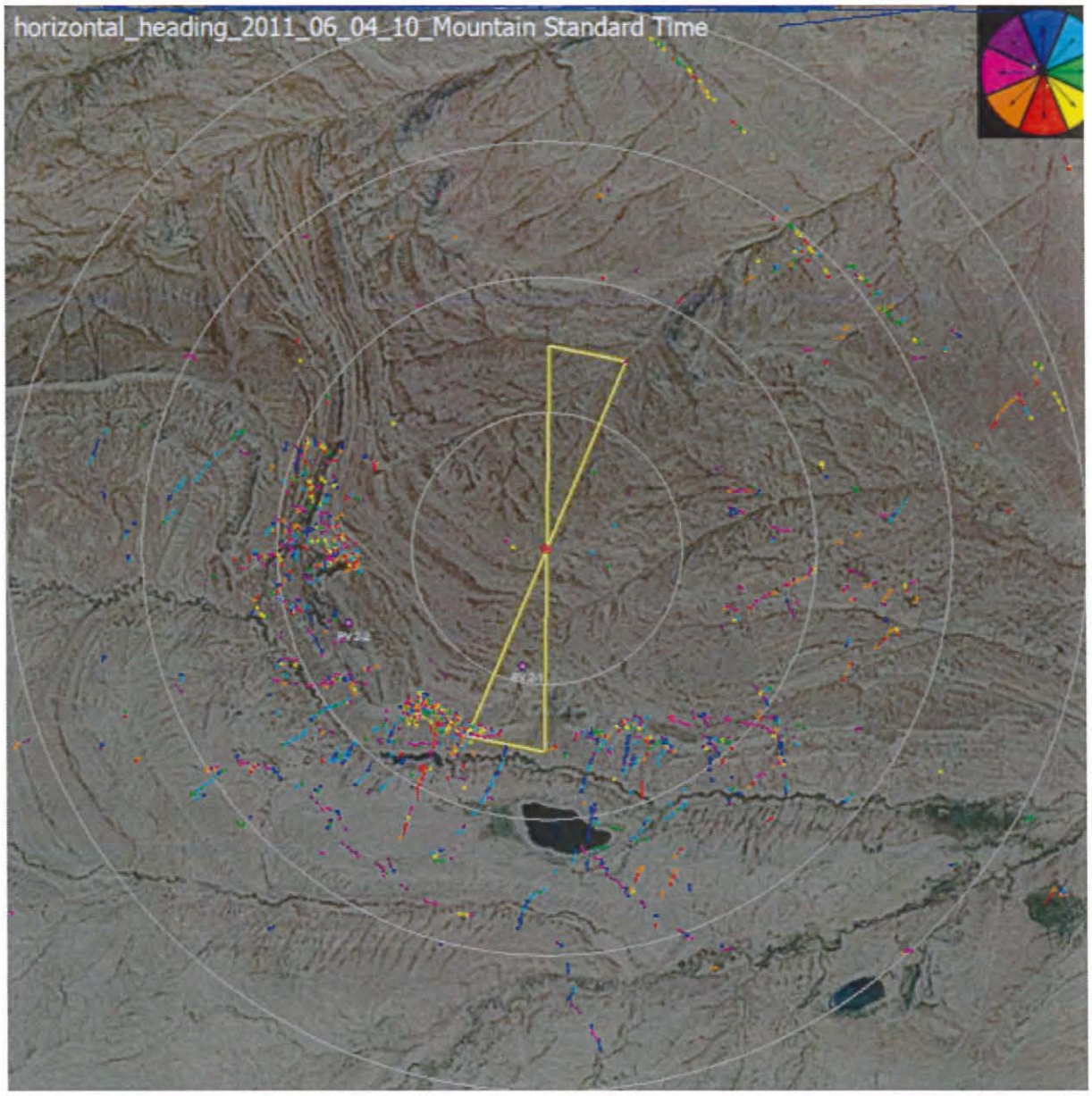

Figure 15. Visual representation of targets recorded by the Radar at the Upper Iron Springs site north of Kindt Reservoir. Eagle and white-throated swift activity can be seen extending south from the Bolten Rim into the Central Basin.

The DFA for short-pulse targets was able to differentiate among species with an accuracy rate of 60% for all species (most of the incorrect classifications were for red-tailed hawk). The short-pulse DFA used a quadratic, common covariance model with stepwise variable selection. Overall, the DFA resulted in 95% of eagle targets being classified correctly. All other species had similarly high classification rates with the exception of prairie falcon and red-tailed hawk. Prairie falcons were only classified correctly 11% of the time. Surprisingly they were most commonly classified as golden eagles (78% of all records). Red-tailed hawks were classified correctly only 37% of the time (most commonly misclassified as turkey vulture and prairie falcon). Significant variables in the model were target compactness, mean chord x, maximum target intercept, target width, range of target reflectivity, and target speed. While prairie falcons were most commonly classified as golden eagles, it was determined that this would result in overestimation of eagle use and would result in a conservative estimate of eagle use in the short-pulse zone.

Many of the data points recorded by the radar are not biological in nature but rather are "clear air" tracking anomalies, vegetation movements, precipitation events, interactions of the radar signal with the ground surface, or some other unknown feature. Most of these false targets have only a single record per Track ID. As a result, most of the data points contained in the daily datasets are not valid biological targets for differentiating among eagle and raptor species and must be removed from the database prior to running the final DFA on the dataset. For the purposes of the analysis of eagle activity and to ensure that only biological targets were considered, only those observations with five or more observations per Track ID were considered. This ensures that only the highest quality tracks are considered for analysis purposes and increases the probability of differentiating between eagles and other species.

The DFA for both the short-pulse and medium-pulse was run on the queried database to classify unknown targets with five or more observations per Track ID. Records with a greater than 65% classification probability of being an eagle were selected from the resulting dataset. This cutoff was used to maximize the likelihood that data used in the subsequent kernel density analysis corresponded to actual eagle targets. The Track IDs associated with those points were converted into flight paths and merged with the eagle flight paths recorded from the long-watch raptor survey dataset. The resulting merged dataset was used to develop a line/kernel density model of use by eagles across the Project area with a resolution of 1 hectare (10,000 square meters). The final results (Figures 16 and 17) consider the density of flight paths within a 500-m search radius on either side of each observation.

Results indicate that eagle use in the Project area is concentrated immediately adjacent to the Interior Chokecherry Rim, immediately north of the Sage Creek Rim in the southeastern corner of the Sierra Madre WDA, and south of the Bolten Rim adjacent to nests above Kindt Reservoir that were active in 2011. Eagle use in these three areas accounts for nearly 50% of all eagle observations for spring, summer, and fall 2011. Additionally, over 70% of eagle use in the Project area was adjacent to the interior rim of Chokecherry during the first winter survey completed in December 2011. These three areas were used consistently across the survey seasons and likely provide soaring and kiting opportunities as the winds interact with the rapid changes in topography in these areas. Other areas in the Project had observed eagle use but use was less predictable and varied by season.

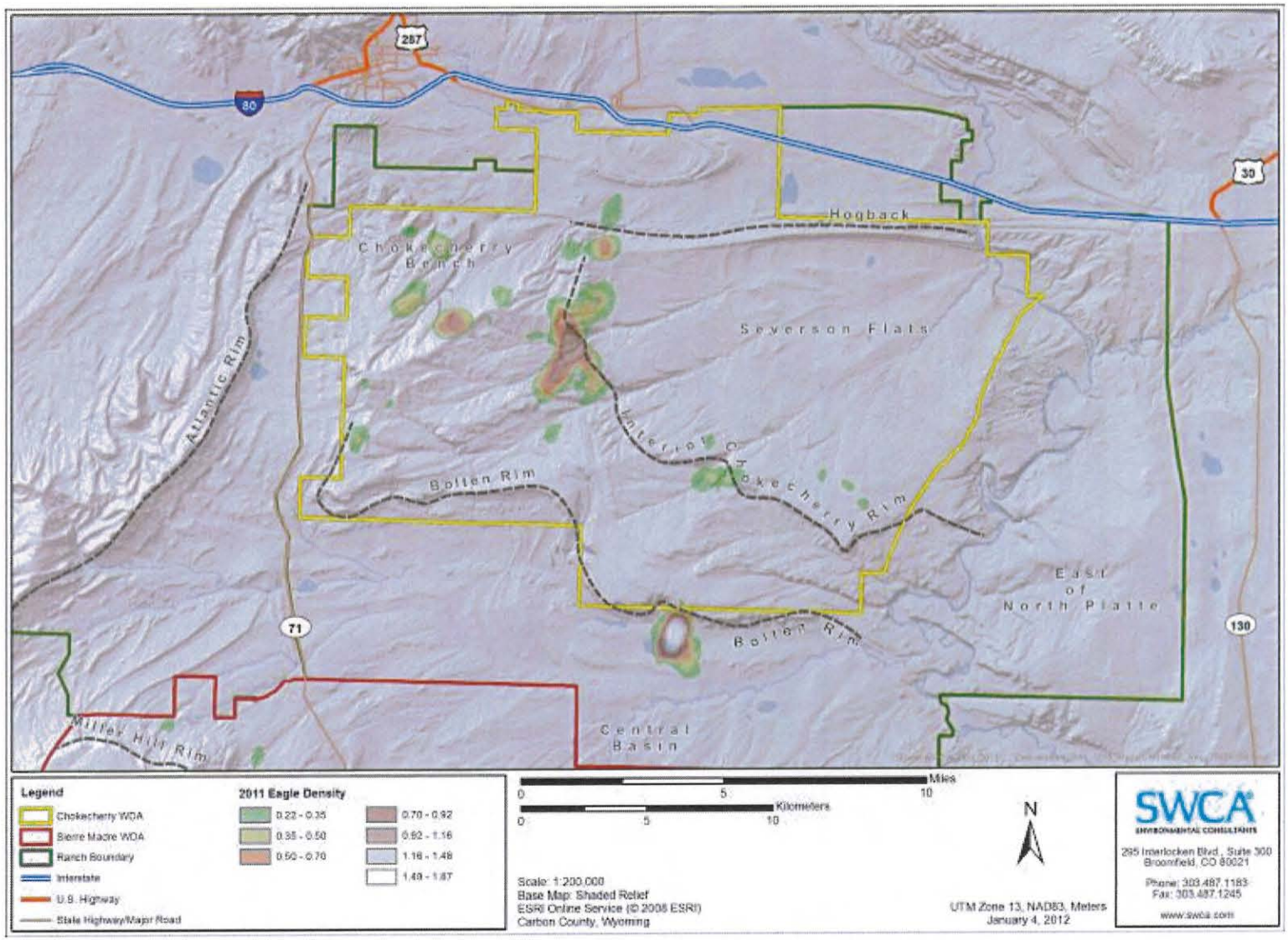

Figure 16. High-density eagle use areas occurring in the vicinity of the Chokecherry WDA.

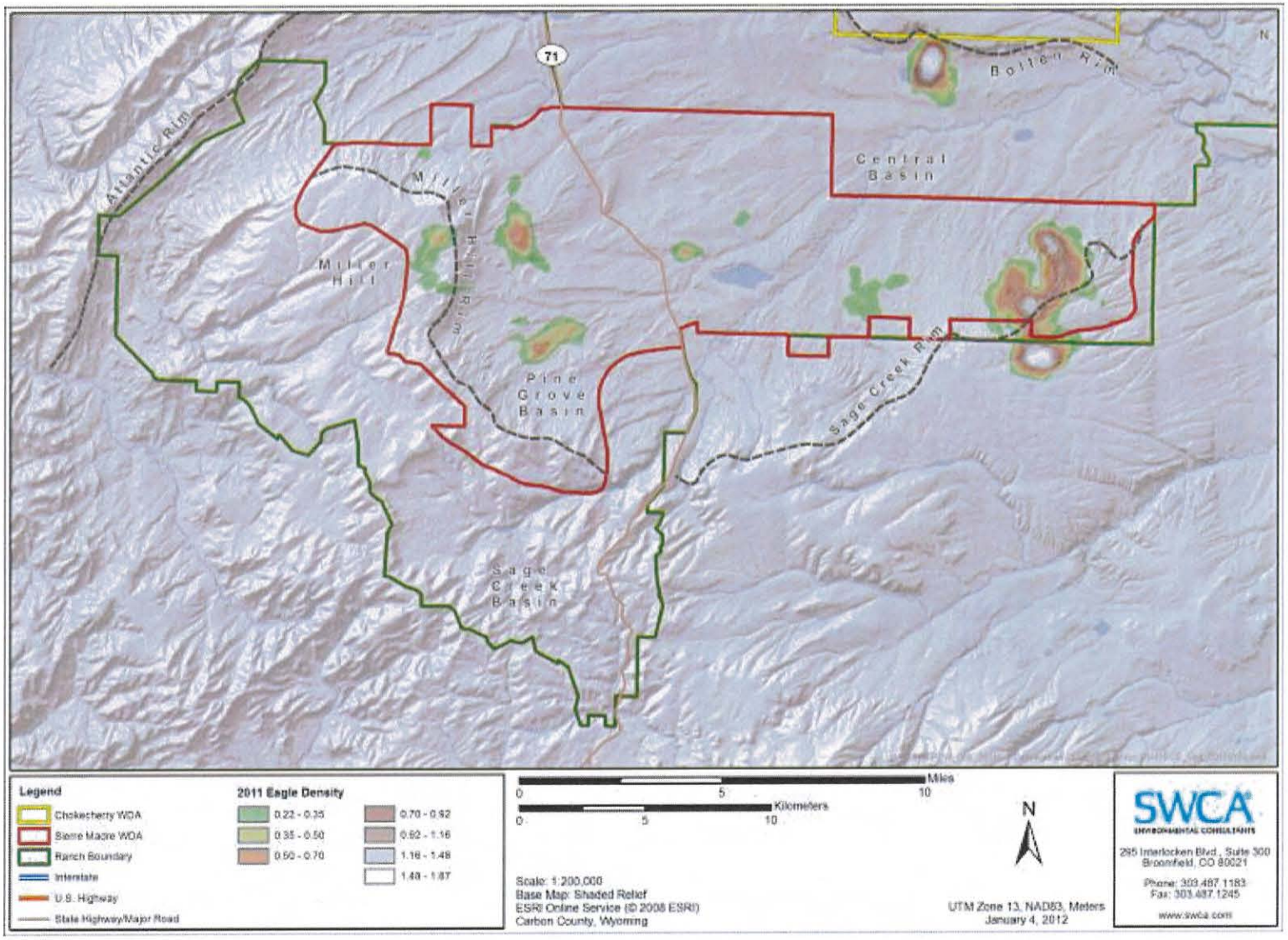

Figure 17. High-density eagle use areas occurring in the vicinity of the Sierra Madre WDA.

6.0 RISK REDUCTION MEASURES

7.0 POST-CONSTRUCTION MONITORING

7.1 POST-CONSTRUCTION MONITORING PLAN

The sections below outline best available information and current monitoring methodologies that may be used for the Project. Since monitoring methods and analytical approaches are constantly improving, the final monitoring methods will be identified in the detailed ECS documents prepared for each of the Project construction stages. It is anticipated that similar monitoring approaches will be used for each Project stage and for all avian and bat species.

Post-construction monitoring will focus on avian mortality surveys at operational wind turbine generator (WTG) sites. These surveys will be completed to document the number and species of birds and bats killed or injured as a result of collision with operational WTGs in the Project. Components of these surveys will include searcher efficiency and carcass removal trials to calibrate the fatality estimate calculations. To further understand the extent of direct mortality at operational turbine sites, background mortality surveys will be used to assess natural mortality in the Project area. Furthermore, continuance of pre-construction nest surveys will allow examination of spatial displacement and change in nest success rates of nesting raptors within the Project area.

7.2 OBJECTIVE

The primary objectives of post-construction fatality surveys are to 1) document avian fatalities directly attributable to operational WTGs, 2) estimate annual number of fatalities, and 3) provide a mechanism and thresholds for triggering the adaptive management process.

7.3 FATALITY STUDIES

Implementation of fatality surveys would meet objectives set forth in *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States* (BLM 2005), *Wildlife Protection Recommendations for Wind Energy Development in Wyoming* (WGFD 2010), and *U.S. Fish and Wildlife Service Interim Guidance for Wind Energy Development in Wyoming* (Service 2011a).

7.3.1 Site Selection

Each stage of the Project will be monitored independently as soon as reasonably possible after WTGs become operational. The final number of turbines that will be monitored for each construction phase will be identified in the detailed ECS for each construction stage. Turbines that will be monitored will be selected using Generalized Random Tessellation Stratified (GRTS) methods across several strata which might include habitat type, turbine density, predicted risk/exposure rates, or other yet to be define strata.

7.3.2 Carcass Searches

Carcass searches are the primary vehicle for deriving mortality estimates. Searches would be conducted by trained personnel at regularly scheduled intervals.

7.3.3 Search Plots

Survey areas would be established as square plots centered on the WTG and oriented in direction of prevailing winds. The radial distance from the WTG to survey plot edge would equal the maximum height of the rotor-swept area (RSA). Therefore, a WTG with a hub height of 80 m and a turbine blade length of 50 m would have a maximum RSA height of 130 m and the study area would be 130 square meters (m^2) in size. The survey plot boundaries would be marked with flagging or other acceptable marker.

Searchable areas within each plot will likely vary as some vegetation types and topographical features (e.g., cliffs) may preclude access. The searchable area for each plot would be delineated and visibility classes mapped to adjust fatality estimates.

7.3.4 Search Protocol

Transects within each survey plot would be spaced 6 m apart and oriented to the prevailing wind. Transects would be marked with flagging or other acceptable marker to avoid the surveyor from having to carry/look at a GPS unit for navigation. One surveyor would walk at a steady rate (~35–45m/minute depending on topography and vegetation) while searching out 3 to 4 m on each side of the transect. Carcasses would be marked with flagging during the search period. After completing the plot survey, the surveyor would then return for collection of the carcasses and gather associated data.

Data for carcasses recorded on a standard datasheet would include standard survey parameters (date, surveyor, time, site name, weather conditions); status of carcass (intact, scavenged, feather spot – minimum of 10 or more feathers or 2 or more primaries); species, sex, age, perpendicular distance from transect line to carcass; GPS coordinates (submeter accuracy); habitat type; estimated age of carcass; and notes further elaborating on carcass condition and location. All carcasses would be photographed prior to collection. A specimen label indicating site, date, species (if known), collector, and carcass number would be placed in the specimen bag with the carcass.

Collection of carcasses will require state and federal permits (CFR 50 Part 21, Subpart C). It is anticipated that the Service will require that PCW, not their consultant, apply for and hold a Collection Permit. Searchers will use rubber gloves to handle carcasses (to reduce human scent bias) in case they are used for scavenger removal trials at a later date. In the case that the surveyor finds a live, injured animal, the surveyor will contact the appropriate agency as soon as reasonably possible.

7.3.5 Search Schedule

Fatality surveys will be completed for three years following construction of each individual stage. Therefore, surveys for the entire Project will be staggered dependent on completion of

each development unit (e.g., the third year of monitoring for Stage 1 will coincide with the first year of Stage 3). Results will be presented on a per stage basis and not for the entire Project until Project construction activities are complete and full year results and analyses can be reasonably applied to the entire Project area.

Mortality surveys would occur throughout the year to evaluate the overall impacts to birds from collision with operational Project WTGs. Surveys would be completed every other week at a representative sample of operational WTGs in each development stage. This schedule may be altered depending on the scavenger removal rate in the development stage. For instance, if the scavenger removal rate is low, then a longer period between survey events may be acceptable.

7.3.6 Searcher Efficiency Trials

One potential bias to fatality estimates is searcher efficiency. That is, how effective is the searcher in finding a carcass if one is present. This bias can be accounted for in fatality estimate calculations by deriving the percent of known carcasses discovered by a surveyor during searcher efficiency trials.

Searcher efficiency trials would be conducted at actual study plots as differences in Visibility Class and other site-specific characteristics would complicate the applicability of the bias estimate to study plot fatality estimates. A searcher efficiency bias would be derived for each surveyor to account for differences between surveyors. Efficiency bias would also be derived for large and small birds separately since detection of birds in each size category differs (i.e., large birds, such as raptors, are easier to find than small passerines). Searcher efficiency can also be derived for Visibility Class and season, if desired.

Searcher efficiency trials would be initiated after the start of the study period without the surveyor's knowledge. Timing of trials and species used would be known only to a non-surveying investigator. Three trials would be conducted per season for a total of 12 trials per calendar year. Multiple trials across a year are necessary to account for temporal changes in searcher efficiency (e.g., searchers become more proficient in finding carcasses with experience) and to match searcher efficiency bias to the respective seasonal fatality estimate. Seasons would be defined as: spring migration (March 16–May 15), breeding season (May 16–August 15), fall migration (August 16–October 31), and winter (November 1–March 15).

Carcasses used for the trials are to be determined closer to start of the trials. If carcasses of birds expected to occur within the Project are not available, suitable surrogates, as allowed by state and federal law, would be used to represent large and small bird categories. In order to have an adequate sample size (>50) (Huso 2010), 20 carcasses would be used for each carcass category.

Location for carcass placement would be randomly selected prior to initiation of field trials, but would be located only within the searchable area of the survey plot as previous described. Carcasses would be dropped from shoulder height so they land in a random position and location to simulate a fall from a turbine strike. Each carcass would be marked with matte finish black tape wrapped around the tarsus of one leg. No more than two carcasses would be placed within an individual survey plot per trial to avoid over-seeding an area and potentially

attracting predators which may result in higher carcass removal rates than normally found in the site. Searcher efficiency should be >25% for small birds. If searchers are below that threshold, additional training or replacement with a more effective surveyor may be necessary.

7.3.7 Carcass Removal Trials

The rate at which carcasses are naturally scavenged and moved from an area by predators also affects the accuracy of fatality estimate calculations. Higher carcass removal rates (i.e., short time between death and scavenging events) may cause an underestimation of fatality estimates from avian-WTG collisions as fewer carcasses would be in the study plot.

To estimate an average carcass persistence rate, carcasses would be placed in survey plots that are not part of the fatality estimate study so as to not attract scavengers to actual study plots. The same parameters (survey effort, timing, carcass size categories) as described for the searcher efficiency trials would be used in the carcass removal trials. One distinction is that study plots are visited daily during the first week, then on every seventh day afterwards to determine how long a carcass remains at the site. All birds used would be handled with disposable nitrile gloves or an inverted plastic bag to avoid leaving a scent on the carcasses and potentially biasing the trial results (Arnett et al. 2010). From these trials an average persistence time can be calculated and the proportion of carcasses remaining over time can be determined.

7.3.8 Background Mortality

Fatality estimates attributed to WTG collision may include bias from naturally occurring deaths (i.e., background mortality) as there is no way of knowing mortality causation for all birds found in the study area. For example, background mortality at the Buffalo Ridge Wind Project in Minnesota was estimated to account for approximately one-third of total mortality at the site (Johnson et al. 2000). Since mortality thresholds would be in place that may trigger additional mitigation measures for the Project, understanding the natural mortality occurring onsite is important.

Parameters for the background mortality surveys would be similar to those used for the carcass surveys. One notable distinction is that background mortality surveys would be conducted at reference plots without operational turbines or other obvious sources of potential human-caused mortality (e.g., along roads).

7.3.9 Fatality Estimate Calculations

Estimators used for the Project fatality study would be those described in Shoenfeld (2004) and Huso (2010). If estimates from these calculations differ substantially, then examination of the dataset may be necessary to explain the difference.

7.4 NEST SURVEYS

Nest surveys will be conducted prior to the nesting season during the first three years following construction and every fifth year after that. Aerial or ground based raptor nest

surveys will be conducted within the entire Project area and a 1-mile buffer for raptors. If aerial nest surveys are conducted, ground-based follow-up surveys will be conducted for all active nests identified. Active raptor nests will be monitored to track the breeding success of resident raptors and evaluate the effectiveness of mitigation measures, if any are applied.

7.5 REPORTING

An annual survey report would be presented in the first quarter of each subsequent year. Report content will include findings from the nest surveys, fatality surveys, searcher efficiency, and carcass removal studies, fatality estimates using Shoenfeld (2004) and Huso (2010) formulas, and an overview of any observable patterns within the fatality data (e.g., "problem" turbines).

All migratory birds recorded as mortalities would be reported to the Service via their Migratory Bird Reporting site. All eagle mortalities would be reported to the Service within 24 hours of detection.

8.0 OTHER CONSERVATION PLANS AND EFFORTS

PCW recognizes the importance of both species conservation and providing clean, renewable and reliable energy sources for the American public. The ECS demonstrates how the development of renewable energy sources can be balanced with species conservation. Under the ECS, PCW will conserve the current eagle population in the Project area and, at the same time, allow for the development of 2,000 to 3,000 megawatts of renewable energy which will have long-term benefits for eagles and other wildlife species resulting in substantial reductions in greenhouse gas emissions. The ECS will address and mitigate threats to eagles, evaluate opportunities for Project designs that will avoid and/or minimize impacts in high-use areas, and will set the standard for the development of renewable resources in an environmentally responsible manner. Furthermore, implementation of the ECS in the Project area will complement other conservation efforts to protect additional species of interest, including greater sage-grouse.

PCW has developed a conservation plan, in coordination with TOTCO, to protect populations of greater sage-grouse across the Ranch. Implementation of conservation measures and monitoring efforts on the Ranch and in the Project area will occur in a staged manner and include pre-, during, and post-wind development activities. The conservation measures that will be implemented include the minimization or removal of existing threats to greater sage-grouse survival and productivity (e.g., removal and marking of fences, water development projects, and riparian/wetland habitat enhancement); and it includes, through the adaptive management process, the identification of additional conservation measures that will serve to achieve conservation goals if initial measures fail to meet the long-term goals and objectives.

In addition to PCW's conservation approach for greater sage-grouse and other species, the State of Wyoming has implemented a core area conservation strategy for sage-grouse as described in Wyoming Executive Order 2001-5. The core area conservation strategy limits development and disturbance activities in large areas of public, private, and state lands across Wyoming. In the vicinity of the Project area, habitats east of the North Platte River and habitats south and west of the Sierra Madre WDA have been identified as core areas for sage-grouse conservation. These areas contain much of the high quality prey base for eagles and other raptors and will not be directly impacted by wind development activities. These areas will aid in the conservation of the local and regional populations of eagles by protecting large acreages of high quality eagle habitat.

The State of Wyoming's Grizzly Wildlife Habitat Management Area (WHMA) is located west and south of the Miller Hill portion of the Sierra Madre WDA. The WHMA would be largely unimpacted by wind energy development as it lies in core area. Year one survey data demonstrated that survey points adjacent to and within the WHMA had relatively high reaptor and eagle use compared to areas that are currently proposed for Project development. The WHMA is managed to benefit big game and other wildlife species that serve as important forage for eagles and other raptors. As the majority of the WHMA will not be impacted by wind energy development and managed to benefit the prey base of eagles, and, because year one survey results indicate it serves as important habitat for eagles, it will continue to provide a conservation benefit to local and regional eagle populations.

9.0 ADAPTIVE MANAGEMENT FRAMEWORK

To provide a feedback mechanism that allows follow-up to the implementation of various ACPs and risk reduction measures, an adaptive management process will be employed. For an adaptive management plan to be functional, it is important to integrate the monitoring of eagle populations and the strategies of the ECS together so that monitoring efforts are clearly tied back to the goals and objectives of the ECS. While the goal of the ACPs and risk reduction measures is to avoid eagle mortality, it is anticipated that some level of impact will occur as a result of Project construction. As part of the final siting process, site-specific risk assessments will be completed to identify the expected level of impacts (e.g., behavior, injury, mortality) to eagles and other avian species that may potentially occur as a result of Project implementation. A tiered approach will be used to evaluate the overall success of the first, second and third tier ACPs and risk reduction measures. Adaptive management thresholds would be identified based on the expected number of eagle mortalities or injuries for each stage of the Project. In the event of an impact threshold exceedance, adaptive management processes would be initiated and additional risk reduction measures from the subsequent tier would be evaluated and implemented.

As part of the adaptive management process, a tiered approach will be used to implement ACPs and reduce risk to eagles and other avian species. It is important to note that the conservation measures and avoidance, minimization, and mitigation measures described in the sections above might be improved or even changed as technology improves or as more information is gathered regarding the impacts of the Project. The adaptive management process will continuously identify new ideas and technologies that could be implemented as part of any of the three tiers, which include:

- **Tier 1** – Avoidance and mitigation measures as well as ACPs that will be implemented across the entire Project area;
- **Tier 2** – Risk reduction measures and ACPs that will be implemented within a stage of the Project if *first tier* site-specific impact thresholds are exceeded and after review by the adaptive management Technical Advisory Committee (TAC); and
- **Tier 3** – Risk reduction measures and ACPs that will be implemented within a stage of the Project if *second tier* site-specific impact thresholds are exceeded and after review by the adaptive management TAC.

By establishing a tiered approach to evaluate the site-specific impact thresholds for ACPs and risk reduction measures, combined with a focused monitoring program to determine if impacts are remaining below these thresholds, a process to clearly direct future management decisions based on the success or failures of those risk reduction measures becomes an integral component to meeting the overall management goals and objectives for eagles and its habitats throughout the Project and surrounding areas. Therefore, it is important to establish a series of impact thresholds which will serve as the measure for determining whether each ACP or risk reduction measure met its intended goal. This recognizes the importance of post-implementation monitoring for ACPs and risk reduction measures, since management actions may require modification if those actions are proving ineffective at protecting eagles. It is

important to note that the adaptive management process will serve as one of the mechanisms in which the goals and objectives of the ECS may be refined. Using information from future research and monitoring of eagle populations response to protection and enhancement throughout Wyoming and other areas, along with a better understanding of which factors are limiting recruitment and survival, may change these priorities.

The adaptive management TAC will be established to integrate a process of reviewing monitoring data, evaluating site-specific thresholds, and determination of additional management actions should ACPs and risk reduction measures fail to meet their intended goals. This group will consist of one representative each of the Service, BLM, WGFD, TOTCO, and PCW. The goals of this group would be:

- meeting annually to review information garnered through population monitoring, habitat management, and risk reduction measure implementation; this meeting will occur at a time such that the majority of data collected during the previous year can be analyzed and presented to the group;

- meeting when mortality thresholds have been exceeded or are expected to be exceeded to identify appropriate actions to take to bring impacts back below the desired threshold; and

- recommending alternative risk reduction measures that could be implemented to reduce potential impacts from Project construction and operation.

Effective implementation of the ECS is the joint responsibility of the Service, BLM, WGFD, and representatives of TOTCO and PCW. The TAC will collectively evaluate the success of the implemented ACPs and risk reduction measures as determined through the project-specific monitoring efforts. Appropriate actions and management techniques will be initiated if the goals of the ECS are not being met, ACPs and risk reduction measures are determined ineffective, and site-specific thresholds are exceeded.

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APPENDIX A

Description for Variables Collected by the DeTect Merlin Radar System

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ATTACHMENT 8

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Kara Morgan

Subject: FW: Power Company of Wyoming Eagle Conservation Strategy Conservation Measures Section
Attachments: Power Company of Wyoming ECS conservation measures section.pdf

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From: Jon Kehmeier
Sent: Wednesday, March 07, 2012 08:34 AM
To: Travis_Sanderson@fws.gov; Tyler_Abbott@fws.gov; Trish Sweanor (Patricia_Sweanor@fws.gov)
Cc: Garry Miller (garry.miller@tac-denver.com); Kelly.Cummins@tac-denver.com; Clint King (cking@swca.com)
Subject: Power Company of Wyoming Eagle Conservation Strategy Conservation Measures Section

Please find attached a copy of the conservation measures section of Power Company of Wyoming's Eagle Conservation Strategy. This information is provided to facilitate our discussion on Monday. The measures contained in this section are still very much in draft form and subject to change. Please note that this document is proprietary and confidential and has been marked as such in the document footer. Please let me know if you have any questions. See you all on Monday morning.

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6.0 RISK REDUCTION MEASURES

The following section identifies the risk reduction measures that will be implemented as part of the Project ECS. Additionally, this section describes the pre-construction planning processes that have been completed to reduce the overall impact of the Project. As described in Section 1.0, this programmatic ECS does not identify the site-specific measures that will be implemented. Rather, site-specific selection and implementation of these measures will occur once the final siting process is complete as part of the ECS for each stage of development. While the goal of the risk reduction measures described in this section is to avoid eagle mortality, it is anticipated that some level of impact will occur as a result of Project construction. As part of the final siting process, a site-specific risk assessment will be completed to identify the expected level of impacts to eagles and other species that would occur for each project stage. Upon completion of the risk assessment, adaptive management thresholds would be identified based on the expected number of eagle mortalities or injuries. If those thresholds are exceeded, the adaptive management process would be initiated and additional risk reduction measures would be identified to reduce impacts to eagle populations.

As part of the adaptive management process described in detail later in this document, a tiered approach will be used to reduce risk to eagles and other avian species. The first tier includes avoidance and conservation measures as well as mitigation measures that will be implemented across the entire Project Site. Second and third tier measures will be implemented in site-specific instances when first tier measures are not adequate to avoid expected impacts. Tier 2 and tier 3 measures would be implemented if impact thresholds are exceeded and after review by the adaptive management Technical Advisory Committee.

The measures identified in this section include ACPs that were identified in the Draft Eagle Conservation Guidance (Service 2011b) as well as site-specific measures that have been developed after completing the initial landscape and site characterizations for the Project. The ACPs outlined in this section meet the Stage 4 objectives in the Draft Eagle Conservation Guidance (Service 2011). PCW will work with the Service to determine whether a take permit for eagles is appropriate under the provisions of the Bald and Golden Eagle Protection Act. Should the opportunity to gain a permit become available, the measures identified below would become conditions of that permit.

6.1 PRE-CONSTRUCTION PROJECT MODIFICATIONS

PCW's original proposed project as identified in BLM's 2008 Notice of Intent for the Project EIS has been substantially altered to benefit a number of resources, including wildlife. As a result of public comments and discussions with the RFO, the WGFD and various non-governmental organizations, PCW became aware of resource issues that could be addressed by modifications to the Applicant's proposed action. Consequently, PCW submitted an Applicant Proposed Alternative (APA) in April 2010 which formed the basis for BLM's Alternative 1R in the DEIS.

In developing the APA, PCW considered not only utilization of the Ranch's best wind resources, but also conservation of the best greater sage-grouse habitat to enable the implementation of measures to avoid, minimize and mitigate impacts to greater sage-grouse and provide a net conservation benefit. PCW's APA represents a major revision to the Applicant's proposed action and is based upon the

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best available science including vegetation and habitat mapping as well as consideration of potential impacts to greater sage-grouse. In addition, PCW considered other resource issues such as recreational concerns (e.g., big game hunting within the Red Rim – Grizzly Wildlife Habitat Management Area and recreation on the Continental Divide Trail) and cultural resource concerns (e.g., potential impacts to the Overland Trail). All of these considerations resulted in significant modifications to the proposed wind development area that have reduced or removed impacts in important eagle foraging habitats.

The revisions to the proposed wind development areas within the Application Area include, but are not limited to, removal of turbines from over 97% of the Red Rim – Grizzly Wildlife Habitat Management Area, removal of turbines from the western portion of the Sierra Madre site and removal of all infrastructure from Wyoming's designated core sage-grouse areas. These areas are important for wildlife and provide high-quality foraging habitat for eagles and raptors. Additional pre-construction project modifications will occur to provide additional benefits to raptors and eagles. Many of these additional pre-construction measures are identified as first-tier measures in the following section.

6.2 FIRST-TIER MEASURES

First-tier risk reduction measures will be implemented for all aspects of the Project. The intent of these measures is to avoid impacts using responsible siting, design, operational, and land management practices while providing conservation benefits to eagle populations in areas that will not be impacted by wind development activities.

6.2.1 Siting and Avoidance Considerations

Avoidance of impacts is the primary measure for conserving eagles and other avian species within the Project Site. As a result of the Project's robust avian survey efforts, several areas of high eagle and raptor use have been identified. These areas are generally associated with nesting locations, foraging and scavenging areas, and topographic features that provide suitable perching, soaring, and kiting opportunities. The following siting considerations and avoidance measures will be used in the final Project design to avoid impacts to eagle populations to the extent practicable.

The final Project layout will be designed to reduce collision risk with wind turbines. Each of the following elements will be considered during final Project siting and engineering design:

1. High use areas will be identified though an appropriate discriminatory process as described in section 5. Siting considerations and avoidance measures will be used to avoid and minimize impacts in the high use areas that are identified.
2. In other areas, efforts will be made to site turbines back from ridge edges with highest soaring and kiting potential. These ridge edges include the Bolten Rim, Interior Chokecherry Rim, Miller Hill Rim, and Sage Creek Rim, most of which are generally west- and southwest-facing slopes that collect wind and provide soaring and kiting conditions. Site-specific setbacks will be determined based on observed eagle use and the type of use, terrain features, and flexibilities for siting individual turbines.

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3. Siting considerations will be made in areas between nesting locations and known foraging or concentration areas that have been identified as part of PCW's avian survey program. Efforts will be made to minimize placement of turbines in known travel corridors between nesting or roosting locations and foraging areas.
4. During construction, the spatial and timing restrictions identified in BLM's Rawlins Field Office (RFO) Resource Management Plan (RMP) will be implemented for all raptor nests that are active during the year of construction. These spatial and timing restrictions will be based on the ROD requirements and will be specified in each site-specific ECS.
5. Turbines will not be sited in the following areas that have been identified as important foraging locations and high-use habitats within the Project Site: Central Basin between the Bolten Rim and 3 miles south of the Bolten Rim; the northern flats between Chokecherry and I-80; all areas inside Wyoming sage-grouse core areas designated under EO-2011-5; and all areas within 1 mile of the North Platte River where the highest eagle nest density was located.
6. A corridor will be identified below the rim of Miller Hill in which no turbines will be constructed. This corridor has potential to serve as a north-south movement corridor during foraging activities and migration and as a nesting area for raptors and other avian species. The specific width and location of the corridor will be determined in subsequent site-specific ECS documents and will be determined based on observed use of the area, terrain features, and flexibilities for siting individual turbines.
7. All existing meteorological monitoring towers have been retrofitted with bird diverters on guy wires to minimize the risk of collision for all avian species.

6.2.2 Engineering Design and Construction Considerations

In areas where wind development activities will occur, design features will be used to minimize impacts to eagles and other avian species. Numerous engineering and construction-related measures will be implemented to avoid or minimize the impacts of wind development activities on eagle populations and other avian species. The site-specific implementation of some of these design features will be dependent on the final layout of the Project. Site-specific measures will be identified in the site specific ECS documents for each stage of the Project.

1. General design considerations – For all infrastructure, the following considerations will be used to develop the final Project design. These considerations are meant to minimize new disturbance and co-locate facilities to minimize impacts to eagles and other avian species.
    a. PCW will construct the Project in stages. This approach will provide greater flexibility for avoiding impacts to active eagle territories during breeding and nesting periods. Additionally, it will reduce the amount of area being constructed at any given time to minimize disruptions in important habitats and foraging areas. This conservation measure was analyzed as mitigation measure GEN-1 in BLM's draft Environmental Impact Statement for the Project
    b. The final Project design will optimize the footprint necessary for construction and operations activities. As part of this commitment, where possible, PCW will

prioritize development on previously disturbed lands and within or adjacent to existing energy corridors and roads where impacts have already occurred.

c. For all new meteorological monitoring towers, bird diverters will be installed on guy wires to minimize the risk of collision for all avian species. All non-operational meteorological towers, turbines, or other above-ground infrastructure will be decommissioned and dismantled per PCW's Plan of Development (POD).

2. Turbine layout considerations – Turbines will be sited in rows and groups rather than haphazardly across the landscape where practicable according to Project topographic and wind resource limitations. Row-based turbine siting leaves travel corridors and natural landscapes between turbines and minimizes risk to eagles moving within the Project footprint.

3. Road Network Considerations – PCW's final Project design will strive to optimize the road network. The Project Site has an existing road network for ranching and agricultural activities. Many of these roads will be repurposed and used for access to turbine locations.

4. Power Line Considerations

   a. The majority of the power collection system will be buried underground to eliminate new perch locations, reduce collision, and minimize electrocution risk.

   b. Where power lines are not buried, the design of above-ground structures will follow the recommendations of the Avian Power Line Interaction Committee (APLIC) guidance on power line construction (APLIC 2006) and power line siting (APLIC 1994).

6.2.3 Operations and Maintenance Considerations:

1. Operational Design Considerations – The final plan for operation and maintenance of the Project will contain the following measures. These measures will reduce impacts to eagles and other avian species by removing threats from Project infrastructure and risks that could be associated with changes in the availability of the forage base within the Project Site.

   a. Lighting within the Project Site will be based upon recommendations from the Federal Aviation Administration. Lights will be installed in such a manner as to limit their visibility from the ground while maintaining the appropriate visibility to pilots. During instances where nighttime activities are required in substations, PCW will utilize a combined switched and motion-detection system for exterior lights. A master control switch for exterior lights will be placed at the gate so that lights can be activated prior to personnel entering the yard (this is required for safety). These lights will remain on when movement is detected within the substation, and for a "safety time period" (perhaps 30 to 60 minutes) after motion has been detected to facilitate worker safety. A few minutes prior to the end of the safety time period, the lights will flash to warn personnel that the lights are about to turn off. If motion is still not detected, the lights will then turn off at the end of the safety time period. The lights will turn back on whenever motion is detected until the master switch at the substation gate is turned off. A similar system will

be used for activities outside the operations and maintenance buildings (with master switches likely within the buildings). This approach will minimize the time the lights are on to avoid attracting wildlife, but provide adequate safety for project personnel. It should also minimize the instances of false motion detection needlessly activating the lights. While lighting is not expected to have a direct impact on eagles, proper lighting design will reduce impacts to eagle prey species and will reduce collisions and resulting carcasses beneath turbines.

b. Construction storage and staging areas will be reclaimed following PCW's Master Reclamation Plan.

c. The Project POD provides several operations and maintenance features that will result in decreased risk to eagles and other avian species.

- Roads will be maintained in winter in accordance with PCW's Winter Access Plan. PCW's Winter Access Plan specifies that where roads are plowed, breaks be created in any snow banks alongside roads to allow free passage of ungulates across the landscape. This will minimize the likelihood of concentrated ungulate use along roads that would result in increased vehicle collisions that could attract eagles. Where collisions with ungulates or other possible eagle food sources occur, the carcasses of those animals would be removed immediately following the Project carcass removal plan that will be developed as part of site-specific ECS documents for each construction stage.
- An appropriate speed limit will be implemented depending on road design limitations. Signs will be posted to remind drivers to stay below posted limits. Limiting speeds will reduce the likelihood for vehicle collisions with avian species and their prey items. Additionally, it will reduce noise impacts and the perception of habitat fragmentation that is associated with high traffic volumes.
- Additional instruction will be given to all operations and maintenance staff to further reduce speeds during inclement weather or when visibility is low to decrease the risk of collisions with avian species and potential prey items.

2. Operations and Maintenance Plans – PCW has developed numerous operations and maintenance plans that will be implemented over the life of the Project. Implementation of various measures in these plans will reduce risk to eagles and other avian species.

a. Carcass Removal Plan – Carcasses that have the potential to attract raptors will be removed immediately from roadways and from areas where eagles could collide with wind turbines. All operations and maintenance staff will be trained to appropriately handle, remove, and dispose of all carcasses that are encountered within the Project Site. Disposal protocols will be developed in coordination with the Service and WGFD to ensure compliance with relevant state and federal wildlife statutes. Disposal areas will be located outside of the turbine footprint area.

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b. Environmental Training Program – As part of the Environmental Compliance and Monitoring Plan (ECMP), PCW will implement an Environmental Training Program (ETP) to support compliance with environmental permits, including permit requirements and conservation measures outlined in the ECS. The training program will be designed to consistently communicate the Project requirements to every individual working on the Project so that both managers and workers understand PCW's expectations, the permit requirements outlined in the ECMP, and how to incorporate them into their daily work activities. All personnel working on the Project will be required to attend environmental training prior to entering the Project Site. PCW will maintain environmental training attendance records through the end of construction. The ECS training will follow the APLIC guidelines training course format (APLIC 2005) and will incorporate site-specific training modules to minimize risks to eagles and other avian species.

c. Reclamation Plan – PCW has developed a Master Reclamation Plan for the Project. Site-specific reclamation plans will be developed for each stage of the Project. As part of these plans, appropriate reclamation techniques, seed mixtures, and avoidance measures will be identified to minimize attraction of small mammals and other potential prey items to recently revegetated sites. Additionally, the site-specific reclamation plans will provide detail on how turbine pads will be reclaimed to decrease the likelihood for fossorial mammal burrowing in recently disturbed soils.

d. Fire Prevention Plan – Impacts to natural habitats from fire can reduce the quality of habitat for eagles and other avian species. PCW's fire prevention plan will identify measures to reduce the likelihood of fires caused by the Project.

e. Post-Construction Monitoring Program – A post-construction monitoring program, as described in later sections of this document, will be implemented to evaluate potential impacts of wind development on eagles and other avian species. In addition to post-construction mortality monitoring, changes in use and behavior of eagles and other avian species will also be evaluated. This program will be carried out for three years following the completion of construction in each stage.

6.2.4 Continued Land Use Management Considerations:

PCW's affiliate, TOTCO, currently manages a cow-calf and yearling operation in much of the Project Site and in adjacent portions of the Ranch. TOTCO currently uses very active management to minimize impacts of grazing activities on wildlife and habitat. This includes responsible livestock husbandry (e.g., removing carcasses, active herd management, managed calving activities, etc.). This level of management will continue for the life of the Project to maintain suitable habitat and prey availability for eagles.

6.2.5 Conservation and Habitat Enhancement Considerations

PCW will coordinate with TOTCO and other committed private landowners and BLM to manage areas outside of the wind turbine footprint to conserve wildlife species. The managed areas would include much of Miller Hill and the south Sage Creek Basin adjacent to the Grizzly WHMA, the Central Basin, and areas of the Ranch east of the North Platte River. Management

actions may include prevention of future development of wind resources, enhancement of habitat, and other measures to protect and conserve important eagle foraging, breeding, and nesting habitat for the life of the Project.

PCW has implemented a Sage-Grouse Conservation Plan that provides for monitoring of sage-grouse within the Ranch and adjacent areas. During PCW's sage-grouse monitoring efforts, golden eagles have been the second greatest predator of sage-grouse behind only mammalian carnivores (presumably coyotes). Conserving sage-grouse in areas adjacent to the wind development areas will enhance the eagle prey base and provide suitable foraging in areas with no risk of impact from wind turbines.

Many of the conservation measures contained in the Sage-Grouse Conservation Plan will benefit eagles and other avian species. PCW's Sage-Grouse Conservation Plan includes conservation measures that will improve habitat for greater sage-grouse and other wildlife species throughout the Ranch and identifies measures for minimizing and/or reducing potential threats to sage-grouse populations and other wildlife species.

Implementation of conservation measures and monitoring efforts in and adjacent to the Project Site will be staged and will include both pre- and post-wind development activities. The conservation measures that will be implemented include the minimization or removal of some existing threats to greater sage-grouse survival and productivity (e.g., removal and marking of fences, water development projects, and riparian/wetland habitat enhancement); and it includes, through the adaptive management process, the identification of additional conservation projects that will serve to achieve conservation goals if initial projects fail to meet the long-term goals and objectives.

Conservation measures that will be implemented as part of the Sage-Grouse Conservation Plan include:

1. Fence Marking and Removal – Fence collisions have been identified as a primary source of mortality for sage-grouse and other bird species (Christiansen 2009). PCW has removed 10 miles of woven wire and barbed wire fences in high-use areas around sage-grouse leks, nesting areas, and brood-rearing habitats. An additional 16 miles of barbed wire fence were marked with reflective bird diverters. While no eagles have been documented colliding with fences within the Project Site, removal of unnecessary fences and fence marking will remove this threat for all avian species.
2. Bird Diverters on Meteorological Towers – Similar to fences, guy wires on meteorological monitoring towers pose a collision risk for most avian species. To remove and reduce this risk, PCW has installed bird diverters on the guy wires of all meteorological towers located throughout the Project Site.
3. Water Tank Escape Ramps – PCW has worked in collaboration with the Saratoga High School Future Farmers of America chapter to construct metal mesh avian escape ladders that have been installed in the water tanks within the Project Sites and other parts of the Ranch. Escape ramps reduce the risk of drowning to all avian species.

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4. Habitat Improvements – PCW is implementing measures to improve sagebrush habitat. Through enhanced rangeland management and utilizing the flexibilities provided by the land and water resources throughout the Ranch, measures are being taken to create and improve nesting and brood-rearing habitats for sage-grouse. These measures include enhanced riparian and wetland resource management, maintenance and enhancement of native understory plants, revegetation of burned areas and fallow agricultural fields, sagebrush treatments, and numerous other vegetation enhancement opportunities.

    a. Wildfire Emergency Stabilization and Burned Area Rehabilitation – Wildfire, particularly in low-elevation Wyoming big sagebrush systems, has resulted in significant habitat loss primarily because of subsequent invasion by cheatgrass and other exotic plant species (BLM 2011b). PCW will work with BLM to prioritize stabilization and burned area revegetation projects to (1) maintain unburned intact sagebrush habitat when at risk from adjacent threats; (2) stabilize soils; (3) reestablish hydrologic function; (4) promote biological integrity; (5) promote plant resiliency; (6) limit expansion or dominance of invasive species; and (7) reestablish native species.

        For example, in 2010, a 170-acre wildfire occurred within sage-grouse habitat in the Chokecherry area of the Project Site. Following the fire, PCW seeded portions of the burned area to stabilize soils, reduce the risk of non-native plant invasion, and encourage use by sage-grouse and other wildlife species. Seed mixtures used were designed to maximize sage-grouse foraging opportunities during summer brood-rearing periods to enhance brood survival within the Project Site.

    b. Water Improvement Projects – The primary objective of all water development conservation projects will be to modify water sources to create and enhance natural free flowing water and wet meadow habitats that are used by sage-grouse for summer and late brood-rearing habitat. Water developments are known to improve sage-grouse brood rearing habitat (Autenrieth et al. 1982; Hanf et al. 1994). The specific locations of water improvement conservation projects will be determined following pre-construction sage-grouse monitoring to identify viable water sources that are in or adjacent to habitat that is likely to be used by sage-grouse for brood rearing and will continue for the life of the Project.

        Water source modifications may include installation of upland "bubblers" and water diversions to create and enhance natural free-flowing water, enhance wet meadow habitat and flood bottomland draws. "Bubblers" will be supplied with water from both artesian wells and other wells actively pumped by windmills. Other water sources to be developed will be supplied through water diversion pipelines from existing reservoirs and stock tank pipeline networks. Water improvement projects will be completed in a manner to minimize standing water and discourage use by mosquitos, which might carry West Nile virus.

    c. Agricultural Field Enhancements – There are approximately 2,023 acres of unused agricultural fields in the eastern portion of the Ranch that are currently dominated with either monocultures of crested wheatgrass (*Agropyron cristatum*) and other introduced grass species, or native bunchgrass communities and encroaching shrubs typical of sagebrush steppe habitats. Sage-grouse lek counts

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and additional observations have identified two active leks within or adjacent to these relict agricultural fields, and surrounding sagebrush habitat is being used for nesting and early brood-rearing habitat. Additional observations have been made during monitoring that sage-grouse are using hayfields (i.e., alfalfa and hay grass species) in the Ranch and the surrounding areas at increased rates during brood-rearing. The primary objectives of the agricultural field enhancement conservation projects are to develop water sources on the eastern portion of the Ranch and establish conditions suitable for year round use as breeding, nesting, brood-rearing, and wintering habitat. This will include, as appropriate, planting of additional sagebrush and/or establishment of high-value forage and cover sources in the relict agricultural fields.

d. Removal and Reclamation of Unnecessary Roadways – The primary objectives of the road closure and enhancement conservation projects are to minimize the extent of habitat fragmentation due to the road network across the Ranch. As such, selected roads would be closed and, where practicable, abandoned roadbeds would be reclaimed. Road closure and abandonment effectively increase habitat patch sizes by providing contiguous habitats and removing conduits used by predators and invasive species. Road closures would target two-track roads that experience periodic yet irregular patterns of vehicular activity across the Ranch. Monitoring efforts have resulted in several observations of grouse mortality on or near two-track roads which serve as conduits and hunting areas for predators. To reduce the effects of roads on the Ranch, selected existing roads will be closed to enhance greater sage-grouse nesting, brood-rearing, and winter habitat. The value of the habitat adjacent to the roadbed would improve in quality due to the removal of the associated traffic, effectively eliminating any buffer zones previously associated with that road.

e. Noxious and Invasive Plant Species Control – The primary objectives of the control of noxious and invasive plant species conservation projects are to limit the spread of weedy species into native habitats, promote the establishment of native plant species, and to provide suitable sage-grouse habitat. Sage-grouse prefer native and diverse vegetation cover and well established sagebrush communities. Noxious and invasive plant species often have a competitive advantage over native species and readily establish, thus decreasing plant diversity and reducing sage-grouse habitat quality. Herbicide application or other appropriate treatments will be used for noxious and invasive plant species control. Control measures will be followed by native vegetation seeding. This conservation measure will include the development of protocols for utilization of agricultural chemicals on the Ranch.

5. Suspension of Hunting – The suspension of sage-grouse hunting on the Ranch would reduce direct mortality of sage-grouse and enhance the forage base for eagles. Suspension of hunting would only be limited to sage-grouse and will continue throughout the life of the Project.

While these activities are designed to conserve sage-grouse populations and habitat, they will have direct benefits to eagles and other raptors by maintaining contiguous habitat patches,

conserving and promoting prey base populations, and improving habitat quality throughout the Project area and the TOTCO Ranch property.

6.3 SECOND-TIER MEASURES

Second-tier measures will be implemented upon review of the success of the first tier risk reduction measures. If anticipated impact levels are exceeded and the Adaptive Management process is triggered, second tier risk reduction measures will be evaluated to identify those most likely to reduce impacts below acceptable thresholds.

6.3.1 Habitat Improvement/Modification Projects

Additional modifications or improvements to habitat for eagles or their prey base will be used as a second tier risk reduction measure. If it can be determined that artificial or natural habitats are attracting prey, removal of those habitat types will be considered. This consideration would be made on a site-specific basis. If an artificial habitat type is identified as attracting prey items for eagles or other large raptors, attempts would be made to relocate or recreate that artificial habitat in an area outside of the wind turbine footprint area in an effort to draw eagles and other raptors away from turbines.

If it is determined that breeding, nesting, and recruitment is impacted by wind development activities, measures would be taken to create or enhance habitats outside the wind development areas in an effort to draw eagles away from turbine locations. Artificial perch and nesting structures can easily be constructed in areas of the Ranch or elsewhere in south-central Wyoming that will not be impacted by wind development. These artificial structures can be placed in areas with adequate prey to minimize the likelihood that eagles using those structures would overlap with wind development areas.

6.3.2 Prey Base Modification

Habitat enhancement and wildlife management techniques will be used as second tier risk reduction measures to draw eagle activity away from wind development areas. The Ranch provides unique opportunities to implement these types of projects and contains the wildlife resources necessary to make this a successful risk reduction approach.

Habitat enhancements would be used to increase prey base populations in areas outside of wind development areas. Where prey base populations have been removed or reduced as part of past land management activities, prey base reintroductions would be considered to create new foraging areas and draw eagles away from turbines. White-tailed prairie dogs, Wyoming ground squirrels, and other prey base species would be considered for possible reintroduction.

In areas within the turbine development footprint, if eagle prey species (rabbits, ground squirrels, prairie dogs, etc.) are attracted to Project infrastructure, measures would be taken to reduce their activity levels and encourage activity elsewhere. If fossorial mammals are attracted to disturbed areas beneath turbines or adjacent to roads, burrows would be evaluated on a case-by-case basis and appropriate measures would be taken to prevent ongoing and future burrowing activities. This could include measures such as filling burrows and the surrounding area with gravel at least 2 inches deep and out to a perimeter of at least 5 feet. Where these types of deterrents are not

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successful or possible, active control would be evaluated to remove the enhanced prey base and reduce threats to foraging eagles. These control measures would be coordinated with the WGFD and other appropriate state and federal agencies.

Hazing big game out of the wind development areas would also be considered as a second tier reduction measure.

6.3.3 Operations and Maintenance Modifications

Modifications to Project infrastructure and operations and maintenance would be evaluated as a second tier reduction measure on a site-specific basis. If a single turbine or series of turbines consistently impact eagles, modifications including visual and auditory flight diverters would be evaluated and implemented if it is determined that those measures would minimize the risk. As other technologies or approaches are developed to reduce risk to eagles those technologies would be evaluated on a case-by-case basis.

6.3.4 Utility Power Pole Retrofits

Utility power pole retrofits would be used as compensatory mitigation in the event that anticipated impact levels are exceeded. Power pole retrofits may be used to remove risks for electrocution of eagles and other raptors, thereby offsetting eagle mortalities occurring within the Project Site.

6.3.5 Carcass Removal on Surrounding Highways

Carcass removal on surrounding highways would be used as compensatory mitigation in the event that anticipated impact levels are exceeded. The largest risk to eagles in the vicinity of the Project area is collision with highway traffic. Wintering and migratory eagles are attracted to roadkill on area highways (including Highway 130 north of Saratoga, Interstate 80 in the area surrounding Rawlins, and other surrounding roadways). During winter 2012, the Service has documented multiple eagle mortalities along these two highways in the vicinity of the Project area. During February 2012 avian survey efforts, 14 individual eagles and 1 ferruginous hawk concentrated around 2 pronghorn carcasses were observed during a 15 minute drive along a 10-mile stretch of Highway 130. At the same time, several others were observed along Interstate 80 north of the Project area. These eagles were under immediate threat of mortality from collision. In contrast, during February 2012 survey efforts, only 8 eagles were observed during 75 hours of survey in the Project area indicating, as would be expected, that winter eagle activity is low where prey and scavenging opportunities are infrequent. In the vicinity of the Project area winter eagle use is closely tied to the availability of winterkill carcasses along area highways. To remove the risk of mortality to wintering eagles and to ensure that there is no net change in regional eagle populations, carcasses will be removed from area highways on a regular basis. PCW will work with the Service and state and local highway department staff to identify appropriate removal protocols and the frequency of carcass removals. Carcasses removed from area highways will be disposed of away from the Project in areas that will attract eagles away from wind development infrastructure.

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6.4 THIRD–TIER MEASURES

Third tier measures will be implemented upon review of the success of the first and second tier risk reduction measures. If anticipated impact levels are exceeded after implementing second tier risk reduction measures, the Adaptive Management process will identify third tier risk reduction measures that are most likely to reduce impacts below acceptable thresholds. Third tier measures would only be implemented if it is determined that impacts to eagles cannot be addressed through implementation of all first and second tier risk reduction measures.

6.4.1 Real-Time Monitoring of Occupied Nest Sites

If it can be determined that construction or ongoing operations and maintenance activities result in decreased nest success or mortality, real-time monitoring of occupied nests would be considered to inform ongoing and future activities. Because most nest locations in the vicinity of the Project Site are located on cliff faces, real-time monitoring might be difficult or impractical. However, in some cases, video or photo monitoring of a nest site could be considered. Practicality of this measure would be evaluated on a case-by-case basis in close coordination with the Service.

6.4.2 Adjusting Turbine Cut-In Speeds

Adjusting turbine cut-in speeds could be evaluated on a case-by-case basis if it can be demonstrated that there is a correlation between eagle impacts and wind speed for individual turbines or groups of turbines. Because of the size of the Project, changing cut-in speeds for all turbines is impractical and unnecessary. However, if as a result of post-construction monitoring it can be demonstrated that impacts can be minimized or removed as a result of changing cut-in speeds, this measure will be evaluated.

6.4.3 Installing Sound Devices to Disorient Eagles

Installation of auditory deterrent technologies will be evaluated on a case-by-case basis. Air cannons and other sound emitting technologies can be used to deter eagle and other avian activity. It is likely that these types of technologies would be used in specific instances where predictable and repeat use of an area results in increased eagle impacts. In these instances, sound devices can be deployed on an intermittent basis when eagle use is most likely. If noise emissions become regular or predictable, eagles and other species might become acclimated, reducing the likelihood for success.

6.4.4 Wind-Wildlife Research Mitigation Fund

If impacts are greater than expected after implementing first and second tier measures, and selected third tier measures, PCW would work with the Service to develop and implement a wind-wildlife research and mitigation fund. Monies placed in this fund could be used to pay for enhancing eagle and prey base habitat, or other appropriate measures to conserve eagle populations. Monies could also be used to research and develop additional conservation and mitigation measures to benefit eagles, or to fund research related to wind energy impacts on golden eagles. Funding amounts for this research mitigation fund will be determined by PCW if it is determined that this is a necessary measure.

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6.4.5 Radar Monitoring and Mitigation System

In 2011, PCW purchased a DeTect Merlin Radar system to survey avian populations within the Project Site. The purchase of the Radar system was solely intended to survey and record avian activity over large areas of the Project Site without requiring regular ground-based surveys. Avian radar systems are often cited as having the capability to provide real-time information that will allow turbine operators to curtail production while a biological target or targets are at risk.

Curtailment of wind turbine operation by idling or braking turbines to prevent blades from spinning has been suggested as a possible mitigation measure to minimize or avoid impacts to avian species. Curtailment as a mitigation tool is typically applied to sites where large-scale broad-front songbird migration activities occur (Gulf Coast, Mississippi River corridor, Eastern Seaboard, etc.). Examples of sites in the United States where curtailment is being examined or implemented include Penascal Wind Farm, Texas, and Gulf Wind I, Texas. These locations have been identified as having high risk of avian mortality due to their proximity to major avian migration corridors or landscape features that act to concentrate birds during certain weather events or periods of broad-front migration.

Effective use of a curtailment program for eagles requires real-time identification of an individual bird, that bird's species, as well as its location, flight height, flight speed, and flight direction. It also requires a systematic approach to determine potential for collision with an operational wind turbine. Current radar technology will provide location, speed, and direction. However, radar technology cannot identify a single target to species or often even relative size class. For instance, in the PCW Radar dataset, based on preliminary analysis of ground-truth data, the signature of a golden eagle is most similar to that of a prairie falcon. Additionally, the Radar cannot predict or measure the other variables listed above that would allow curtailment to be an effective strategy to avoid risk. Further, because deviations from known high-use areas or flight paths are not predictable and cannot be determined in real-time, use of curtailment would not be effective to minimize impacts to eagles or other large species.

Even if radar technology were able to predict or measure the variables described in the above paragraph, the operational constraints of slowing or stopping turbines prevent the use of curtailment as a mitigation measure for eagles and other large species. It takes several minutes to shut down a spinning turbine. Eagle flight speeds have been calculated at 16 to 90 miles per hour (mph) during resident activities and migration (see references in Buehler 2000, PCW radar data). Using radar validation data, average eagle flight speed in the Project area is 29.75 miles per hour. Therefore, an eagle in direct flight would need to be identified as a potential risk more than 2.0 miles from a turbine (assuming a flight speed of 30 mph and a 4-minute time period to identify the bird to species, enter the curtailment command in the operations system, and brake the turbine). The difficulties of identifying a bird at more than 2.0 miles and determining that it is at risk for collision do not make curtailment a viable option for eagle mitigation. It is also probable that a bird identified at more than 2.0 miles could identify the turbine as a risk and alter its flight path prior to reaching the turbine location. This would result in unnecessary curtailment and loss of generating capacity.

Technological, logistical, and economic constraints prevent the practical application and efficacy of implementing a radar-based mitigation program for mitigating risk to eagles and other avian

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Proprietary & Confidential – Wyo. Stat. § 16-4-203(d)(v)

species. While this technology has proven effective for broad-front migration of passerines during high-use periods during spring and fall migration, it is not currently capable of providing adequate information to curtail turbines when eagles or other large avian targets are detected. Currently, this technology is not appropriate for avoiding or minimizing risks to eagles and other large avian targets. However, if the technology advances to a level making this risk reduction measure realistic, PCW will evaluate its use if all other first, second, and third tier measures cannot reduce impacts to acceptable levels.

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Proprietary & Confidential – Wyo. Stat. § 16-4-203(d)(v)

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ATTACHMENT 9

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Valerie Lightholder

Subject: Chokecherry and Sierra Madre Eagle Conservation Strategy Meeting

From: Patricia_Sweanor@fws.gov [mailto:Patricia_Sweanor@fws.gov]
Sent: Monday, March 12, 2012 5:06 PM
To: Clint King; garry.miller@tac-denver.com; Jon Kehmeier; Travis_Sanderson@fws.gov; Tyler_Abbott@fws.gov; kelly.commins@tac-denver.com
Subject: Re: Chokecherry and Sierra Madre Eagle Conservation Strategy Meeting

hi,

Thanks so much for coming up to Cheyenne to meet with us today. The meeting was very informative and helped Tyler and I understand your survey effort and the issues you face with project development. We are trying to get up to speed with Travis! I think we all realize how important this project is and that it requires a FWS team approach to ensure that your project needs are met while we work together to protect trust resources. We appreciate your efforts to achieve both results.

As a result of this meeting and to enable us to best help you, I am identifying the information we look forward to receiving from you prior to our being able to fully assess project avian issues and to review your ECP risk reduction measures in section 6.0 of your draft eagle conservation strategy.

To summarize, as we discussed, we look forward to receiving:

1. Eagle and other raptor data from on the ground counts: (1) Number and duration of counts per season; (2) Tabulated data (minutes of observation) by count location and season; (3) Flight paths (including distance of observer to flight path recorded and methods used to validate location of flight path, i.e, second observer, radar etc)

A question I still have is if there are radar locations that are verifiable as eagle/other raptor without corroboration of an observer on the ground?

2. Your revision to the CCSM eagle conservation strategy in response to FWS comments.

3. A framework for an Avian Protection Plan or Migratory Bird Conservation Strategy for the project area.

An additional point of clarification I was hoping you could provide me is how the radar results will be used to aid in depicting bird use geographically and seasonally across the project area. When I asked if radar results would be overlaid, I think I was told I would just get a blacked-out map. But doesn't that mean use was evenly distributed across the project area? Can't maps be developed, for example, for diurnal spring use, where heavier used areas with more radar locations are given a darker color and areas with fewer observations are given a lighter color? Is there not a correlation between number of dots on the map and number of bird "sightings' or locations?

As Travis mentioned, for third year surveys it will be important for understanding the geographic extent of high use areas in addition to assuring that project areas not yet thoroughly surveyed, but where turbines may be moved, are covered by effective survey efforts.

Thanks again and we look forward to hearing from you. Please continue directing your correspondence to Travis, and if you could, please cc me as back-up.

Trish

****

Trish Sweanor

Fish & Wildlife Biologist
U.S. Fish & Wildlife Service
5353 Yellowstone Rd, Suite 308A
Cheyenne, Wyoming 82009

ph (307)772-2374 ext 239
fax (307) 772-2358

ATTACHMENT 10

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Valerie Lightholder

Subject: RE: Chokecherry and Sierra Madre Eagle Conservation Strategy Meeting

From: Jon Kehmeier [mailto:jkehmeier@swca.com]
Sent: Wednesday, March 14, 2012 8:47 AM
To: Patricia_Sweanor@fws.gov; Clint King; Garry Miller; Travis_Sanderson@fws.gov; Tyler_Abbott@fws.gov; kelly.commins@tac-denver.com
Subject: RE: Chokecherry and Sierra Madre Eagle Conservation Strategy Meeting

Trish,

Thank you for taking the time on Monday. We thought it was a very productive meeting and look forward to working closely with you, Travis, and Tyler as we move forward. To answer some of your questions/comment:

1. Eagle and other raptor data from on the ground counts: (1) Number and duration of counts per season; (2) Tabulated data (minutes of observation) by count location and season; (3) Flight paths (including distance of observer to flight path recorded and methods used to validate location of flight path, i.e, second observer, radar etc) **Clint and I are in the process of incorporating/clarifying these data in the current version of the eagle conservation strategy and will do the same for the avian conservation strategy.**

A question I still have is if there are radar locations that are verifiable as eagle/other raptor without corroboration of an observer on the ground? **No, radar targets cannot be 100% verified without an observer on the ground. We are developing models to help us define which targets are most likely eagles, other raptors, etc. These models will help us better understand flight patterns in the project area for siting purposes but cannot be verified without a ground observer and someone in the radar marking the bird as an eagle/raptor. The radar is helping us understand patterns of use by different categories (small, large, migratory, etc.).**

2. Your revision to the CCSM eagle conservation strategy in response to FWS comments.
We are nearing completion of our response to your initial comments and will incorporate/clarify some other items that we discussed with you and Tyler on Monday.

3. A framework for an Avian Protection Plan or Migratory Bird Conservation Strategy for the project area.
We are in the process of completing our annual avian survey report and will use that as the basis for the avian conservation strategy. We will begin to put together an outline/framework for this document and will share that when it is complete.

An additional point of clarification I was hoping you could provide me is how the radar results will be used to aid in depicting bird use geographically and seasonally across the project area. When I asked if radar results would be overlaid, I think I was told I would just get a blacked-out map. But doesn't that mean use was evenly distributed across the project area? Can't maps be developed, for example, for diurnal spring use, where heavier used areas with more radar locations are given a darker color and areas with fewer observations are given a lighter color? Is there not a correlation between number of dots on the map and number of bird "sightings' or locations? **We haven't explored this in enough detail to know if this will yield informative results. I agree with you that bird use is not evenly distributed across the landscape. We see this with our avian ground surveys. Clint began exploring this option yesterday and we will keep you posted on whether it is an appropriate use of the data.**

As Travis mentioned, for third year surveys it will be important for understanding the geographic extent of high use areas in addition to assuring that project areas not yet thoroughly surveyed, but where turbines may be moved, are covered by effective survey efforts.
We are in the process of developing our final recommended year 3 surveys. I hope to have those to you the first of next week.

Jon Kehmeier
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http://www.linkedin.com/company/swca-environmental-consultants

From: Patricia_Sweanor@fws.gov [mailto:Patricia_Sweanor@fws.gov]
Sent: Monday, March 12, 2012 5:06 PM
To: Clint King; garry.miller@tac-denver.com; Jon Kehmeier; Travis_Sanderson@fws.gov; Tyler_Abbott@fws.gov; kelly.commins@tac-denver.com
Subject: Re: Chokecherry and Sierra Madre Eagle Conservation Strategy Meeting

hi,

Thanks so much for coming up to Cheyenne to meet with us today. The meeting was very informative and helped Tyler and I understand your survey effort and the issues you face with project development. We are trying to get up to speed with Travis! I think we all realize how important this project is and that it requires a FWS team approach to ensure that your project needs are met while we work together to protect trust resources. We appreciate your efforts to achieve both results.

As a result of this meeting and to enable us to best help you, I am identifying the information we look forward to receiving from you prior to our being able to fully assess project avian issues and to review your ECP risk reduction measures in section 6.0 of your draft eagle conservation strategy.

To summarize, as we discussed, we look forward to receiving:

1. Eagle and other raptor data from on the ground counts: (1) Number and duration of counts per season; (2) Tabulated data (minutes of observation) by count location and season; (3) Flight paths (including distance of observer to flight path recorded and methods used to validate location of flight path, i.e, second observer, radar etc)

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An additional point of clarification I was hoping you could provide me is how the radar results will be used to aid in depicting bird use geographically and seasonally across the project area. When I asked if radar results would be overlaid, I think I was told I would just get a blacked-out map. But doesn't that mean use was evenly distributed

across the project area? Can't maps be developed, for example, for diurnal spring use, where heavier used areas with more radar locations are given a darker color and areas with fewer observations are given a lighter color? Is there not a correlation between number of dots on the map and number of bird "sightings' or locations?

As Travis mentioned, for third year surveys it will be important for understanding the geographic extent of high use areas in addition to assuring that project areas not yet thoroughly surveyed, but where turbines may be moved, are covered by effective survey efforts.

Thanks again and we look forward to hearing from you. Please continue directing your correspondence to Travis, and if you could, please cc me as back-up.

Trish

****

Trish Sweanor

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ATTACHMENT 11

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Valerie Lightholder

From: Jon Kehmeier <jkehmeier@swca.com>
Sent: Wednesday, March 21, 2012 9:02 PM
To: Tyler_Abbott@fws.gov; Patricia_Sweanor@fws.gov; Travis_Sanderson@fws.gov
Cc: Garry Miller; cking@swca.com
Subject: PCW Eagle Data and Year 3 Survey Protocols
Attachments: PCW Year 3 protocols - DRAFT.docx; PCW_AllEagles_AllObservations_20120321_EagleDataForFWS.xlsx

Travis, Trish, and Tyler,

I have attached a copy of the eagle data collected as part of Power Company of Wyoming's year 2 surveys. These data do not include all of the winter data. Those data will be forwarded once we have gone through our QA process (likely within the next few weeks). The spreadsheet has three tabs. The first tab is the survey locations and time of survey at each location on the date the survey occurred. The second tab contains all of the eagle observations that were recorded, the duration of those observations, and the species of eagle observed. The third tab contains a glossary of the variables contained in each tab. These data should allow you to look at site-specific eagle use per minute of survey time (number of observations per minute). Please take a look at the data and let me know what additional information you need for your modeling purposes. Trish, Tyler mentioned to me on Monday that you have a new model for risk assessment. Would it be possible to get a copy of that model to review? I think it would help us understand all of the datasets that you need from us for modeling purposes. I think it will be helpful as we continue working through the risk assessment process and the finalization of the eagle conservation strategy and APP.

I have also attached a copy of the year 3 survey protocols. The protocols consist of running the radar through November of 2012, completing aerial surveys for raptors in the same areas we surveyed in 2011, and to conduct 3-4 hour long-watch raptor surveys at 14 sites. Two long-watch surveys would be completed per day and each site would be visited twice per month. The intent of the year 3 survey is to better understand the eagle use areas that we have identified, evaluate eagle and raptor use in areas where survey coverage is lacking, to compare nesting trends across years, and to use the radar to better understand home ranges around raptor/eagle nests and migratory bird migration and patterns of use. Following year 3 surveys we will have 100% survey coverage of all of the probable turbine footprint. We will begin our year 3 surveys at the beginning of April.

If you have any questions about either attached file please let me know.

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Date	SurveyPoint	StartTime	EndTime	SurveyMins
4/4/2011	RM 2-ALT	11:50	18:35	406
4/4/2011	RM 1	10:00	18:24	505
4/5/2011	RM 5	10:03	18:15	493
4/5/2011	RM 8	10:10	18:30	501
4/7/2011	RM 7	10:00	18:00	481
4/7/2011	RM 6	9:20	17:50	511
4/8/2011	RM 14	9:34	17:55	502
4/8/2011	RM 13-ALT	9:00	17:34	515
4/11/2011	RM 1	8:35	16:35	481
4/11/2011	RM 2	8:12	16:45	514
4/12/2011	RM 14	9:30	18:00	511
4/12/2011	RM 13-ALT	9:00	17:00	481
4/13/2011	RM 6	9:00	17:35	516
4/13/2011	RM 7	9:00	15:00	361
4/15/2011	RM 5	9:15	18:05	531
4/15/2011	RM 8	8:30	16:30	481
4/19/2011	RM 9	9:10	19:10	601
4/19/2011	RM 10-ALT	9:55	18:25	511
4/20/2011	RM 15	8:36	17:06	511
4/20/2011	RM 13	8:45	15:50	426
4/21/2011	RM 11	9:40	17:00	441
4/21/2011	RM 11-ALT	9:40	17:00	441
4/21/2011	RM 12	9:55	16:55	421
4/24/2011	RM 4	8:00	14:00	361
4/24/2011	RM 15	8:16	14:16	361
4/24/2011	RM 3	8:16	14:16	361
4/25/2011	RM 9	7:45	16:15	511
4/25/2011	RM 10	8:15	16:45	511
4/26/2011	RM 13	7:45	16:45	541
4/26/2011	RM 15	7:30	16:00	511
4/27/2011	RM 12	10:05	18:35	511
4/27/2011	RM 11	10:00	18:30	511
4/28/2011	RM 4	9:32	18:02	511
4/28/2011	RM 3	9:15	17:45	511
5/2/2011	RM 1	8:35	17:05	511
5/2/2011	RM 2	8:20	17:00	521
5/3/2011	RM 8	8:17	16:47	511
5/3/2011	RM 9	8:00	16:30	511
5/4/2011	RM 10	9:45	17:45	481
5/4/2011	RM 11	10:00	18:30	511
5/5/2011	RM 7	9:00	17:30	511
5/5/2011	RM 5	9:00	17:30	511
5/9/2011	RM 12	8:20	13:50	331
5/9/2011	RM 6	7:50	14:00	371
5/10/2011	RM 4	7:20	16:20	541
5/10/2011	RM 14	7:35	16:05	511

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5/12/2011	RM 13	7:05	15:35	511
5/13/2011	RM 15	8:27	16:12	466
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5/16/2011	RM 11	7:29	15:59	511
5/17/2011	RM 9	8:12	9:45	94
5/18/2011	RM 8	8:34	15:48	435
5/18/2011	RM 9	8:22	16:00	459
5/20/2011	RM 7	12:55	17:30	276
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5/22/2011	RM 1	7:30	16:00	511
5/22/2011	RM 2	9:15	17:45	511
5/23/2011	RM 4	7:45	15:22	458
5/23/2011	RM 14	7:40	15:24	465
5/24/2011	RM 13	8:00	16:30	511
5/24/2011	RM 15	7:20	15:50	511
5/25/2011	RM 12	9:17	17:47	511
5/25/2011	RM 6	9:05	17:35	511
5/28/2011	RM 5	8:00	14:15	376
5/28/2011	RM 3	8:20	10:59	160
5/31/2011	RM 11	9:00	17:30	511
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6/1/2011	RM 1	8:15	16:45	511
6/2/2011	RM 7	8:01	16:31	511
6/2/2011	RM 5	7:50	17:15	566
6/3/2011	RM 9	8:40	17:10	511
6/3/2011	RM 10	8:50	17:20	511
6/3/2011	RM 8	8:55	17:25	511
6/6/2011	RM 14	9:14	17:44	511
6/6/2011	RM 4	9:20	17:50	511
6/7/2011	RM 13	9:00	17:30	511
6/7/2011	RM 3	10:15	17:30	436
6/8/2011	RM 12	8:00	16:30	511
6/8/2011	RM 6	7:54	16:24	511
6/9/2011	RM 15	7:15	15:45	511
6/13/2011	RM 2	9:30	18:00	511
6/13/2011	RM 1	9:30	18:00	511
6/14/2011	RM 5	9:10	17:40	511
6/14/2011	RM 7	10:05	18:00	476
6/15/2011	RM 10	8:30	16:30	481
6/15/2011	RM 11	8:00	16:30	511
6/16/2011	RM 9	8:25	11:18	174
6/16/2011	RM 8	8:20	11:14	175
6/21/2011	RM 3	8:04	16:34	511
6/21/2011	RM 8	9:15	15:30	376
6/21/2011	RM 9	8:15	16:45	511

6/23/2011	RM 14	8:05	16:15	491
6/23/2011	RM 4	8:05	16:15	491
6/24/2011	RM 15	9:50	17:50	481
6/24/2011	RM 13	7:30	16:00	511
6/25/2011	RM 6	8:15	16:45	511
6/25/2011	RM 12	7:50	16:20	511
6/27/2011	RM 5	11:30	18:05	396
6/27/2011	RM 7	9:35	18:05	511
6/28/2011	RM 1	8:15	16:45	511
6/28/2011	RM 2	8:40	17:15	516
6/29/2011	RM 8	8:05	15:05	421
6/29/2011	RM 9	9:20	15:00	341
6/30/2011	RM 11	8:55	10:26	92
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7/1/2011	RM 11	8:45	16:45	481
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7/10/2011	RM 14	13:35	17:40	246
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7/10/2011	RM 13	13:55	17:55	241
7/11/2011	RM 11	8:40	12:40	241
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7/27/2011	RM 12	12:05	15:05	181
7/27/2011	RM 2	7:32	11:32	241
7/27/2011	RM 1	12:50	16:50	241
7/28/2011	RM 14	9:05	13:05	241
7/28/2011	RM 11	13:40	17:40	241
7/28/2011	RM 6	8:47	12:47	241
7/29/2011	RM 8	7:40	11:40	241
7/29/2011	RM 5	12:57	17:15	259
8/7/2011	RM 15	13:45	17:45	241

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8/9/2011	RM 3	8:25	12:25	241
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8/9/2011	RM 4	13:02	17:06	245
8/9/2011	RM 14	12:54	16:54	241
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8/10/2011	RM 12	8:40	12:40	241
8/12/2011	RM 10	10:55	14:55	241
8/12/2011	RM 6	10:55	14:55	241
8/15/2011	RM 13	9:03	16:50	468
8/15/2011	RM 3	9:05	16:25	441
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8/17/2011	RM 12	8:50	17:20	511
8/18/2011	RM 14	7:55	16:25	511
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8/22/2011	RM 11	8:50	17:20	511
8/23/2011	RM 10	8:30	16:30	481
8/23/2011	RM 6	8:30	17:00	511
8/30/2011	RM 12	8:48	15:30	403
8/30/2011	RM 7	8:50	15:20	391
8/31/2011	RM 3	7:32	16:06	515
8/31/2011	RM 13	7:30	16:00	511
9/1/2011	RM 4	7:36	16:06	511
9/2/2011	RM 15	8:10	16:40	511
9/2/2011	RM 14	8:10	16:20	491
9/7/2011	RM 9	10:30	18:00	451
9/7/2011	RM 8	10:25	18:00	456
9/8/2011	RM 2	9:15	17:45	511
9/8/2011	RM 1	9:05	17:35	511
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9/14/2011	RM 13	8:50	17:20	511

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9/15/2011 RM 4	9:15	17:45	511
9/15/2011 RM 14	9:12	17:42	511
9/16/2011 RM 3	8:57	17:27	511
9/19/2011 RM 1	8:10	16:40	511
9/19/2011 RM 2	7:44	16:14	511
9/20/2011 RM 5	9:37	18:07	511
9/20/2011 RM 11	9:20	17:40	501
9/21/2011 RM 8	7:55	16:25	511
9/21/2011 RM 9	7:50	16:20	511
9/22/2011 RM 10	9:00	17:30	511
9/22/2011 RM 6	9:00	17:30	511
9/26/2011 RM 12	9:00	17:30	511
9/26/2011 RM 7	9:00	17:30	511
9/27/2011 RM 4	8:22	16:52	511
9/27/2011 RM 14	8:25	16:55	511
9/28/2011 RM 3	8:15	16:45	511
9/28/2011 RM 13	8:22	16:52	511
9/30/2011 RM 15	8:20	16:50	511
10/3/2011 RM 9	8:32	15:30	419
10/3/2011 RM 8	8:30	15:30	421
10/4/2011 RM 10	8:25	14:20	356
10/4/2011 RM 6	8:25	14:20	356
10/5/2011 RM 5	9:20	17:50	511
10/5/2011 RM 1	11:00	18:00	421
10/10/2011 RM 2	8:35	17:05	511
10/10/2011 RM 11	8:55	17:25	511
10/11/2011 RM 12	8:30	17:00	511
10/11/2011 RM 7	8:30	17:00	511
10/12/2011 RM 13	9:05	17:38	514
10/12/2011 RM 3	9:09	17:39	511
10/13/2011 RM 15	8:50	17:20	511
10/14/2011 RM 4	8:30	17:00	511
10/14/2011 RM 14	8:30	17:00	511
10/18/2011 RM 8	8:58	17:28	511
10/18/2011 RM 9	9:00	17:30	511
10/19/2011 RM 6	8:44	17:14	511
10/19/2011 RM 10	8:30	17:00	511
10/19/2011 RM 6	8:44	17:14	511
10/20/2011 RM 1	8:00	16:30	511
10/20/2011 RM 2	8:04	16:34	511
10/21/2011 RM 5	8:55	17:25	511
10/21/2011 RM 11	9:00	17:30	511
10/24/2011 RM 13	8:35	17:05	511
10/24/2011 RM 7	8:45	12:30	226
10/24/2011 RM 3	8:30	17:00	511
10/25/2011 RM 12	8:45	12:45	241

10/27/2011	RM 15	8:30	17:00	511
10/27/2011	RM 4	8:30	17:00	511
10/28/2011	RM 7	9:45	17:30	466
10/28/2011	RM 12	9:50	17:30	461
10/29/2011	RM 14	10:00	17:00	421
10/31/2011	RM 6	8:35	17:05	511
10/31/2011	RM 10	8:30	17:00	511
11/3/2011	RM 9	9:11	17:00	470
11/3/2011	RM 9	9:11	17:00	470
11/3/2011	RM 1	8:10	17:30	561
11/3/2011	RM 8	9:18	16:55	458
11/5/2011	RM 2	8:51	14:45	355
11/7/2011	RM 3	8:35	16:40	486
11/7/2011	RM 13	8:25	16:55	511
11/8/2011	RM 7	10:05	15:00	296
11/8/2011	RM 15	10:00	15:30	331
11/9/2011	RM 14	9:46	16:30	405
11/9/2011	RM 4	10:10	16:30	381
11/9/2011	RM 5	9:30	16:00	391
11/10/2011	RM 11	9:07	16:20	434
11/10/2011	RM 12	10:10	16:00	351
11/14/2011	RM 1	8:40	16:50	491
11/14/2011	RM 2	10:07	16:30	384
11/15/2011	RM 8	9:36	16:30	415
11/15/2011	RM 9	10:01	16:30	390
11/15/2011	RM 10	9:49	16:17	389
11/16/2011	RM 11	10:00	16:19	380
11/16/2011	RM 5	11:30	16:45	316
11/16/2011	RM 6	10:10	16:30	381

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ATTACHMENT 12

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Valerie Lightholder

From:	Tyler_Abbott@fws.gov
Sent:	Thursday, April 12, 2012 2:29 PM
To:	Jon Kehmeier
Cc:	Clint King; Garry Miller; Patricia_Sweanor@fws.gov; Mark_Sattelberg@fws.gov
Subject:	Information Request re. PCW Eagle Data and Year 3 Survey Protocols
Importance:	High

Jon and Garry:

Trish is in the middle of reviewing the data provided.

In order for us to understand the survey data-- and for us to provide meaningful recommendations on the Migratory Bird Conservation Strategy and ECP for CCSM-- we have the following requests and/or questions:

1. Provide maps showing evolution of the CCSM project area and survey efforts within those boundaries.
2. Provide a map with count locations as identified in the excel spreadsheet entitled "PCW_AllEagles_AllObservations_20120321_EagleDataforFWS".
3. Provide a map of the flight paths of eagles observed in the 2011 surveys and overlaid on the count locations.
4. Provide maps with all radar point locations determined by "substantial analysis and post-processing" to be eagles. (Phrase in quotes is from the PCW Draft Programmatic ECP).
5. Provide step-by-step descriptions, with examples, of what "substantial analysis and post-processing" of the radar data is.
6. Include column in the excel spreadsheet PCW_AllEagles_AllObservations_20120321_EagleDataforFWS with distance from the observer for each eagle observation.
7. Provide eagle data from WEST's 2008 surveys in a spreadsheet with the following data entries: identification of point count location, date of survey, duration of survey, minutes eagles were observed (or at least no. of eagles observed) per survey. Also provide eagle flight path maps if available.
8. Identify any eagle survey efforts in 2009 and 2010.

Thanks

Tyler Abbott
Deputy Field Supervisor
U.S. Fish and Wildlife Service
Wyoming Ecological Services Office
Office: (307) 772-2374 x 231

Cell: (307) 286-7242
tyler_abbott@fws.gov

"Jon Kehmeier" <jkehmeier@swca.com>

"Jon Kehmeier"
<jkehmeier@swca.com>

03/21/2012 09:02 PM

To<Tyler_Abbott@fws.gov>, <Patricia_Sweanor@fws.gov>, <Travis_Sanderson@fws.gov>

cc<garry.miller@tac-denver.com>, <cking@swca.com>

SubjectPCW Eagle Data and Year 3 Survey Protocols

Travis, Trish, and Tyler,

I have attached a copy of the eagle data collected as part of Power Company of Wyoming's year 2 surveys. These data do not include all of the winter data. Those data will be forwarded once we have gone through our QA process (likely within the next few weeks). The spreadsheet has three tabs. The first tab is the survey locations and time of survey at each location on the date the survey occurred. The second tab contains all of the eagle observations that were recorded, the duration of those observations, and the species of eagle observed. The third tab contains a glossary of the variables contained in each tab. These data should allow you to look at site-specific eagle use per minute of survey time (number of observations per minute). Please take a look at the data and let me know what additional information you need for your modeling purposes. Trish, Tyler mentioned to me on Monday that you have a new model for risk assessment. Would it be possible to get a copy of that model to review? I think it would help us understand all of the datasets that you need from us for modeling purposes. I think it will be helpful as we continue working through the risk assessment process and the finalization of the eagle conservation strategy and APP.

I have also attached a copy of the year 3 survey protocols. The protocols consist of running the radar through November of 2012, completing aerial surveys for raptors in the same areas we surveyed in 2011, and to conduct 3-4 hour long-watch raptor surveys at 14 sites. Two long-watch surveys would be completed per day and each site would be visited twice per month. The intent of the year 3 survey is to better understand the eagle use areas that we have identified, evaluate eagle and raptor use in areas where survey coverage is lacking, to compare nesting trends across years, and to use the radar to better understand home ranges around raptor/eagle nests and migratory bird migration and patterns of use. Following year 3 surveys we will have 100% survey coverage of all of the probable turbine footprint. We will begin our year 3 surveys at the beginning of April.

If you have any questions about either attached file please let me know.

Jon Kehmeier
Principal Ecologist
SWCA Environmental Consultants
295 Interlocken Blvd., Suite 300

Broomfield, CO 80021
P 303.487.1183 | M 720.951.0600 | F 303.487.1245

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http://on.fb.me/SWCA_Environmental_Consultants
http://www.linkedin.com/company/swca-environmental-consultants
[attachment "PCW Year 3 protocols - DRAFT.docx" deleted by Tyler Abbott/R6/FWS/DOI] [attachment "PCW_AllEagles_AllObservations_20120321_EagleDataForFWS.xlsx" deleted by Tyler Abbott/R6/FWS/DOI]

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ATTACHMENT 13

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Valerie Lightholder

From: Jon Kehmeier <jkehmeier@swca.com>
Sent: Tuesday, April 17, 2012 5:34 PM
To: Tyler_Abbott@fws.gov; Patricia_Sweanor@fws.gov
Cc: Clint King; Garry Miller; Mark_Sattelberg@fws.gov
Subject: RE: Information Request re. PCW Eagle Data and Year 3 Survey Protocols
Attachments: 2011_2012_EagleFlightPaths.docx; 2011_2012 _LongWatchAndRadarSurveyLocations.docx; 2012-04-09_OriginalDev-CurrentDev_ 11x17_lr.pdf; EagleAnalysis_AllSeasons_April17_2012_forUSFWS.xlsx; WESTAvianObservationPoints.jpg

Tyler and Trish,

Please find attached copies of the information you requested. Details of the contents of this email are as follows:

1. Provide maps showing evolution of the CCSM project area and survey efforts within those boundaries.

   See attached PDF titled 2012-04-09 OriginalDev-CurrentDev file. This map shows the current project boundaries in a purple color and the original in an orange color. Sage-grouse core areas have been included as reference as they help to define the outer boundaries of the current development area. Note the shift in the Sierra Madre project area. The current Chokecherry project area is largely similar to the original boundary.

2. Provide a map with count locations as identified in the excel spreadsheet entitled "PCW_AllEagles_AllObservations_20120321_EagleDataforFWS".

   See attached Word file titled 2011_2012LongWatchAndRadarSurveyLocations. These maps are also included in the latest version of PCW's ECS which is nearing completion.

3. Provide a map of the flight paths of eagles observed in the 2011 surveys and overlaid on the count locations.

   See attached Word file titled 2011_2012EagleFlightPaths. These maps are also included in the latest version of PCW's ECS which is nearing completion.

4. Provide maps with all radar point locations determined by "substantial analysis and post-processing" to be eagles. (Phrase in quotes is from the PCW Draft Programmatic ECP).

   The newest version of the ECS will not include radar data analyzed to be eagles. The uncertainty regarding each radar target is too great for us to include those data at this time. Radar data are being used to identify avian use patterns as part of PCW's BBCS but will not be relied on for species identification, including for eagles and other raptor species.

5. Provide step-by-step descriptions, with examples, of what "substantial analysis and post-processing" of the radar data is.

   See response for question 4. Radar data will not be included in the newest version of the ECS.

6. Include column in the excel spreadsheet PCW_AllEagles_AllObservations_20120321_EagleDataforFWS with distance from the observer for each eagle observation.

   See attached Excel spreadsheet titled EagleAnalysis_AllSeasons... This file contains all observations of eagles in flight for all seasons, a summary of survey duration for all survey events, and calculations of eagle use by survey site and season. These data should be used to replace those that were sent to the Service earlier as the earlier version did not include winter data and contained several records that have been corrected as part of our ongoing QA/QC program for this dataset. The Excel spreadsheet contains a glossary tab that should provide the information you need to decipher the various datasets.

7. Provide eagle data from WEST's 2008 surveys in a spreadsheet with the following data entries: identification of point count location, date of survey, duration of survey, minutes eagles were observed (or at least no. of eagles observed) per survey. Also provide eagle flight path maps if available.

   WEST's 2008 data are still in process. I anticipate delivering that dataset in the next day or two. I have attached a copy of WEST's observation locations. WEST's data only include number of observations per 20 minute point count and thus will not be able to provide the number of minutes in which eagles were observed or the flight paths of those eagles but will be able to provide number of eagles per 20 minute survey.

8. Identify any eagle survey efforts in 2009 and 2010.

There were no specific eagle survey efforts in 2009 or 2010 other than those that were completed in winter 2009 by WEST. SWCA has maintained an incidental observation dataset that contains observations that have been made during 2009 and 2010.

I will forward the WEST dataset as soon as it has been compiled. If you have any questions regarding the information attached please let me know.

Jon Kehmeier
Principal Ecologist
SWCA Environmental Consultants
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http://www.linkedin.com/company/swca-environmental-consultants

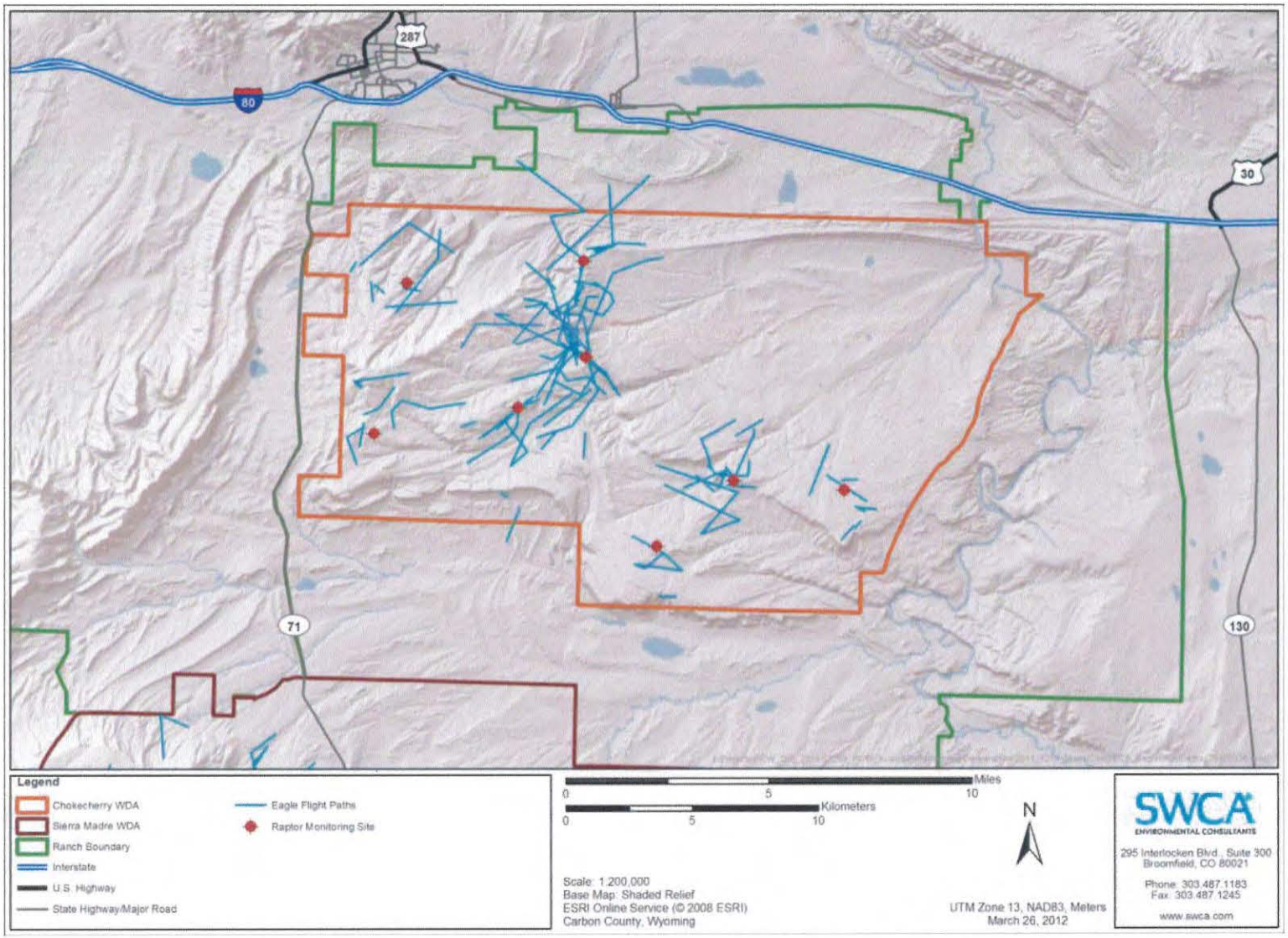


Figure 17. All eagle flight paths documented in the Chokecherry WDA during Year Two long-watch surveys.

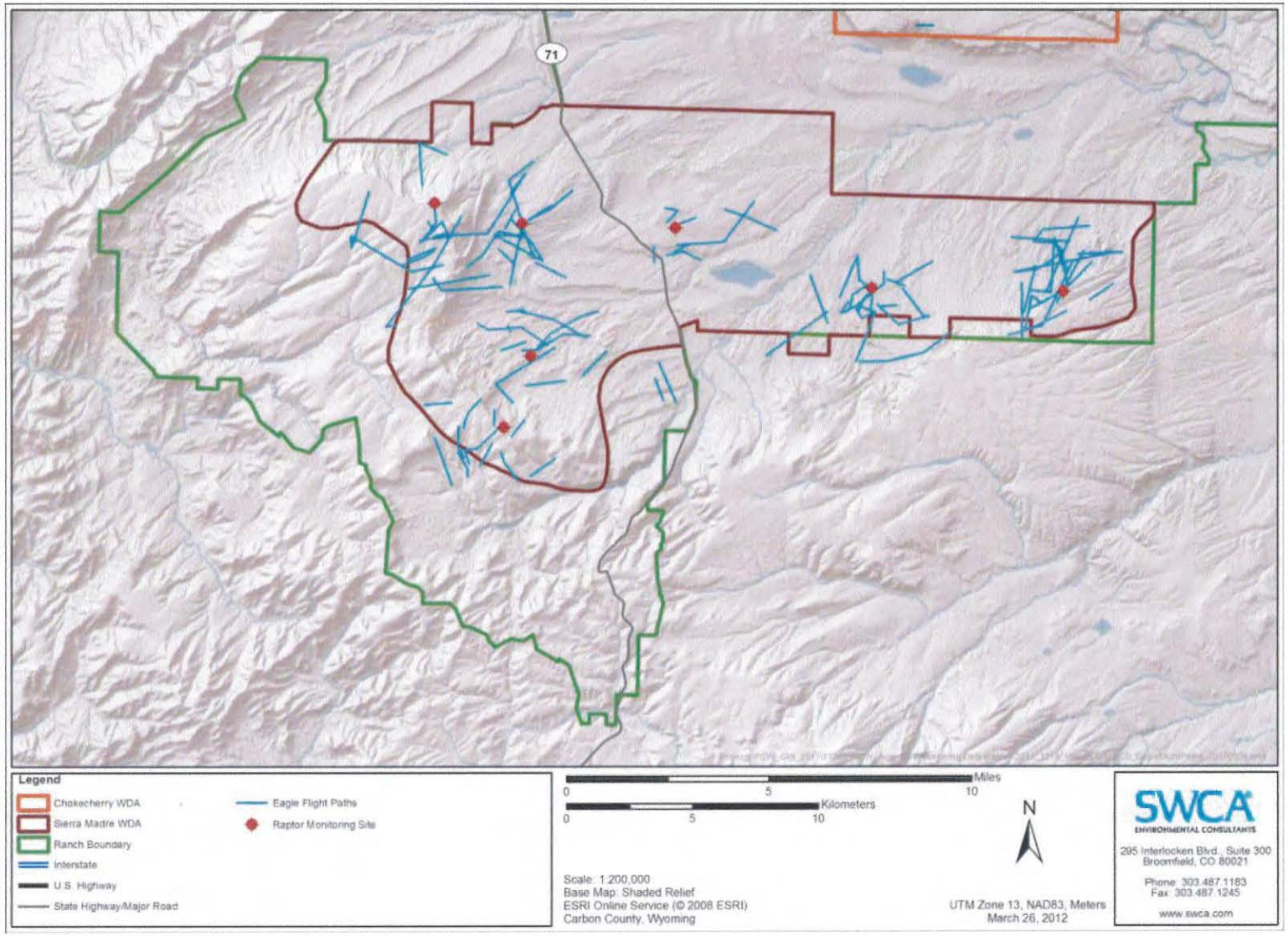


Figure 18. All eagle flight paths documented in the Sierra Madre WDA during Year Two long-watch surveys.

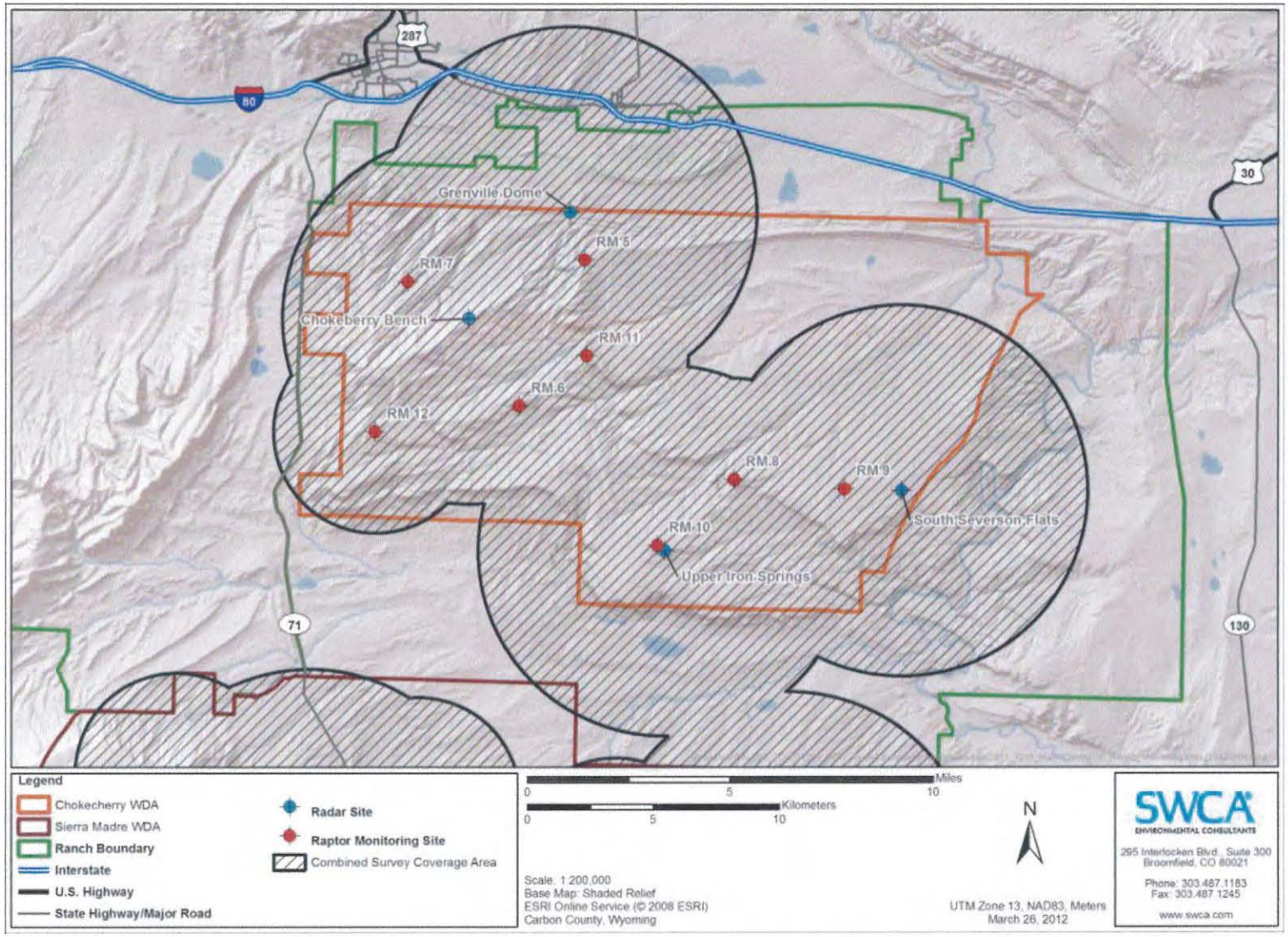


Figure 10. Radar and long-watch raptor survey sites and survey coverage areas in Chokecherry.

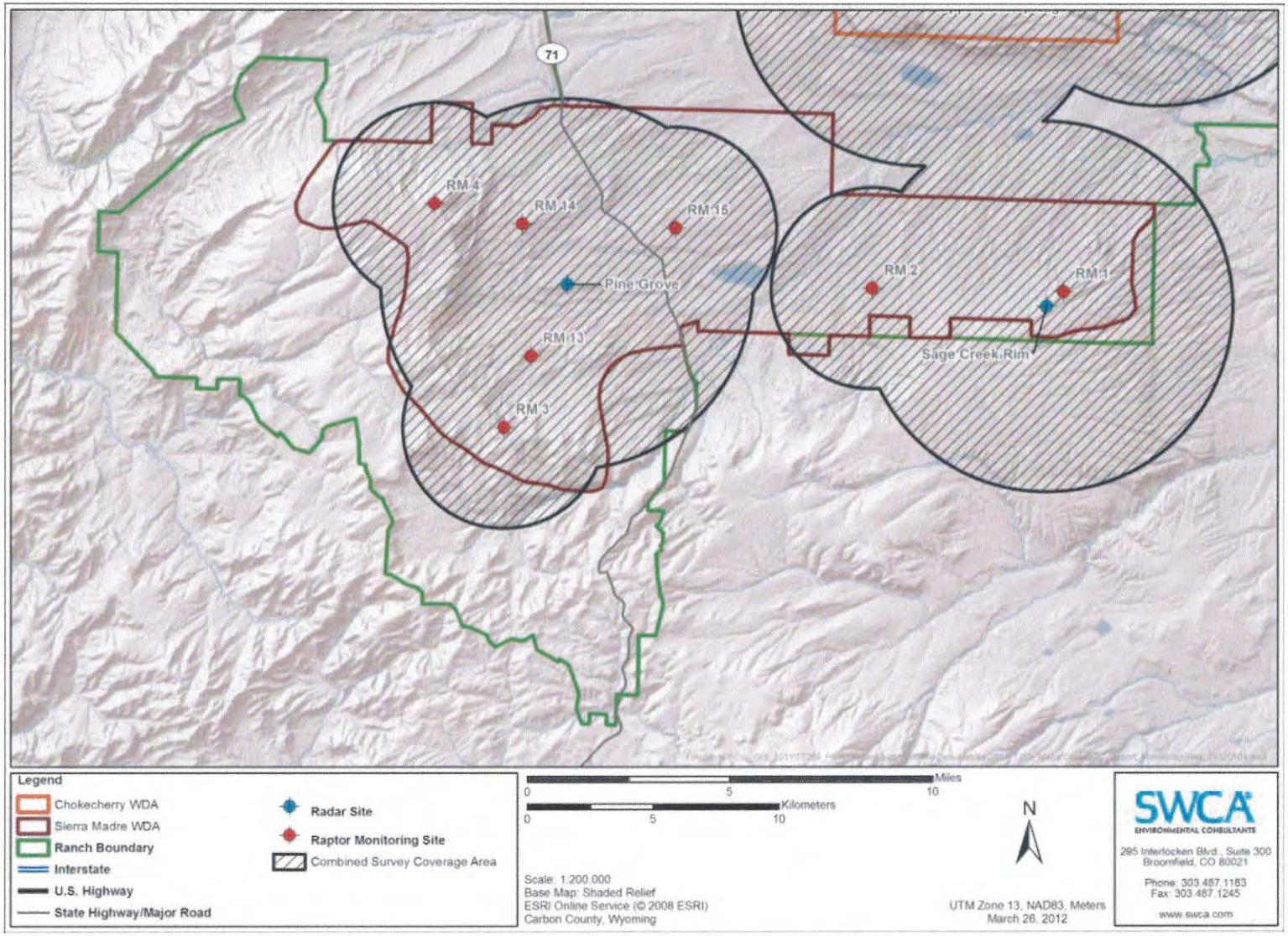
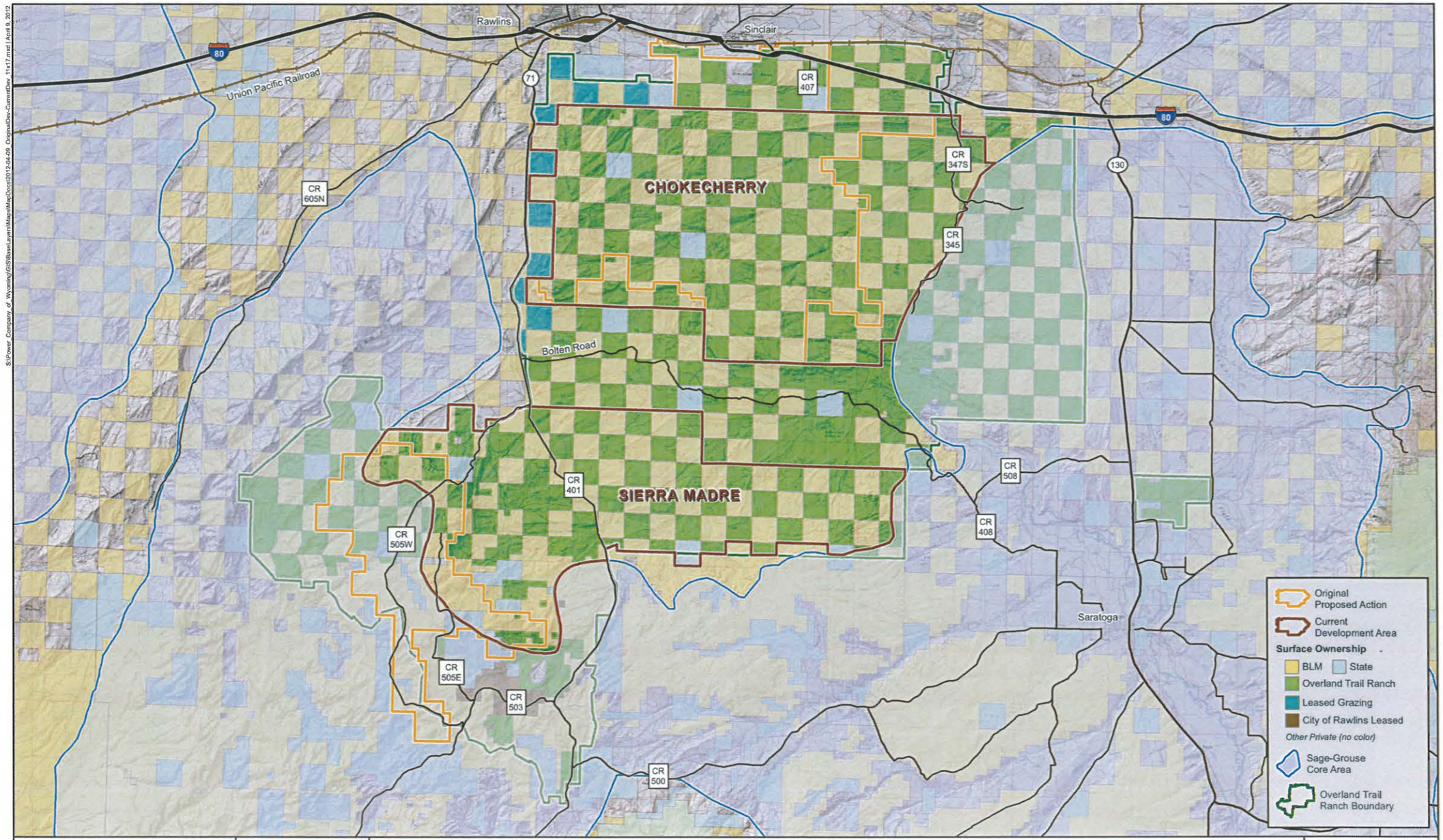


Figure 11. Radar and long-watch raptor survey sites and survey coverage areas in Sierra Madre.



N W E S

0 1 2 3 4 5
Miles

Surface Ownership (BLM and PCW, 2010)
Topographic Base (USGS, 1:100,000)

Proprietary & Confidential

Original Proposed Action and Current Development Areas

Chokecherry and Sierra Madre Wind Energy Project | Apr. 9, 2012

Power Company of Wyoming LLC

S:\Power Company of Wyoming\GIS\BaseLayers\Maps\MapDocs\2012-04-09_OriginalDev-CurrentDev_11x17.mxd | April 9, 2012

SiteSummary Data

SurveyEvent	Unique identifier for each survey event, used for relational purposes in master database
SurveyPoint	Survey point at which observations were made
Date	Date on which survey occurred
StartTime	Start time of survey
EndTime	End time of survey
SurveyMins	Minutes of survey completed (end time - start time)
ProjectArea	Project area in which survey point is located (SM = Sierra Madre, CC = Chokecherry)
Season	Migratory bird season in which survey occurred (spring = April 1 - June 30, summer = July 1 - August 14, fall = August 15 - November 15, winter = November 15 - March 31)

EagleUse

SurveyEvent	Unique identifier for each survey event, used for relational purposes in master database
SurveyPoint	Survey point at which observations were made
Date	Date on which survey occurred
Season	Migratory bird season in which survey occurred (spring = April 1 - June 30, summer = July 1 - August 14, fall = August 15 - November 15, winter = November 15 - March 31)
NumberOfEagles	Number of eagles observed per observation
FlightMinutesPerTarget	Number of minutes eagles were observed
TotalEagleFlightMinutes	Product of number of eagles per observation multiplied by number of minutes that the eagles were in flight (NumberOfEagles * FlightMinutesPerTarget)
DistanceToTarget	Distance from observer for each eagle target
ProjArea	Project area in which survey point is located (SM = Sierra Madre, CC = Chokecherry)

Valerie Lightholder

From: Jon Kehmeier <jkehmeier@swca.com>
Sent: Wednesday, April 18, 2012 3:29 PM
To: Tyler_Abbott@fws.gov; Patricia_Sweanor@fws.gov
Cc: Clint King; Garry Miller; Mark_Sattelberg@fws.gov
Subject: RE: Information Request re. PCW Eagle Data and Year 3 Survey Protocols
Attachments: PCW WEST 2008-2009 eagle data.xlsx

Tyler and Trish,

I have attached the 2008 and 2009 eagle observations recorded by WEST. In 2008-2009 there were 433, 800-meter, 20-minute point counts completed within the original wind development area. A total of 8660 minutes of observation occurred during these surveys. A total of 72 individual eagles were observed during 58 of the 433 surveys. The other 375 surveys did not record any eagle activity. If you have any questions regarding the attached spreadsheet, please let me know.

Jon Kehmeier
Principal Ecologist
SWCA Environmental Consultants
295 Interlocken Blvd., Suite 300
Broomfield, CO 80021
P 303.487.1183 | M 720.951.0600 | F 303.487.1245

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http://www.linkedin.com/company/swca-environmental-consultants

---

From: Jon Kehmeier
Sent: Tuesday, April 17, 2012 5:34 PM
To: 'Tyler_Abbott@fws.gov'; Patricia_Sweanor@fws.gov
Cc: Clint King; garry.miller@tac-denver.com; Mark_Sattelberg@fws.gov
Subject: RE: Information Request re. PCW Eagle Data and Year 3 Survey Protocols

Tyler and Trish,

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I will forward the WEST dataset as soon as it has been compiled. If you have any questions regarding the information attached please let me know.

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date	Station Number	species	indivs	duration (minutes)
10/30/2008	2	GOEA	1	20
4/22/2009	2	GOEA	1	20
10/23/2008	3	GOEA	1	20
11/6/2008	3	GOEA	2	20
11/12/2008	3	GOEA	1	20
4/29/2009	3	GOEA	2	20
10/3/2008	4	GOEA	1	20
10/23/2008	4	GOEA	1	20
10/30/2008	4	GOEA	1	20
11/12/2008	4	GOEA	1	20
4/28/2009	4	GOEA	1	20
11/6/2008	5	GOEA	1	20
5/28/2009	5	BAEA	1	20
5/28/2009	5	GOEA	1	20
5/13/2009	6	GOEA	2	20
5/28/2009	6	BAEA	1	20
6/26/2008	7	GOEA	2	20
8/1/2008	7	GOEA	1	20
8/29/2008	7	GOEA	1	20
9/14/2008	7	GOEA	1	20
10/3/2008	7	GOEA	1	20
10/13/2008	7	GOEA	1	20
5/14/2009	7	GOEA	1	20
6/3/2009	7	GOEA	1	20
7/23/2008	9	GOEA	1	20
11/6/2008	9	GOEA	2	20
9/14/2008	10	GOEA	2	20
10/30/2008	10	GOEA	1	20
12/17/2008	10	GOEA	1	20
12/23/2008	10	GOEA	1	20
6/16/2009	10	GOEA	1	20
7/8/2008	11	GOEA	1	20
8/16/2008	11	GOEA	2	20
10/14/2008	11	GOEA	1	20
5/29/2009	11	GOEA	1	20
6/8/2009	11	GOEA	1	20
10/14/2008	12	UNEA	1	20
10/24/2008	12	GOEA	1	20
6/27/2008	13	GOEA	1	20
8/31/2008	13	GOEA	1	20
10/2/2008	13	GOEA	1	20
10/14/2008	13	GOEA	1	20
10/24/2008	13	GOEA	2	20

5/29/2009	13	GOEA	1	20
7/31/2008	14	GOEA	2	20
8/2/2008	14	GOEA	2	20
9/15/2008	14	GOEA	1	20
10/14/2008	14	GOEA	1	20
11/13/2008	14	GOEA	2	20
5/18/2009	14	GOEA	1	20
7/23/2008	15	GOEA	1	20
8/18/2008	15	GOEA	1	20
10/21/2008	15	GOEA	2	20
11/7/2008	15	GOEA	2	20
11/13/2008	15	GOEA	1	20
10/14/2008	16	GOEA	1	20
10/24/2008	16	GOEA	2	20
4/27/2009	19	GOEA	1	20

ATTACHMENT 14

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Valerie Lightholder

From: Jon Kehmeier <jkehmeier@swca.com>
Sent: Tuesday, May 01, 2012 3:49 PM
To: Patricia_Sweanor@fws.gov
Subject: FW: Information Request re. PCW Eagle Data and Year 3 Survey Protocols
Attachments: 2011_2012_EagleFlightPaths.docx

Hi Trish,

I just got your voicemail from yesterday. I have attached the flight path file that you mentioned on your message. Sorry that it did not come through the first time. If you could, please let me know that you received it this time around. Thanks. Hope you had a great field visit to the project area.

Jon

From: Jon Kehmeier
Sent: Tuesday, April 17, 2012 5:34 PM
To: 'Tyler_Abbott@fws.gov'; Patricia_Sweanor@fws.gov
Cc: Clint King; garry.miller@tac-denver.com; Mark_Sattelberg@fws.gov
Subject: RE: Information Request re. PCW Eagle Data and Year 3 Survey Protocols

Tyler and Trish,

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1. Provide maps showing evolution of the CCSM project area and survey efforts within those boundaries.

   See attached PDF titled 2012-04-09 OriginalDev-CurrentDev file. This map shows the current project boundaries in a purple color and the original in an orange color. Sage-grouse core areas have been included as reference as they help to define the outer boundaries of the current development area. Note the shift in the Sierra Madre project area. The current Chokecherry project area is largely similar to the original boundary.

2. Provide a map with count locations as identified in the excel spreadsheet entitled "PCW_AllEagles_AllObservations_20120321_EagleDataforFWS".

   See attached Word file titled 2011_2012LongWatchAndRadarSurveyLocations. These maps are also included in the latest version of PCW's ECS which is nearing completion.

3. Provide a map of the flight paths of eagles observed in the 2011 surveys and overlaid on the count locations.

   See attached Word file titled 2011_2012EagleFlightPaths. These maps are also included in the latest version of PCW's ECS which is nearing completion.

4. Provide maps with all radar point locations determined by "substantial analysis and post-processing" to be eagles. (Phrase in quotes is from the PCW Draft Programmatic ECP).

The newest version of the ECS will not include radar data analyzed to be eagles. The uncertainty regarding each radar target is too great for us to include those data at this time. Radar data are being used to identify avian use patterns as part of PCW's BBCS but will not be relied on for species identification, including for eagles and other raptor species.

5. Provide step-by-step descriptions, with examples, of what "substantial analysis and post-processing" of the radar data is.

   See response for question 4. Radar data will not be included in the newest version of the ECS.

6. Include column in the excel spreadsheet PCW_AllEagles_AllObservations_20120321_EagleDataforFWS with distance from the observer for each eagle observation.

   See attached Excel spreadsheet titled EagleAnalysis_AllSeasons... This file contains all observations of eagles in flight for all seasons, a summary of survey duration for all survey events, and calculations of eagle use by survey site and season. These data should be used to replace those that were sent to the Service earlier as the earlier version did not include winter data and contained several records that have been corrected as part of our ongoing QA/QC program for this dataset. The Excel spreadsheet contains a glossary tab that should provide the information you need to decipher the various datasets.

7. Provide eagle data from WEST's 2008 surveys in a spreadsheet with the following data entries: identification of point count location, date of survey, duration of survey, minutes eagles were observed (or at least no. of eagles observed) per survey. Also provide eagle flight path maps if available.

   WEST's 2008 data are still in process. I anticipate delivering that dataset in the next day or two. I have attached a copy of WEST's observation locations. WEST's data only include number of observations per 20 minute point count and thus will not be able to provide the number of minutes in which eagles were observed or the flight paths of those eagles but will be able to provide number of eagles per 20 minute survey.

8. Identify any eagle survey efforts in 2009 and 2010.

There were no specific eagle survey efforts in 2009 or 2010 other than those that were completed in winter 2009 by WEST. SWCA has maintained an incidental observation dataset that contains observations that have been made during 2009 and 2010.

I will forward the WEST dataset as soon as it has been compiled. If you have any questions regarding the information attached please let me know.

Jon Kehmeier
Principal Ecologist
SWCA Environmental Consultants
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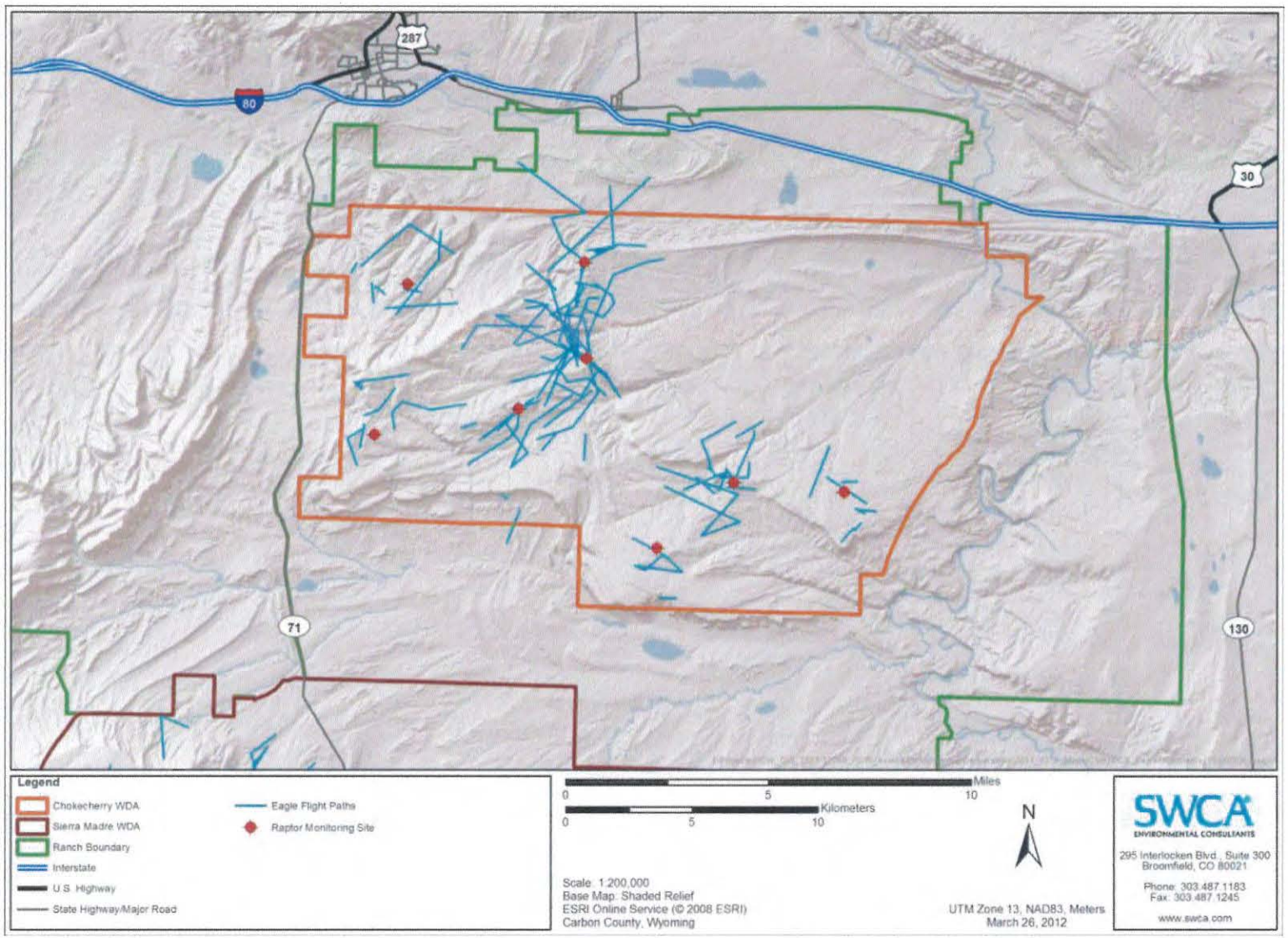

Figure 17. All eagle flight paths documented in the Chokecherry WDA during Year Two long-watch surveys.

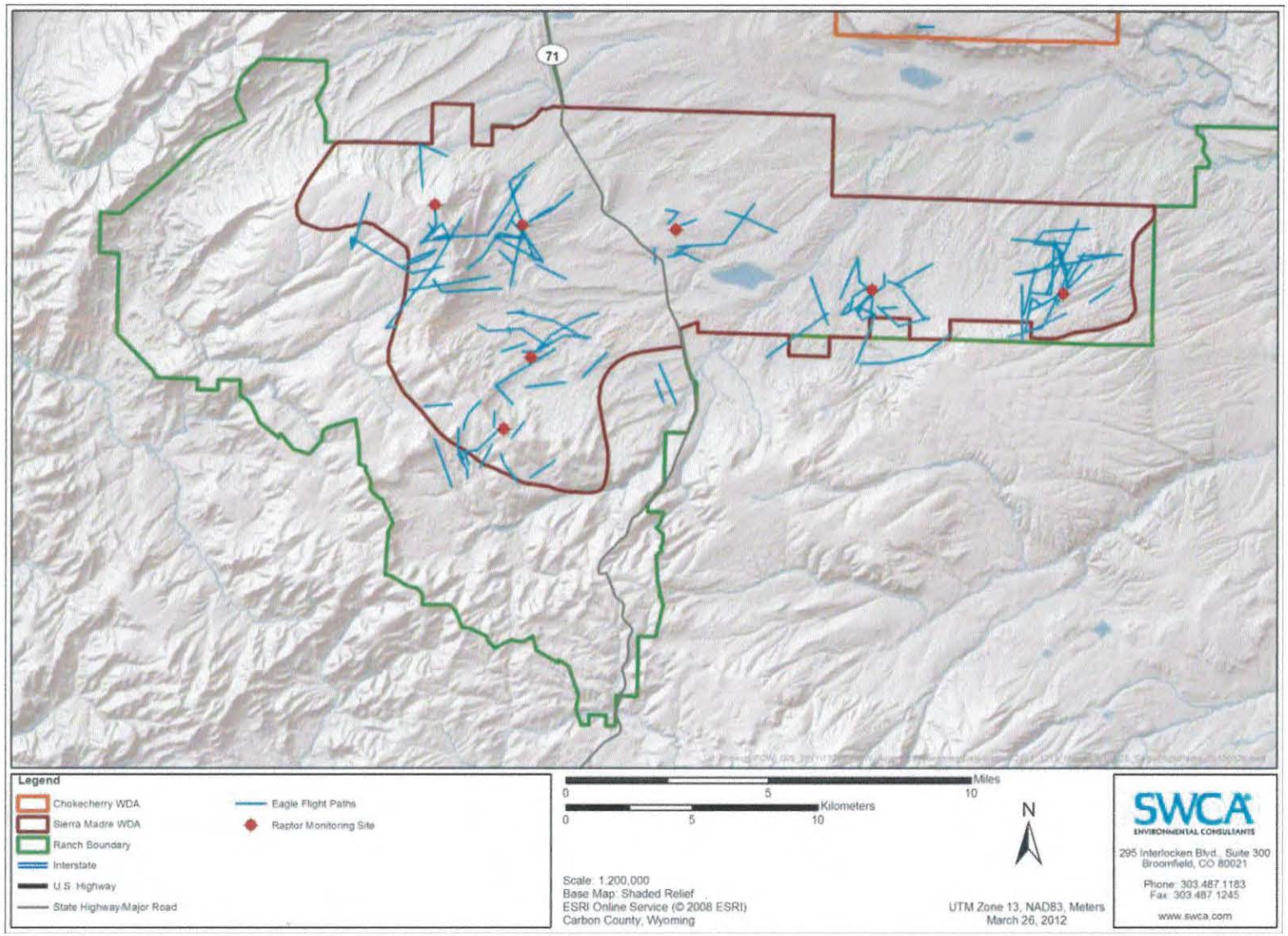

Figure 18. All eagle flight paths documented in the Sierra Madre WDA during Year Two long-watch surveys.

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ATTACHMENT 15

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Valerie Lightholder

From: Jon Kehmeier <jkehmeier@swca.com>
Sent: Monday, May 07, 2012 3:47 PM
To: Patricia_Sweanor@fws.gov
Subject: PCW eagle use data
Attachments: EagleAnalysis_AllSeasons_April17_2012_forUSFWS.xlsx; PCW WEST 2008-2009 eagle data.xlsx

Hi Trish,

I have attached the most current eagle use data for PCW. The files are for the SWCA data collected in 2011-2012 and the WEST data collected in 2008-2009. If you have any questions please let me know.

Jon Kehmeier
Principal Ecologist

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date	Station Number	species	indivs	duration (minutes)
10/30/2008	2	GOEA	1	20
4/22/2009	2	GOEA	1	20
10/23/2008	3	GOEA	1	20
11/6/2008	3	GOEA	2	20
11/12/2008	3	GOEA	1	20
4/29/2009	3	GOEA	2	20
10/3/2008	4	GOEA	1	20
10/23/2008	4	GOEA	1	20
10/30/2008	4	GOEA	1	20
11/12/2008	4	GOEA	1	20
4/28/2009	4	GOEA	1	20
11/6/2008	5	GOEA	1	20
5/28/2009	5	BAEA	1	20
5/28/2009	5	GOEA	1	20
5/13/2009	6	GOEA	2	20
5/28/2009	6	BAEA	1	20
6/26/2008	7	GOEA	2	20
8/1/2008	7	GOEA	1	20
8/29/2008	7	GOEA	1	20
9/14/2008	7	GOEA	1	20
10/3/2008	7	GOEA	1	20
10/13/2008	7	GOEA	1	20
5/14/2009	7	GOEA	1	20
6/3/2009	7	GOEA	1	20
7/23/2008	9	GOEA	1	20
11/6/2008	9	GOEA	2	20
9/14/2008	10	GOEA	2	20
10/30/2008	10	GOEA	1	20
12/17/2008	10	GOEA	1	20
12/23/2008	10	GOEA	1	20
6/16/2009	10	GOEA	1	20
7/8/2008	11	GOEA	1	20
8/16/2008	11	GOEA	2	20
10/14/2008	11	GOEA	1	20
5/29/2009	11	GOEA	1	20
6/8/2009	11	GOEA	1	20
10/14/2008	12	UNEA	1	20
10/24/2008	12	GOEA	1	20
6/27/2008	13	GOEA	1	20
8/31/2008	13	GOEA	1	20
10/2/2008	13	GOEA	1	20
10/14/2008	13	GOEA	1	20
10/24/2008	13	GOEA	2	20

5/29/2009	13	GOEA	1	20
7/31/2008	14	GOEA	2	20
8/2/2008	14	GOEA	2	20
9/15/2008	14	GOEA	1	20
10/14/2008	14	GOEA	1	20
11/13/2008	14	GOEA	2	20
5/18/2009	14	GOEA	1	20
7/23/2008	15	GOEA	1	20
8/18/2008	15	GOEA	1	20
10/21/2008	15	GOEA	2	20
11/7/2008	15	GOEA	2	20
11/13/2008	15	GOEA	1	20
10/14/2008	16	GOEA	1	20
10/24/2008	16	GOEA	2	20
4/27/2009	19	GOEA	1	20

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SiteSummary Data

SurveyEvent	Unique identifier for each survey event, used for relational purposes in master database
SurveyPoint	Survey point at which observations were made
Date	Date on which survey occurred
StartTime	Start time of survey
EndTime	End time of survey
SurveyMins	Minutes of survey completed (end time - start time)
ProjectArea	Project area in which survey point is located (SM = Sierra Madre, CC = Chokecherry)
Season	Migratory bird season in which survey occurred (spring = April 1 - June 30, summer = July 1 - August 14, fall = August 15 - November 15, winter = November 15 - March 31)

EagleUse

SurveyEvent	Unique identifier for each survey event, used for relational purposes in master database
SurveyPoint	Survey point at which observations were made
Date	Date on which survey occurred
Season	Migratory bird season in which survey occurred (spring = April 1 - June 30, summer = July 1 - August 14, fall = August 15 - November 15, winter = November 15 - March 31)
NumberOfEagles	Number of eagles observed per observation
FlightMinutesPerTarget	Number of minutes eagles were observed
TotalEagleFlightMinutes	Product of number of eagles per observation multiplied by number of minutes that the eagles were in flight (NumberOfEagles * FlightMinutesPerTarget)
DistanceToTarget	Distance from observer for each eagle target
ProjArea	Project area in which survey point is located (SM = Sierra Madre, CC = Chokecherry)

ATTACHMENT 16

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Garry Miller

From: Jon Kehmeier <jkehmeier@swca.com>
Sent: Monday, June 25, 2012 11:55 AM
To: Patricia_Sweanor@fws.gov
Cc: Garry Miller; Kevin_Kritz@fws.gov; Tyler_Abbott@fws.gov; Nathan_Darnall@fws.gov; James_Linstrom@fws.gov
Subject: RE: SWCA eagle take model an request for data

Hi Trish,

The conference was great. Lots of good information on sage-grouse.

Regarding the GIS files, I will begin pulling all of those together with a goal of having them to you mid-week. If I think of any other layers that might be useful for you I will throw those in as well. If you have any questions in the meantime, please let me know.

Jon

Jon Kehmeier
Principal Ecologist

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From: Patricia_Sweanor@fws.gov [mailto:Patricia_Sweanor@fws.gov]
Sent: Monday, June 25, 2012 11:43 AM
To: Jon Kehmeier
Cc: garry.miller@tac-denver.com; Kevin_Kritz@fws.gov; Tyler_Abbott@fws.gov; Nathan_Darnall@fws.gov; James_Linstrom@fws.gov
Subject: RE: SWCA eagle take model an request for data

hi Jon,

I heard from Pat and Lynn that the conference in Steamboat was very good - with a lot of information to absorb. What were your thoughts on it? And thanks for the opportunity to meet with you to discuss how you constructed your eagle model for CCSM.

First, however, I was looking forward to receiving the CCSM project GIS layers. To clarify my previous email, the important bird habitat or information data layers I would like to receive include such data sets as active nest sites 2008, 2011 and 2012, flight path data for all raptor species, avian survey point locations, vegetation cover, BLM historical nest sites (we have that) , prairie dog towns (we have that), ungulate crucial winter ranges, sage-grouse leks,ungulate parturition areas, grouse brood rearing habitat, rodent concentrations, e.g., ground squirrel. I realize you may not have all of these layers or may have different ones so please just let me know what you will be able to provide to us. Thanks. Additionally, if you have a GIS layer for the project area boundary map that was modified when the Grizzly Wildlife Habitat Mgmt area was omitted, could you provide that to us as well?

Thanks so much!

Trish

****

Trish Sweanor

Fish and Wildlife Biologist
Wyoming Energy Program Coordinator
U.S. Fish & Wildlife Service
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Cheyenne, Wyoming 82009

ph (307)772-2374 ext 239
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"Jon Kehmeier" <jkehmeier@swca.com>

06/20/2012 03:52 PM

To <Patricia_Sweanor@fws.gov>
cc <Tyler_Abbott@fws.gov>, <garry.miller@tac-denver.com>, <Kevin_Kritz@fws.gov>
Subject RE: SWCA eagle take model an request for data

Hi Trish,

Unfortunately I won't be able to get you the information you requested by tomorrow. I am in Steamboat Springs at the western agencies sage-grouse conference and won't be back until Friday afternoon. When I get back in town I would be more than happy to schedule a time to meet with you, Kevin, and other members of the strike team if possible to describe how we constructed our model, the assumptions we made, and the data that underlie the model. I know that Kevin and I had talked about scheduling something like that once he heard back from the modeler that built the Service risk assessment model. Let me know what dates might work for a meeting or even a web conference.

Regarding the spatial data, if you can provide a list of what you are looking for we can determine how to best meet your needs.

Thanks. I hope your meetings go well with the strike team.

Jon

Jon Kehmeier
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From: Patricia_Sweanor@fws.gov [mailto:Patricia_Sweanor@fws.gov]
Sent: Wednesday, June 20, 2012 9:54 AM
To: Jon Kehmeier
Cc: Tyler_Abbott@fws.gov; garry.miller@tac-denver.com>
Subject: SWCA eagle take model an request for data

hi Garry and Jon,

We are meeting with the FWS Eagle Team tomorrow regarding CCSM. First, would you be able to supply our office with the eagle model that you are using to estimate eagle take from your survey data?

Secondly, I am also requesting your GIS important bird habitat layers. I can either provide you a list of the habitat features we would like or perhaps you can provide us with a list of the layers you have. Thank you!

Trish

****

Trish Sweanor

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MEMORANDUM

BY ELECTRONIC MAIL

TO: Steve Guertin, Noreen Walsh, Michael Thabault, Casey Stemler, Mark Sattelberg, Tyler Abbott, Nathan Darnall, Patricia Sweanor, Kevin Kritz, Tim Modde

CC: David Cottingham, Steve Black, Dennis Carpenter, Pam Murdock

FROM: Roxane Perruso, Vice President and General Counsel

DATE: August 1, 2012

RE: State and County Permitting Processes for the Chokecherry and Sierra Madre Wind Energy Project

---

This memorandum follows up on concerns that have been raised with Power Company of Wyoming LLC (PCW) regarding the Wyoming state and county permitting processes for the Chokecherry and Sierra Madre Wind Energy Project (the Project).

Specifically, it addresses the question of whether the permits that are expected to be issued by the state and county in the near future will negatively impact the ability of the U.S. Fish and Wildlife Service (Service) and Bureau of Land Management (BLM) to require future modifications to the Project based on additional environmental analysis and to enforce the modifications.

As set out in more detail below, the state and county processes have the procedural and statutory mechanisms in place to address Project modifications after the respective permits are granted. In addition, the state and county permits will both require compliance with federal standards. Thus, the situation in which the state and county permits are granted prior to the issuance of the BLM rights-of-way in no way impacts either the ability of the Service or BLM to require Project modifications or to enforce such modifications.

I. WYOMING STATE PERMITTING PROCESS

Pursuant to W.S. §35-12-106(a), PCW must obtain a permit from the Wyoming Industrial Siting Council (ISC) to construct and operate the Project. PCW completed the required jurisdictional meeting with the Industrial Siting Division (ISD) on April 25, 2012 and plans to submit an application for a permit in mid-November of 2012. Based on the statutory timeframes, if PCW submits its application in mid-November, the ISC will hold an administrative hearing in February 2013 and will issue a decision on the permit application at the end of March 2013.

When PCW submits its application to the ISC in November, it will include an overall Plan of Development as well as preliminary plans showing turbine layouts and infrastructure design (Project Plans). This complies with ISC rules that the application must include "preliminary site plans at an appropriate scale indicating the anticipated location for all major structures" Section 9 (b), ISC Rules. The Project Plans will represent PCWs best planning to date in conformance with all of the conditions, commitments and constraints known at the time of the application by PCW. Because the BLM's Record of Decision on the Project is expected prior to PCWs submission of its ISC application, the Project Plans will conform with the mitigation measures identified in the BLMs Record of Decision, as well as the Eagle Conservation Plan, the Bird and Bat Conservation Strategy, and any other known site constraints.

The issuance of a permit by the ISC based upon the preliminary site plans in no way limits the BLM or the Service in requiring modifications to the Project. First, any permit issued by the ISC will contain a condition that PCW "shall obtain and maintain all required State and local permits and approvals in accordance with W. S. 35-12-109 (a) (xv), 35-12-113 (a) (i), and 35-12-115 during the term of this permit."

The reference in the permit condition to W.S. 35-12-115(a)(i) is key because the statute specifically provides that the

> department of environmental quality shall retain authority which it has or which it may be granted to determine compliance of the proposed facility with state and <u>federal standards</u> and implementation plans and to enforce those standards.

W.S. 35-12-115(a)(i).

Therefore, any ISC permit will require PCW comply with applicable federal standards, including obtaining all necessary approvals.

Second, the ISC process anticipates the potential need for modifications to the Project and the applicable statute W.S. 35-12-106, ISC Rules, and the ISC permit conditions, provide the mechanism and process for addressing modifications after issuance of the permit.

The Wyoming statute addresses the issue of amendment as follows:

> (c) Except as provided in subsection (d) of this section, the council may allow the amendment of a permit or application for a permit for good cause if the holder demonstrates to the council at its next meeting that the requested change is in compliance

> with local ordinances and applicable land use plans and will not significantly add to adverse environmental, social and economic impact in the impacted area.
>
> (d) On an application for an amendment of a permit, the council shall hold a hearing in the same manner as a hearing is held on an application for a permit if in the council's opinion the requested change in the facility would result in a significant adverse increase in any environmental, social or economic impact of the facility or a change in the location of all or a portion of the facility unless the change in location was specifically approved by the council in the permit.

W.S. 35-12-106(c) and (d)

ISC Rules implement the statute by requiring a permit amendment "if the applicant makes a significant change to the scope, purpose, size, or scheduling of the project; which would result in different impacts not within the scope of the approved permit." ISC Rules, Section 16(a).

Then, the ISC Permit will contain the following condition:

> The Permittee shall notify the ISD in advance of proposed changes to the scope, purpose, size or schedule of the project. The Director may authorize such changes if he or she finds that:
>
> a. The change should not result in any significant adverse environmental, social, and economic impacts in the area of site influence; and
> b. The Director has provided public notice of the proposed change and his intent to approve the request; and
> c. No party nor Council Member has requested that the matter be heard before the Council in accordance with the permit procedures of W. S. 35-12-106 (c) and (d).

This condition authorizes administrative project changes by the DEQ Director, including approvals of project phases, changes in project scope, schedule, size or purpose, without formal ISC approval, following notice to the parties and consideration of possible impacts. The permit conditions are consistent with the general rule in the regulations and the statute that an ISC hearing for a permit amendment, comparable to the original permit hearing, is not required unless the project change will significantly add to environmental, social or economic impacts.

Because any modifications required by the BLM and/or Service will be to lessen impacts, PCW believes that the amendment process will be straightforward and most likely approved by the DEQ Director. As the developer, however, PCW bears the risk that modifications to the Project Plans could require a hearing.

The enforcement mechanism for project modifications required by the BLM and/or Service is two-fold. If PCW does not comply, the BLM will not issue the required rights-of-way grants nor the notice to proceed. In addition, PCW would be in violation of the ISC permit for not meeting the applicable federal standards.

PCW and ISD staff recognize that after the BLM issues the Record of Decision on the Project, PCW will be required to submit Project Plans (referred to as site-specific plans of development in the Final Environmental Impact Statement) to the BLM and that the BLM's review may result in adjustments to the Project Plans submitted by PCW to the ISC.

On July 26, 2012, two representatives from the Service along with two representatives from the BLM, Carbon County's Planning Director and representatives from PCW met with Tom Schroeder, Program Principal, Department of Environmental Quality, Industrial Siting Division and Tia Raamot, Principal Economist, Department of Environmental Quality, Industrial Siting Division.

During the meeting both Mr. Schroeder and Ms. Raamot assured the Service and BLM that the ISC has the tools to handle project modifications and that they did not see a problem and believe that the ISC process can accommodate amendments to the site plan and its features after an ISC decision.

II. CARBON COUNTY PERMITTING PROCESS

In addition to the ISC permit, PCW must obtain a Conditional Use Permit (CUP) from the Board of Carbon County Commissioners. Wyoming law provides that it "is unlawful to locate, erect, construct, reconstruct or enlarge a wind energy facility without first obtaining a permit from the board of county commissioners in the county in which the facility is located." W.S. 18-5-502(a). The statutes relating to county regulation of wind energy projects are set out at W.S. 18-5-501 through W.S. 18-5-513 and require that board of county commissioners adopt standards that are not less stringent than the standards set out in the statute. W.S. 18-5-504 (a)(i).

A. Carbon County Zoning Resolution

In conformance with the applicable statutes, Carbon County has adopted comprehensive standards – set out in the Carbon County Zoning Resolution, April 5, 2011. PCW filed its application for a Conditional Use Permit with Carbon County on July 16, 2012. The next steps include: (1) a completeness determination by the County with respect to the application; (2) a Planning and Zoning Commission public meeting and recommendation regarding the application to the Commissioners; (3) a hearing on the application in front of the Carbon County Commissioners; and (4) a decision from the County Commissioners on the CUP application. PCW anticipates that Carbon County will issue a decision on the application by the end of 2012.

As with the ISC permit, the issuance of the county permit will not interfere with the ability of the BLM and/or the Service to require Project modifications. First, the Carbon County Zoning Resolution states that the county regulations will not supersede state and federal laws and, in fact, it requires compliance with all federal requirements. As set out in Chapter V, Section 5.11(d)(7):

> a) Nothing in these Regulations is intended to preempt other applicable State and Federal laws or regulations. All WECS Project[1] facilities shall be constructed to meet and be maintained in compliance with all Federal, State and County requirements, including all Wyoming Industrial Siting Council requirements, if applicable. If compliance issues arise at any time during the review, development or operational phases, the Applicant(s) or Owner(s), at the discretion of the County may be requested to provide additional studies or reports prepared by qualified professionals addressing the issues and mitigation measures that may be needed to maintain compliance.

Second, the Carbon County CUP process contemplates that State and Federal approvals may be granted following issuance of the CUP and mandates that the CUP be issued "subject to" obtaining the required approvals. Section 5.11(d)(1)(a)(8) setting forth the requirements for the CUP application provides:

> (8) A list of all State and Federal agencies requiring approval and a copy of such approval, including all required studies, reports and certifications. In the event that a State or Federal Agency has not yet approved a required study, report or certification, then the conditional use permit shall be subject to receipt of a copy of such approval, unless good cause is shown to the satisfaction of the County;

Third, although a Project Plan is included with the application, the applicable Carbon County Planning and Zoning Resolution sections recognize that the application may be based on a "preliminary site plan":

Chapter V, Section 5.11(d)(1)(a) states:

1. Commercial WEC Project
   The Conditional Use Permit application for a Commercial WEC Project shall contain, or be accompanied by, the following information:

---

[1] "Wind Energy Conversion System" ("WECS") means all necessary devices that together convert wind energy into electricity, including the rotor, nacelle, generator, WECS Tower, electrical components, WECS foundation, transformer, and electrical cabling from the WECS Tower to Substation(s) and their support facilities, including collector systems." Section 5.11(c).

"WECS Project" means the WECS and associated support facilities including, but not limited to, roads, substations, operation and maintenance buildings, and permanent towers as specified in the application, including the project area as defined by the Owner(s) and includes, but is not limited to a Wind Energy Facility. Section 5.11(c).

a) A WECS Project summary, including, to the extent available:

(1) A general description of the project, . . . including its approximate total name plate generating capacity; the potential equipment manufacturer(s), type(s) of WECS(s), number of WECS, and name plate generating capacity of each WECS; the maximum height of the WECS Tower(s) and maximum diameter of the WECS rotor(s); the general location of the project; and

(5) A preliminary site plan for the installation of a WECS Project showing the planned location of each WECS Tower, guy lines and anchor bases (if any), Primary Structure(s), property lines (including identification of adjoining properties), setback lines, public and private access roads and turnout locations, Substation(s), ancillary equipment, transmission lines, and layout of all structures within the geographical boundaries of any applicable setback.

Finally, "[i]f the application is granted, the board of county commissioners shall require that the project plan be revised to show the final location of all facilities." W.S. 18-5-503(a)(viii).

III. CONCLUSION

In sum, the state and county permitting processes do not negatively impact the federal permitting processes. They are distinct processes with their own requirements that do not conflict and, in fact, complement and further the goals of the BLM and the Service to avoid, minimize and mitigate the environmental impacts of the Project. Based on the applicable state statutes, rules, regulations, and standard permit conditions, the situation in which the state and county permits are granted prior to the issuance of the BLM rights-of-way in no way impacts either the ability of the Service or BLM to require Project modifications or to enforce them.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

In Reply Refer To:
06E13000/WY12CPA0168

AUG 1 0 2012

Mr. Garry L. Miller
Vice President, Land and Environmental Affairs
Power Company of Wyoming LLC
555 Seventeenth Street, Suite 2400
Denver, Colorado 80202

RE: Service Recommendations on Avoidance and Minimization for the Chokecherry Sierra Madre Wind Project

Dear Mr. Miller:

Thank you for the opportunity to discuss the avian protection plan (APP) for the Chokecherry Sierra Madre Wind Project (Project) on July 24, 2012. During the meeting, we identified a number of concerns with the July 17, 2012, Eagle and Raptor Avoidance Map (avoidance map) developed by Power Company of Wyoming (PCW), and we suggested several items for further analysis and possible study. This letter serves to articulate our concerns discussed during the meeting and to provide recommendations to PCW regarding development of an APP.

Our standard in evaluating the adequacy of an APP (in relation to BLM IM-2010-156) is that avoidance and minimization must be sufficient so that any remaining take (of eagles) is unavoidable. As such, the APP should identify and commit to avoid areas of high eagle use (both bald eagles and golden eagles) such as nests, areas of concentrated prey base, and movement corridors. While the avoidance map identifies and buffers a number of high eagle use areas (e.g., interior rim, Bolton Rim, and Rasmussen Lake), it does not address additional locations we have identified as areas of potential high eagle use. We are also concerned about the adequacy of the spatial coverage provided by the existing point counts and whether an adequate analysis of eagle use across the project area can be completed with the available data to inform adjustments in project layout and turbine siting.

Data

We only recently received raw data and shapefiles for the Project and are still becoming familiar with them; therefore, it is possible that some of our concerns will be addressed with better understanding of the data. We also look forward to reviewing the remaining data from 2012, as they should increase our knowledge about avian use of the Project area and may reduce

uncertainties. Examples of data sets we anticipate receiving from PCW include eagle flight paths for winter 2012-2013, raptor flight path data, and eagle and raptor nesting data from the summer of 2012. We also anticipate receiving other datasets we requested previously (e.g., flight paths for all raptors, passerine breeding bird densities, prey-base surveys and rodent concentrations). Please let us know if these do not exist or cannot be obtained. We anticipate that data collection will continue through at least March 2013 to be incorporated into the draft APP for Sierra Madre, and we strongly recommend that data collection continue through 2013 to provide further refinement in the APP. Similarly, we anticipate data collection will continue through 2014 to be incorporated into the draft APP for Chokecherry. Because PCW has determined that the radar data are not useful for understanding finer-scale habitat use by eagles, specific recommendations will be forthcoming from our office regarding more extensive coverage in future survey efforts. Finally, we appreciate your time and effort answering our questions and helping us understand the many datasets.

Eagle Nests

The avoidance map includes the Bolton Rim and the Hogback, two features that contain numerous golden eagle nests. We agree with your conclusion that wind turbines should not be placed in these areas; however, the current avoidance of important nesting areas is insufficient and we recommend further Project modification to avoid and minimize impacts to these areas. Nests indicate where high eagle use will occur during the breeding season, but they also suggest areas that could be occupied during fall and winter months because of available perching and foraging opportunities. Ideally, we would have detailed information about how eagles use the landscape around each nest, particularly during the breeding season; however, absent detailed information, we can use the one-half inter-mean distance as a surrogate for territory size and an expectation of high eagle use (Service 2011).

Using known, active nests within and near the Project area (year 2 for GOEA, year 3 for BAEA), we calculated a project-specific one-half mean inter-nest distance of 3,495 meters for golden eagles and 3,686 meters for bald eagles. We then buffered all active and inactive eagle nests as a starting point for evaluation of high eagle use areas. Because the one-half mean inter-nest distance is a surrogate for territory size and only approximates eagle use, we recommend that site-specific information be used to adjust buffers around eagle nests. For example, the one-half mean inter-nest distance around the bald eagle nest south of Rasmussen Lake does not extend to the north side of the lake, which is used by bald eagles during the breeding season and likely during fall and winter months too. In this case, site-specific information would elongate the buffer northward to encompass the entire lake and any surrounding areas of high use such as tall tree that serve as perch sites or roost locations, as your proposed avoidance map does. Site-specific information might also be used to shorten the one-half mean inter-nest buffer in other directions, provided enough is known about eagle use patterns of the area's topographical features.

In other cases, site-specific data might provide a justification for reducing the one-half mean inter-nest distance, especially if the vast majority of the eagle use occurred outside of the Project area. This level of detailed information, however, is rarely available. For example, a golden eagle nest (#162) was active during the second year of monitoring on the southwest side of the Sierra Madre project area, but we do not have flight path data or eagle observations in this area when the nest was active. Without good habitat use data, we must assume this pair of eagles

actively defended its territory and foraged within the Project area to the north and east of the nest. Nest-specific data showing the birds did not fly or forage far within the Project area might provide biological support to reduce the one-half mean inter-nest distance buffer for this particular nest.

The project area contains a number of historic golden eagle nests along the Bolton Rim that were not active in 2008, 2011 or 2012. Unless conditions have changed (e.g., cliff subsided, habitat is no longer suitable), any of these nests could become active in future years. Without informed knowledge about how eagles at these historic nests might use the surrounding landscape during active years, placing turbines near the historic nests could create a source of eagle fatalities and result in nest abandonment. It may be impossible to gather the necessary information if the nests are not active during the period of study; however, additional evaluation and/or modeling of the geologic features and prey base might provide a scientific basis to reduce or eliminate the one-half mean inter-nest distance around the historic golden eagle nests.

Concentrated Prey Base

The Draft Eagle Conservation Plan Guidance recommends that wind projects, "Avoid siting turbines in areas where eagle prey are abundant" (Service 2011, p. 67), and "foraging areas" are included in the definition of important eagle use areas (50 CFR 22.3). Another issue of concern is the presence of concentrated prey base (i.e., white-tailed prairie dog towns and colonies) within much of the Sierra Madre portion of the Project area. Prairie dogs and other colonial rodents (e.g., Wyoming ground squirrel) are valuable food resources and provide important foraging areas for eagles and other raptors; therefore, it is possible to have many birds of prey concentrated around areas of colonial rodents.

Surveys conducted in 2008 identified small, scattered pockets of white-tailed prairie dogs, including colonies along the proposed access and utility corridors that would connect the Chokecherry and Sierra Madre areas (WEST 2008). The survey report also identified two general areas of relatively extensive white-tailed prairie dog colonies which covered more than 1,500 and 2,000 acres, respectively (WEST 2008). While the 2008 study found scattered pockets of prairie dogs, a study in 2010 identified a substantial prey base in the project area:

> Based on BLM survey criteria, background literature, and field surveys, SMITH identified 198 [white-tailed prairie dog] towns across 352 sq mi of mostly BLM land within the Bolton Ranch [black-footed ferret] Complex Study Area…most of the [white-tailed prairie dog] towns exceeded [black-footed ferret] preferred densities 8 or 27 burrows per acre...Based on SMITH's analysis, sufficient [white-tailed prairie dog] towns exist that exceed both [black-footed ferret] criteria (7km and 1.5 km). SMITH believes that the Bolton Ranch Study area consists of suitable habitat characters for the [black-footed ferret]" (SMITH 2010, p. 19).

Both of these studies found white-tailed prairie dog colonies within and adjacent to the Project area, though they disagree somewhat on the densities of this prey base. Differences in the studies might be explained by survey methods or by variation in the prairie dog population over the course of three years. As we evaluate the adequacy of the APP, it is important for us to consider all of available scientific information and to consider the potential growth of prairie dog populations in the future (e.g., re-colonization, expansion). We understand that SWCA is

conducting surveys of potential white-tailed prairie dog colonies that may explain some of the apparent discrepancy in the two previous studies. At this time, we do not have information regarding SWCA's survey methods or study design: it is important that methods from the study follow approved protocols and survey designs, and that surveyors are adequately trained. Based on the results of the SWCA study, in conjunction with WEST and SMITH studies, the Service will evaluate opportunities to avoid and minimize potential risks to eagles from areas of high density prey base.

Kernel Analysis for Eagles

Portions of the proposed eagle and raptor avoidance map were developed through a kernel estimator using eagle flight path data. Based on our initial analysis of the eagle flight path data, it appears that some areas of high eagle use (e.g., the interior rim) were included in the avoidance map, while others (e.g., Miller Hill) were excluded from the avoidance map. It is unclear how the kernel analysis was conducted: we ask that SWCA provide a complete description of the methods used including data, software, assumptions, estimator, and supporting documentation and literature.

We are concerned that the available eagle data may not be suitable for use in the kernel analysis. Because the kernel analysis depends on some likelihood of eagle presence, it is important that the observations of eagle activity closely align with actual eagle activity. One example is that the kernel estimator will treat areas of zero observations the same as areas of no eagle activity. Unfortunately, there are portions of the vast Project area where there are no recorded observations of eagle activity. While this could be due to the lack of eagle activity, it could also be due to the lack of survey effort in these locations. If true, this means portions of the Project area could have substantial eagle activity but would not be identified by the kernel estimator. Therefore, it might not be appropriate to use the kernel estimator to evaluate eagle use patterns, especially in areas of little or no data.

Another concern with the eagle data used in the kernel analysis is the assumptions about the ability for observers to detect eagles at greater distances. Point count surveys for eagles and other large raptors should not exceed 800 meters, and while observations can be recorded at distances greater than 800 meters, they should be analyzed separately (Service 2011; Strickland 2011). While it is true that approximately 60 percent of all eagle observations by SWCA occurred at distances greater than 800 meters, it is also true that 40 percent of the detections occurred in an area of just two square kilometers (km), while the remaining 60 percent occurred over an area of about 126 km^2 (assuming 6.4-km radius). Furthermore, based on the frequency of detections within 0.8 km, it appears the surveyors were detecting only about half of the eagles between 0.8 and 2.0 km, and were detecting only a quarter of the eagles between 2.0 and 4.0 km (Table 1). Detections beyond 4 km were a fraction of those observed near the survey point.

Table 1. Average number of eagle detections within grouped distances from the observer, based on similarity of detections. Percent detection is the average number of detections divided by the average number of detections within 800 meters (i.e., 72).

Distance	Average Detection	Percent Detection
0 to 800 meters	72	100
801 to 2000 meters	35	49
2001 to 4000 meters	18	25
4001 to 7600 meters	1.9	2.6

The underlying assumption for the kernel analysis is that any difference in eagle activity is due to eagle use and not the detectability of the eagle. Determining how much of the observed eagle use (e.g., eagle flight paths) is due to non-random sample location (e.g., on ridgelines) and actual eagle use (e.g., higher use on and near ridgelines) and how much is due to observer detectability (i.e., distance) may present our biggest challenge in evaluating the eagle flight path data. If survey locations are situated in areas of high eagle use and with good vantage points, we should expect some increased level of detectability near the observer; however, that would not explain all of the lower detectability at greater distances. Consequently, we recommend more intensive survey efforts be conducted over the next year in order to provide finer scale data. The Service will provide survey recommendations in the near future.

Miller Hill

We are concerned that the proposed avoidance area near Miller Hill is not sufficient given the considerable use of the area by eagles and other raptors. For example, the eagle flight path data show Miller Hill receives similar use as the interior rim (Figures 1a and 1b). Also, a golden eagle nest is located in the southwest corner of Sierra Madre near Miller Hill and was active in the second year of surveys. Unfortunately, we do not have eagle use data (e.g., flight path data, foraging areas) from that year to evaluate how the pair and young used Miller Hill and the surrounding landscape, but we must assume the amount of use was greater when the nest was active than during the third year of surveys in which the eagle flight path data were collected. In addition, Miller Hill is immediately adjacent to (and apparently within) areas identified as white-tailed prairie dog towns and colonies (Smith 2010). White-tailed prairie dogs are an example of a concentrated prey base that is heavily used by eagles and other raptors. Other small rodents like Wyoming ground squirrels might be intermixed within the prairie dog colonies, increasing the density of the local prey base. In addition, there are numerous sage-grouse leks near Miller Hill, and sage-grouse can provide a valuable food resource for golden eagles. Finally, like bald eagles that regularly prey upon waterfowl, golden eagles will occasionally take waterfowl. It is possible that golden eagles (and bald eagles) may travel between Miller Hill and Rasmussen Lake, particularly in the fall as prairie dogs begin hibernating. Given the high eagle and raptor use of Miller Hill, the location of the active golden eagle nest on the border of Sierra Madre, the availability of concentrated prey base including prairie dogs, ground squirrels, sage-grouse and perhaps waterfowl, we recommend the proposed avoidance area be enlarged to include more of the high eagle and raptor use areas.

Summary of Specific Recommendations

(1) Eagle Nests (letters correspond to items in Figure 2)

(a) Add avoidance area around GOEA nest #162 at SW corner of Sierra Madre

(b) Confirm BAEA use around Rasmussen Lake and adjust avoidance area if necessary to protect eagles from nest #171 as well as fall and winter eagle use

(c) Based on eagle use and prey base densities, add an avoidance area around GOEA nest 199 on south end of Sierra Madre

(d) Collect additional data on eagle use of nests on the Bolton Rim, including foraging areas of any active nests. For inactive nests, describe likely foraging areas and potential use within Chokecherry portion of the project area. Adjust avoidance areas for confirmed or suspected use.

(e) Collect additional data on eagle use of nests on the northern rims, including foraging areas of active nests. For inactive nests, describe likely foraging areas and potential use within Chokecherry portion of the project area. Adjust avoidance areas for confirmed or suspected use.

(f) Collect additional data on eagle use at the GOEA nest in Chokecherry West, including foraging areas. If inactive, describe likely foraging areas and potential use within Chokecherry West. Expand avoidance area in NW to protect eagle use near the nest.

(g) Evaluate and/or model the geologic features and potential flight paths and foraging areas to estimate the areas of high eagle use in the event these inactive nests (territories) are reoccupied. Based on results of the modeling or site-specific evaluation, adjust the proposed avoidance area to protect areas of highest eagle use.

(2) Concentrated Prey Base (letters correspond to items in Figure 3)

(h) Previous studies came to different conclusions on prairie dog burrow densities in the project area. Determine current prairie dog activity, including burrow densities, following approved protocols, survey designs, and surveyor training. Ensure sampling effort provides adequate spatial coverage.

(i) The avoidance map includes an area in eastern Sage Creek Basin. Based on the available data, we agree that this area receives considerable eagle use and should be avoided; however, the avoidance area may need to be expanded. Only two eagle point counts are located in Sage Creek Basin, an area reported to contain high concentrations of prairie dog burrows. While eagle activity occurs in Sage Creek Basin, it appears highly correlated with the survey locations, suggesting the observed eagle activity patterns may be due to observer detectability rather than actual eagle activity. Given the reported high density prey base, we recommend (h) above as well as additional avian point count surveys in Sage Creek Basin to determine if eagles and other raptors are foraging within this area. Specific recommendations from the Service on the number and location of survey points will be forthcoming.

(3) Miller Hill (letters correspond to items in Figure 4). The avoidance map includes an area in Miller Hill; however, it is unclear how this avoidance area was determined as it does not correspond to high eagle use, high density prey base, other prey resources, and active eagle nests.

(j) Based on eagle exposure rates, RM14 had the third highest eagle use (similar to that of the Interior Rim) of all 15 eagle/raptor point count locations, and RM13 had the fourth highest use. Both of these points occur on the eastern side of the proposed avoidance area, suggesting additional survey data are needed in this location. We will provide survey recommendations in the near future.

(k) At least one study reported high density prairie dog colonies and towns occur on the western side of Miller Hill. Eagle flight path data on this side suggest lower eagle use than on the eastern side; however, additional survey data are also needed for this area due to potential high density prey base, and the presence of sage-grouse that are also prey items for golden eagles. We will provide survey recommendations in the near future.

(l) Monitor GOEA nest #162 at SW corner of Sierra Madre. If active in 2013, determine activity patterns of the eagles including flight paths, foraging locations, and roosts, and continue monitoring activity of the adults and fledglings.

(m) In evaluating eagle use on the western side of Miller Mountain (and at nest #162), monitor eagle use patterns at and near the greater sage-grouse leks, particularly while grouse are on leks.

(n) Determine if golden eagles are moving between Miller Hill and Rasmussen Lake in search of prey, particularly during the fall when prairie dog numbers decline and waterfowl and coot numbers increase.

(4) Recommendations for Additional Data Needs

We have not yet seen (i) the flight path data for raptors, (ii) the eagle flight path data for winter of 2013, (iii) the eagle use and flight path data for the spring and summer of 2013, including data for points added for 2012. These data may prove useful. For example, Not only will the raptor flight path data help identify raptor use as surrogates for eagles, activity use patterns of other raptors can help understand how eagles may move across the project area following areas of uplift for example.

Based on data we have seen, we do not have sufficient information to provide site-specific recommendations for avoidance areas or micro-siting of turbines. Given the lack of data coverage (e.g., only 3% of project area covered by 800-m point counts, based on second year of surveys), our initial recommendations are to avoid construction within the one-half mean inter-nest distance around nests, and avoiding areas of concentrated prey base as well as flight/migration corridors and winter roosts. We recognize our proposed avoidance areas include large blocks of the proposed project area; therefore, we recommend additional data collection to reduce uncertainty and to allow refinement of avoidance areas.

We are working with the Region and Washington Offices to develop specific recommendations for data collection needs and design, to be provided in the near future.

If you have questions regarding this letter, please contact Nathan Darnall or Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 246 or 231, respectively.

Sincerely,

For R. Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc: SWCA, Jon Kehmeier (via e-mail)
BLM, Pam Murdock (via e-mail)
BLM, Mike Valle (via e-mail)
FWS, Pam Repp (via e-mail)
FWS, Casey Stemler (via e-mail)

References Cited

Smith Environmental and Engineering (SMITH). 2010. White-tailed Prairie Dog Town Inventory and Assessment on the Bolton Ranch Black-Footed Ferret Complex in Carbon County, Wyoming. September 2010. 37 pp.

U.S. Fish and Wildlife Service (Service). 2011. Draft Eagle Conservation Plan Guidance. January 2011. 106 pp.

Western EcoSystems Technology, Inc. (WEST). 2008. Prairie Dog and Black-footed Ferret Habitat Analysis Summary, Chokecherry and Sierra Madre Wind Resource Areas.

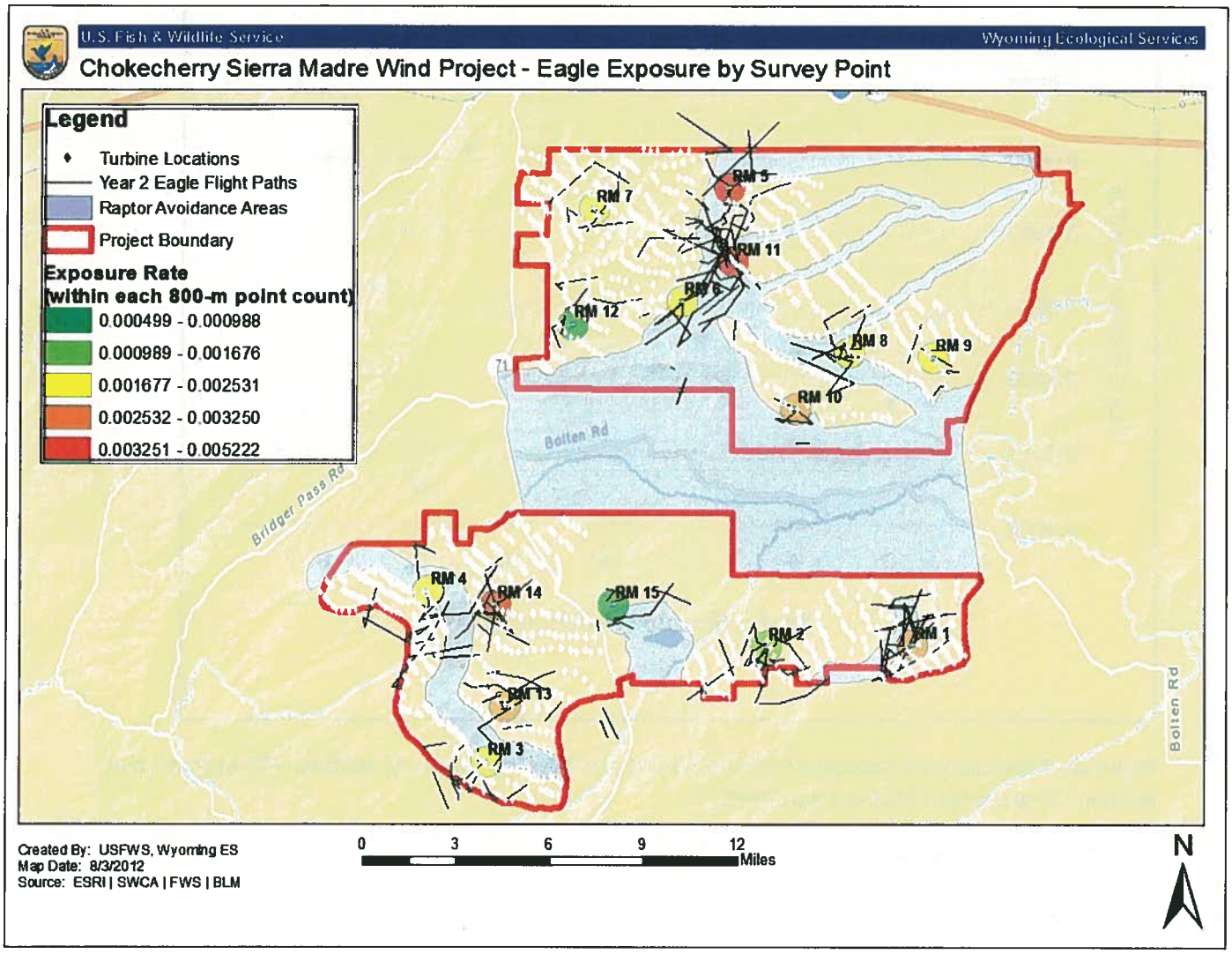

Figure 1a. Spatial distribution of eagle exposure rates (eagle minutes/[survey minutes*survey area]) at fifteen 800-m point count locations between April 2011 and April 2012. Exposure rates were highest at RMs 5, 11 and 14 and were lowest at RMs 12 and 15.

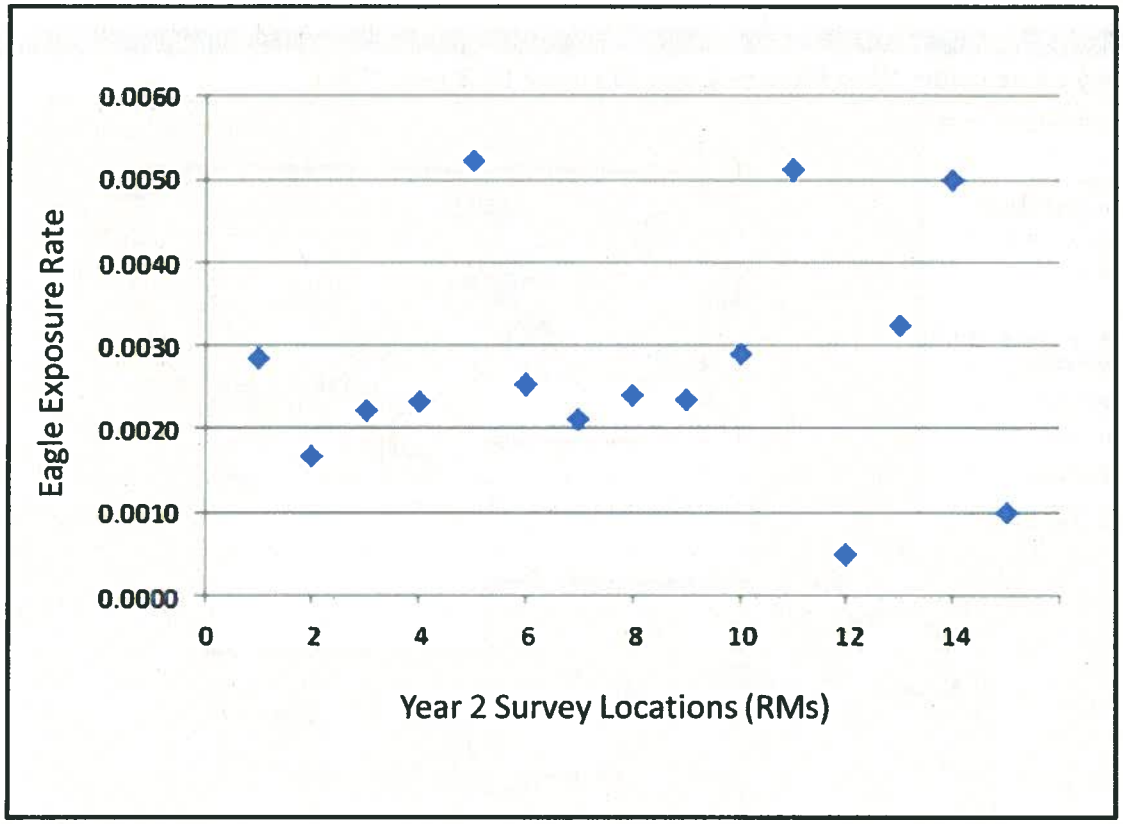

Figure 1b. Eagle exposure rates (eagle minutes/[survey minutes*survey area]) at fifteen 800-m point count locations between April 2011 and April 2012.

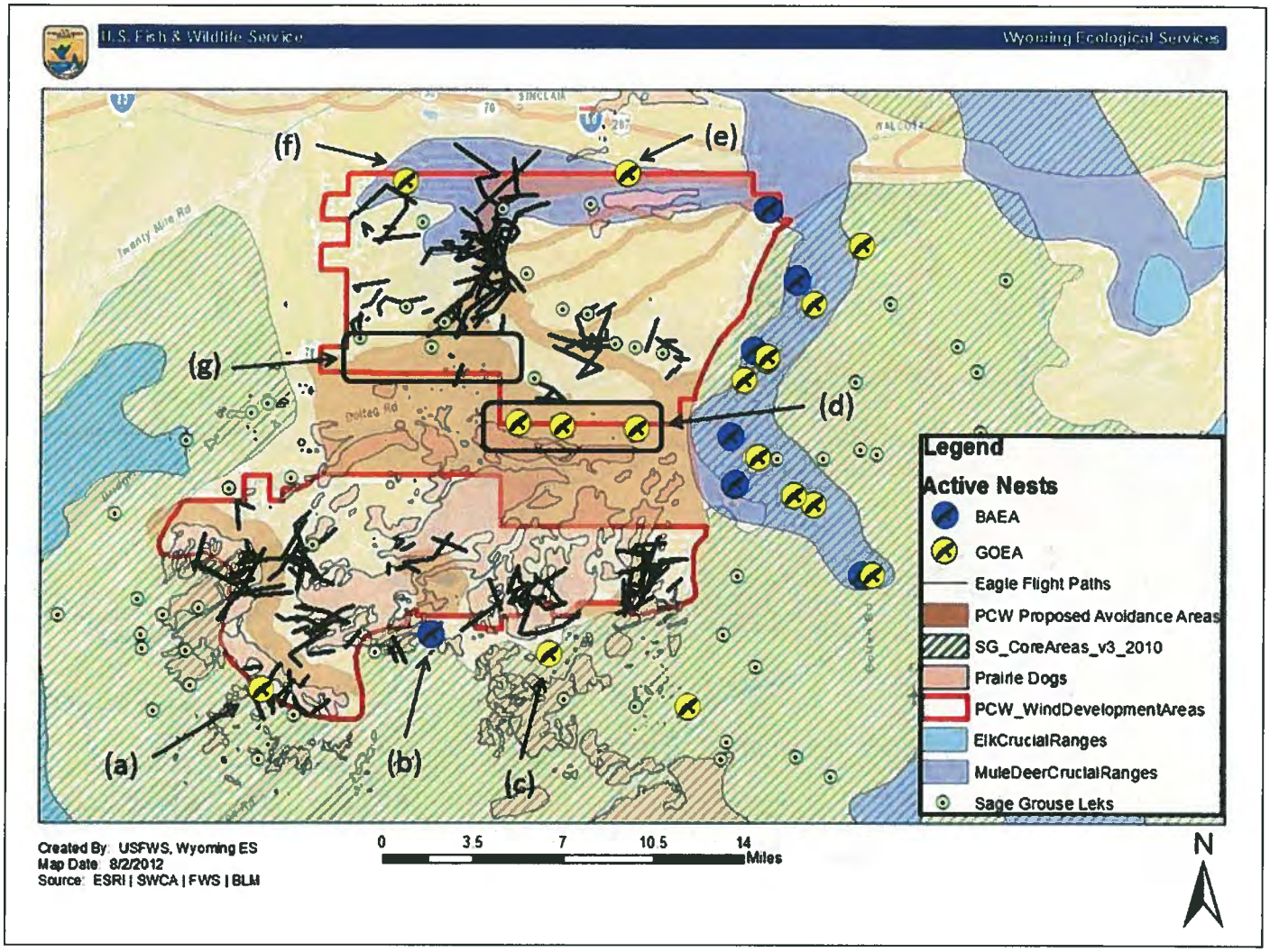

Figure 2. Location of the specific eagle nest recommendations. Letters in the figure correspond to recommendations described in the text.

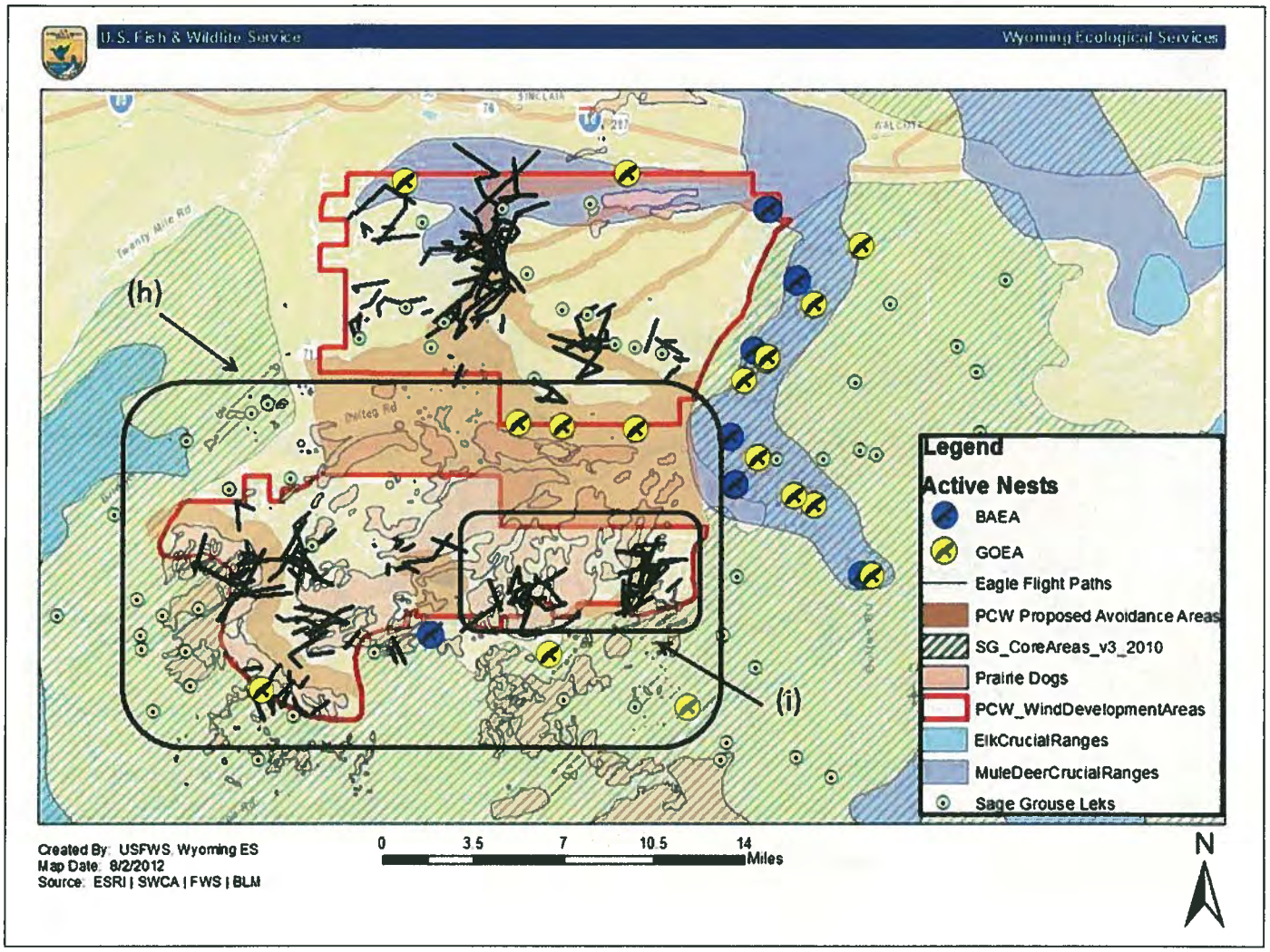

Figure 3. Location of the specific concentrated prey base recommendations. Letters in the figure correspond to recommendations described in the text.

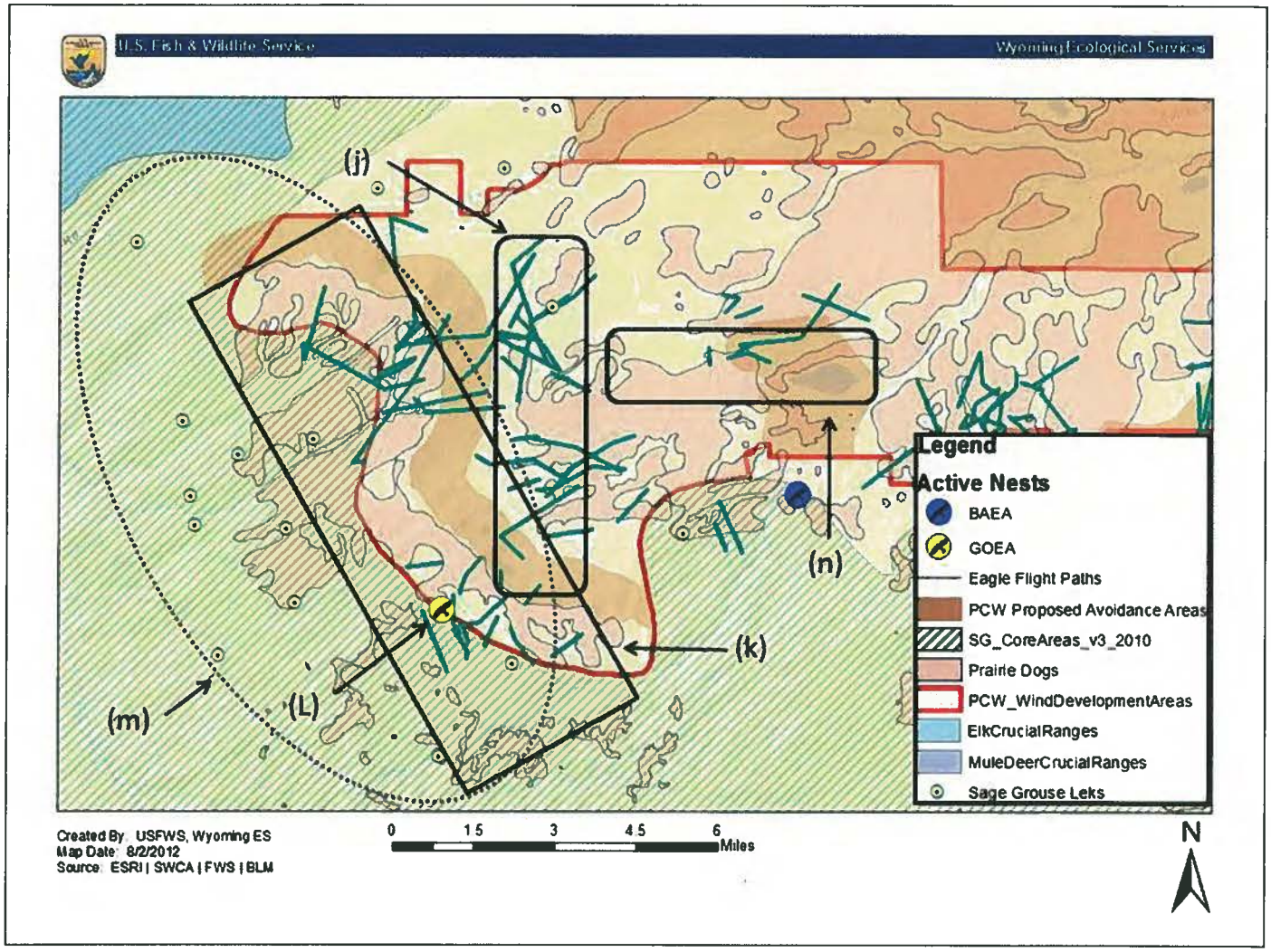

Figure 4. Location of the specific concerns near Miller Hill. Letters in the figure correspond to recommendations described in the text.

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MEMORANDUM

BY ELECTRONIC MAIL

TO: Nathan Darnall, U. S. Fish and Wildlife Service

FROM: Garry L. Miller

DATE: August 10, 2012

RE: Response to August 8, 2012 Data Request

This memo responds to the data request sent by you to Jon Kehmeier and me via e-mail on August 8, 2012. Responses below correspond to the numbered requests.

One issue I would like to address up-front is additional data collection going forward. As discussed on a number of prior occasions, Power Company of Wyoming's (PCW's) avian survey protocols were developed in conjunction with the U. S. Fish and Wildlife Service (Service) in 2010 and 2011. The protocols are based upon the Service's strong recommendation to (1) sample eagle high-use areas and (2) employ an avian radar unit for sampling. PCW followed the Service's recommendations explicitly. As a result, the ground survey data (long-watch raptor surveys) are biased towards high-use areas and significantly overstate eagle-minutes/hour/km^2 on a project-wide basis. In addition, the radar data (collected at a cost of several hundred-thousand dollars) are not suitable for use in the Service's risk assessment model.

I understand the Service is meeting internally next week to discuss additional data needs. As stated during our telephone call on August 9, 2012, PCW wants to work collaboratively with the Service to identify data needs, survey methods, and sampling designs appropriate for use in the Service's risk assessment model. PCW's evaluation of the Service's model is that the model makes important assumptions about the underlying sampling strategy used to collect data. Therefore, the Service's risk assessment model is very sensitive to survey data inputs and requires further consideration of data collection methods and sampling designs. PCW/SWCA looks forward to meeting with the Service in the very near future to discuss additional data collection with the objective of obtaining robust data that are well-suited for the Service's risk assessment model.

1. Request: Flight paths for all raptors.

   Response: As set forth in my July 6, 2012 memo to the Service, SWCA Environmental Consultants, consultant to PCW, has not yet compiled flight path data for raptors other than eagles. This data will be compiled and included with the Bird and Bat Conservation Strategy. The BBCS is under development and will be submitted to the Service following submission of PCW's Eagle Conservation Plan. A shapefile of all raptor observation locations from April 2011 through March 2012, in addition to other GIS data layers, was made available to the Service on July 6, 2012 by e-mail from me to Trish Sweanor, Tyler Abbot, Mark Sattleberg and Kevin Kritz. That e-mail contained a link to a PCW FTP site where the data were available for download. At a meeting on July 24, 2012 at the Service's office in Cheyenne, the Service requested that this dataset be updated. On July 27, 2012 an e-mail was sent by Clint King of SWCA to you, Tyler Abbot, Trish Sweanor, Kevin Kritz and Tim Modde that contained a GIS data layer of all raptor observations from April 2011 to June 20, 2012. In addition, the eagle flight path data layer from April 2011 through March 2012 and an associated description of all the attributes contained therein was resubmitted at that time.

2. Request: Data for the 1 km^2 breeding bird densities.

   Response: These data were previously requested and were provided to you, Tyler Abbot, Trish Sweanor, Kevin Kritz, Mark Sattleberg, and Tim Modde on July 18, 2012. Please let me know if the data need to be resubmitted.

3. Request: Ungulate parturition areas.

   Response: As stated in my July 6, 2012 Memo, no ungulate parturition areas have been identified by the Bureau of Land Management (BLM), Wyoming Game and Fish Department (WGFD), or PCW/SWCA within the vicinity of the Chokecherry and Sierra Madre Wind Energy Project area (CCSM Project). *See FEIS at page 4.14-11*[1]. Ungulate parturition areas do not provide foraging opportunities for eagles within the vicinity of the CCSM Project.

4. Request: Sage-grouse brood rearing habitat.

   Response: As detailed in my July 6, 2012 memo, important sage-grouse brood rearing habitat is located within the Sage Grouse Core Population Areas established under the Wyoming Governor's Executive Order 2011-5. PCW has committed to no development in Core Population Areas. *See Appendix C - Applicant Committed Measures, FEIS, at page C-4.* To the extent that important sage-grouse brood rearing areas provide significant eagle foraging opportunities, these areas will not disturbed by development of the CCSM Project. In addition, PCW and its ranching affiliate have committed to place approximately 26,000 acres of private land located in Core Population Areas in a conservation easement in conjunction with construction and

[1] FEIS: Final Environmental Impact Statement for the Chokecherry and Sierra Madre Wind Energy Project, Bureau of Land Management, Rawlins Field Office, June 2012.

operation of the CCSM Project. The conservation easement will protect this important sage-grouse habitat in perpetuity. *See attached Map delineating the proposed conservation easements as well as proposed eagle and raptor avoidance areas discussed at the July 24, 2012 meeting.*

5. Request: Results from sage-grouse monitoring program.

   Response: PCW is presently updating its CCSM Project Sage-Grouse Conservation Plan (January 2012) previously submitted to BLM as a part of the CCSM Project Plan of Operations. The updated Conservation Plan will contain demographic data that describe the current status of the greater sage-grouse population within the CCSM Project area and vicinity. The updated Conservation Plan will be submitted to the BLM by August 17, 2012. A copy will be provided to the Service upon submission to BLM.

6. Request: Prey-base survey data across entire area.

   Response: This topic has been discussed a number of times over the past several months. Due to the importance of the issue, I will provide a response by separate memo. The memo will address the current status of PCW/SWCA knowledge and best available scientific information. In the meantime, the FEIS contains the best available scientific information as of its release date (July 2, 2012). *See FEIS at pages 3.15-1, 4.15-9, 4.15-20, 4.15-26, and 4.15-31.* Notably, the FEIS did not rely on information from the Smith Report (2010) which both SWCA and BLM have now concluded is seriously flawed as the Report's findings cannot be corroborated through independent field investigations and surveys. I understand that Heath Cline, biologist from the BLM's Rawlins Field Office, will contact the Service and discuss the Smith Report *(personal communication between Jon Kehmeier and Heath Cline)*. Mr. Cline recently accompanied SWCA staff on a site visit to investigate findings of the Smith Report.

7. Request: Rodent concentrations (e.g., ground squirrel).

   Response: As detailed in my July 6, 2012 memo, over the course of the greater sage-grouse and avian studies SWCA's field biologists record incidental observations of rodents within the CCSM Project area which may provide a qualitative assessment of relative abundance and spatial distribution. However, no rodent surveys have been undertaken by PCW/SWCA and PCW/SWCA are not aware of any other data sources. As previously mentioned and as will be detailed in the separate memo on prey-base data, PCW has recently engaged SWCA to undertake studies and surveys to examine the validity of the Smith Report (2010) and to provide better data. This data will be provided with SWCA's report assessing prairie dog habitats within the CCSM Project area.

8. Request: Update on additional point count locations for 2012.

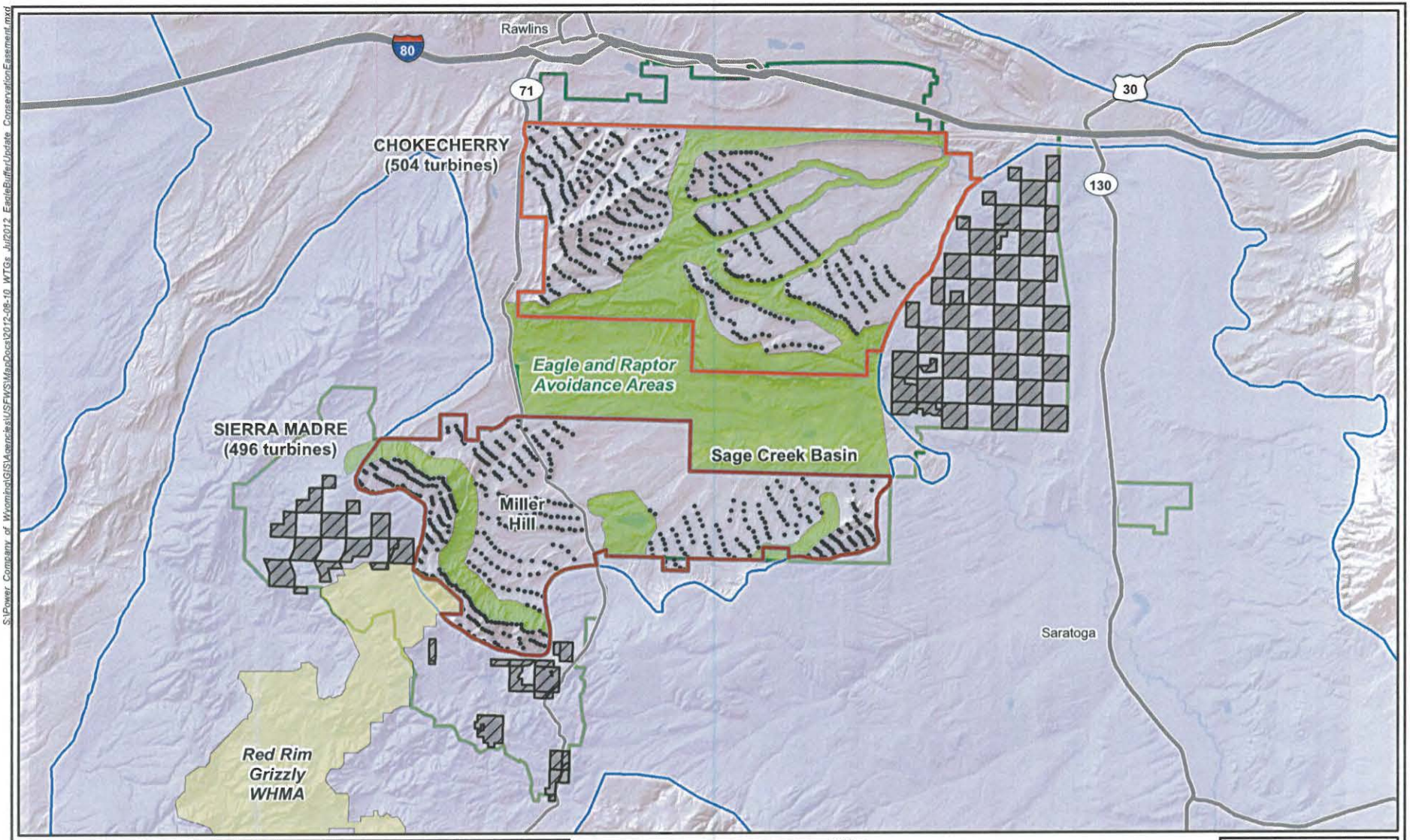
   Response: The coordinates for Year Two and Year Three point count locations were made available to the Service on July 6, 2012 by e-mail from me to Trish Sweanor, Tyler Abbot, Mark

Sattleberg and Kevin Kritz. That e-mail contained a link to a PCW FTP site where the data were available for download.

Please let me know if you have any additional data needs or questions. Thank you.

Garry L. Miller

cc: Jon Kehmeier, Tyler Abbott, Trish Sweanor, Kevin Kritz, Tim Modde, Mark Sattelberg, Emily Bjerre, Brian Millsap, Mark Otto, Stephen Guertin, Noreen Walsh, Michael Thabault, Casey Stemler, David Cottingham, Clint King, Dr. Joshua Millspaugh, Pam Murdock



Legend

- Turbine Location
- Ranch Boundary
- Chokecherry WDA (current)
- Sierra Madre WDA (current)
- Sage-grouse Core Area (v.3)
- Lands Proposed for Conservation Easement
- Red Rim Grizzly WHMA
- Eagle and Raptor Avoidance Areas

July 2012
Eagle Buffer Update

Miles: 0 5 10
Kilometers: 0 5 10

Scale: 1:350,000
Base Map: Shaded Relief
ESRI Online Service (© 2008 ESRI)
Carbon County, Wyoming

N

UTM Zone 13, NAD83, Meters

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Tel 303.298.1000
Fax 303.299.1518

VIA EMAIL

August 14, 2011

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project
Eagle Conservation Plan

Dear Tyler:

The Power Company of Wyoming LLC (PCW) is pleased to provide the U.S. Fish & Wildlife Service (Service) with an updated Eagle Conservation Plan (ECP) for the Chokecherry and Sierra Madre Wind Energy Project in Carbon County, Wyoming (Wind Project). We believe that this ECP is best-in-class, fully adheres to the Service's Land-based Wind Energy Guidelines (2012) and Draft Eagle Conservation Plan Guidance (2011), and in fact, sets the standard for characterizing and addressing risks to eagles.

As you know, the Wind Project is subject to a two-step approval process as outlined below:

First, Bureau of Land Management (BLM) has completed a "project-wide level" or "project-landscape level" Final Environmental Impact Statement (FEIS). Based on this FEIS, the BLM is expected to issue a Record of Decision (ROD). Before, however, the BLM will issue a ROD, BLM has indicated that it will require concurrence from the Service on the associated project-landscape level Eagle Conservation Plan (ECP) pursuant to IM 2010-156. The ROD and associated ECP will set out the basic parameters such as the boundaries of the wind development areas, and the applicable environmental and site constraints with which PCW must comply. The issuance of the ROD in this first step will form the basis for the second round of submissions from PCW, additional NEPA analysis, and project modification/refinement.

Second, following BLMs issuance of the ROD, PCW will finalize the siting of the wind turbine generators (WTGs) and submit site-specific Plans of Development (site-specific PODs) to the BLM. These site-specific PODs will be subject to additional NEPA analysis to ensure they conform to all the requirements of the ROD and consider any new

information that is available. For each site-specific POD with WTGs, PCW will submit a site-specific ECP to the Service. The site-specific ECPs will consider all current survey and modeling information and will include site-specific measures to avoid, minimize and mitigate adverse effects to eagles. In conformance with BLM Instructional Memorandum 2010-156, BLM will not issue PCW a Notice to Proceed with the construction outlined in the site-specific POD with WTGs until the Service reviews and concurs with the site-specific ECP.[1]

As a result of this two-step process, the Service will have the opportunity to review the site-specific ECPs with WTGs in light of the project-level ECP and to work with PCW on the final siting of the turbines using the best available data. PCW has voluntarily elected to prepare this ECP and to make the significant commitments outlined in the ECP. PCW also plans to voluntarily apply for a programmatic take permit under the Bald and Golden Eagle Protection Act (BGEPA). However, BLMs Record of Decision should not be conditioned on PCW obtaining a programmatic take permit. PCW should not be delayed in the commencement of construction of this critical renewable infrastructure Project pending the possible receipt of a programmatic take permit, particularly where the Service has never issued a programmatic take permit.

Moreover, as addressed in detail in *Appendix D* in the ECP, the state and county permits that are expected to be issued in the near future will not negatively impact the ability of the Service and the BLM to require future modifications or to enforce them. Both the state and county permits will require compliance with all applicable federal laws and standards and both the state and county processes have the procedural and statutory mechanisms in place to address Project modifications after the respective permits are granted.

In developing its Project and this ECP, PCW has complied with both the Service's Draft ECP Guidance and the Service's Land-Based Wind Energy Guidelines. A summary of PCWs compliance with both is set out in *Table 11* of the ECP.

Stage 3 of the ECP Guidance requires the prediction of the annual number of fatalities for the Project. The FEIS for the Project uses Year One data and regression analysis to estimate fatalities for the Project at 46 to 64 eagles annually. This estimate is unreliable and should not form the basis for decisions relating to the Project or this ECP. First, the Year One data does not represent the best available science. There is more current data in that Year Two annual survey data is now available.[2] Second, the Year One data was

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[1] This initial project-landscape level ROD and associated ECP are analogous to a subdivision plat that sets out the location of infrastructure such as roads and building sites or lots along with the applicable zoning and building requirements that must be met. The subdivision plat is followed by specific building plans for each lot that must be reviewed to ensure that they conform to all the requirements of both the subdivision plat and any constraints particular to the site.

[2] The regression analysis requires a full year of eagle use data; therefore, Year Two data are most appropriate for use in the model and for comparison to the WEST Year One data. Upon completion of Year Three surveys (Winter 2012-2013), comparisons using both Year Two and Year Three data will be made.

collected over only 3.2% of available daylight minutes in a year and cover only 4.9% of the likely turbine development areas. In contrast, the Year Two survey data account for approximately 49.4% of all available daylight minutes in a year and cover 97% of the likely turbine development areas. Using BLMs regression analysis with the more current Year Two data, annual eagle fatalities are predicted to be between 8 and 12 golden eagles.

The estimate of annual golden eagle fatalities of 8 to 12 is a more realistic estimate in light of the data collected on the resident population (18 to 28 individuals; Project Site plus 5 mile buffer), the eagle use patterns observed throughout the Wind Development Areas, and the fact that the Project Site is not a major eagle migration corridor. This range is also consistent with the estimate of 22 individuals generated using Bird Conservation Region 10 (BCR 10) eagle density values. Under the BGEPA Permit Final Environmental Assessment, annual take levels of 5% of the local area population (Project Site plus 10 miles plus 140 miles[3]) is considered the maximum while annual take levels of 1% or less are deemed a benign harvest rate. For the Project's local area population of 2,655 golden eagles, 5% take would equal 133 golden eagles per year and 1% take would equal 27 golden eagles per year. Therefore, at 8 to 12 golden eagles per year – even before the application of the Advanced Conservation Practices outlined in the ECP, the Project-level impacts will be consistent with conservation of eagle populations and will result in no measurable net-loss of golden eagles from the development of the Project.

As outlined in detail in the attached ECP, PCW has identified and commits to significant measures to avoid, minimize and mitigate the Project's impact on eagles, including: (a) compliance with the significant and detailed Advanced Conservation Practices set out in *Section 8.0* of the ECP; (b) compliance with the identified eagle and raptor avoidance areas and setbacks where the highest eagle use of the Project occurs based upon ground surveys and radar data which will substantially reduce risk to eagles and collision mortality; (c) granting conservation easements in conjunction with construction and operation of the Project on approximately 26,000 acres of private land.

The commitments in the ECP, in combination with the various applicant-committed conservation measures and conservation plans included in the Project Plan of Development and described in the ECP, along with the requirements outlined in the Environmental Impact Statement (EIS), promote the conservation of bald and golden eagles as well as many other avian, wildlife and fish species within the Project Site. Moreover, prior to the issuance of Project authorizations, PCW has proactively moved forward with a variety of science-based programs to both better understand wildlife habitats and use and to implement advanced conservation measures that will avoid,

[3] In accordance with procedures set forth in the BGEPA Permit Final Environmental Assessment, the Project Site was buffered by 10 miles to capture potential nesting territories surrounding the Project Site, and then buffered an additional 140 miles to account for the average natal dispersal distance of golden eagles.

minimize and mitigate adverse effects on wildlife and ecosystems. PCWs data collection, planning and conservation commitments are setting the standard for developing renewable resources in an environmentally responsible manner.

PCW requests that the Service review this ECP, work with PCW to include revisions that are consistent with the requirements of applicable statutes and the purpose of the Project, and issue a concurrence letter to BLM stating that the attached project-landscape level ECP satisfies the requirement set out in the BLMs IM 2010-156.

Sincerely,

Garry L. Miller
Vice President, Land and Environmental Affairs

Power Company of Wyoming LLC
555 Seventeenth Street
Suite 2400
Denver, CO 80202
Tel 303.298.1000
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VIA EMAIL: Tyler_Abbott@fws.gov

September 7, 2012

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Tyler:

Attached is an Expert Report prepared by Dr. Joshua J. Millspaugh, O'Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, concerning his review and analysis of the U.S. Fish and Wildlife Service's Eagle Fatality Model, the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service, the data on eagles that the Service used in the Model, and the use of the Service's Model to estimate eagle fatalities on a re-designed project that excludes certain designated high eagle use areas.

As you know, and as detailed in the Eagle Conservation Plan prepared by PCW and submitted to the Service on August 14, 2012, based on the Service's estimated eagle fatalities for the Project, PCW followed the Service's Draft Eagle Conservation Plan Guidance (January 2011) and re-designed the Project. Data from field surveys were used to generate eagle use densities for identification of high use areas that were then used to develop the turbine no-build areas identified in PCW's ECP.

In accordance with Stage 3 guidance, Dr. Millspaugh applied the Model to the Project as re-designed to evaluate the potential for take of eagles. Dr. Millspaugh concluded that applying the Model to the Project as re-designed results in an 80% quantile number estimate of 23 *or fewer* eagle fatalities. According to Dr. Millspaugh, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

In addition, Dr. Millspaugh opines that the Model run using the re-designed Project still likely overstates the impacts of the Project because the Model does not account for population abundance, turbine daylight operating hours, eagle flight height, and survey sampling bias. Dr. Millspaugh is preparing a separate report addressing some of the assumptions contained in the Model when applied at the Project area. This report will be provided to you as soon as available.

Nevertheless, based upon the Service's Model, PCW's Project re-design resulted in a 63.5% reduction in predicted eagle fatalities compared to the Service's model run that did not consider the turbine no-build areas.

Please let me know if you should have any questions concerning the attached. Thank you.

Sincerely,

/s/ Garry L. Miller

Garry L. Miller
Vice President, Land and Environmental Affairs

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WILDLIFE MANAGEMENT INSTITUTE
EDWARD K. LOVE FOUNDATION

Date: September 7, 2012

To: Garry Miller, Vice President, Land and Environmental Affairs, Power Company of Wyoming LLC, 555 Seventeenth Street, Suite 2400, Denver, CO 80202

From: Dr. Joshua J. Millspaugh, O'Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, 302 Natural Resources Building, Columbia, MO 65211

Subject: Expert Report

I. Executive Summary and Expert Opinions

I was asked to perform a review and critical analysis of the U.S. Fish and Wildlife Service's Eagle Fatality Model, the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service, the data on eagles that the Service used in the Model, and the use of the Service's Model to estimate eagle fatalities on a re-designed project that excludes certain designated high eagle use areas. My opinions are based upon my training, experience, education, and my expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues. In sum, my opinions are:

- For purposes of this report and analysis, no adjustments were made to the base assumptions used by the Service in the Service's Eagle Fatality Model. However, the Service's Eagle Fatality Model maintains some questionable assumptions when applied at the Project area. This conclusion will be explained in detail in a subsequent report, however, my examination of the Model has shown that it assumes (1) an infinite population of eagles exposed each year; (2) turbines operate during all daylight hours, all year long; (3) eagles are at risk whether their flight height is above, below, or at rotor height; and (4) data on eagle use were collected randomly with respect to space and time. By not considering the validity of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. This conclusion will be explained in detail in a subsequent report.

- Eagle data collected for the Project and used as input in the Model was biased in terms of its relationship to the eagle fatality models. My review of the input data suggests that sampling focused on presumed high use eagle areas. Sampling in this manner does not provide a representative sample of total eagle use of the project area. It results in an upward bias of eagle minutes and consequently, inflates the number of predicted eagle fatalities that would occur each year.

- The kernel density maps prepared by SWCA Environmental Consultants (SWCA) are accurate in delineating high use areas from the available data.

- Using the data for all land areas prior to the Project's re-design to remove turbines from high eagle use areas results in an 80% quantile number estimate of 63 *or fewer* eagle fatalities. The output of the Service's Model is a probability distribution representing a range of fatality estimates. This Model output should not be used to assert that there will be 63 eagle fatalities per year. Reliance on the 63 eagle fatality value is very conservative and Model results suggest the actual number of eagle fatalities is likely to be far fewer. For example, the median estimated number of fatalities for this scenario was 29 eagle fatalities. This conservative benchmark is added on top of the already risk averse approach taken by the Service in developing the Model.

- Data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the project as re-designed was clipped accurately. The overall data set was appropriately modified to remove eagle use data for the areas removed from the wind farm (turbine no-build areas).

- Using the clipped data in the Model representing the Project as re-designed results in an 80% quantile number estimate of 23 *or fewer* eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

II. Relevant Experience and Expertise

My experience and expertise are in wildlife ecology and the application of statistical techniques and models to address conservation issues. I have attached my Curriculum Vitae (see Attachment 1), but am providing a summary here of my relevant experience and expertise. Currently, I am a full professor and the Pauline O'Connor Distinguished Professor of Wildlife Management in the School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri. I have a Ph.D. in Wildlife Ecology from the College of Forest Resources, University of Washington, Seattle. I did postdoctoral studies in quantitative ecology at the School of Aquatic and Fishery Sciences, University of Washington. Selected honors and awards are detailed on my C.V., however, they include a 2008 award from the U.S. Department of Agriculture for National Teacher of the Year, a 2007 award from the Wildlife Society for Best Article (with Steve Buskirk), and a 2005

award from the Missouri Department of Conservation for "Outstanding Research Collaborator of the Year."

I have obtained about 55 grants and contracts as either PI or Co-PI since starting my faculty position in 1999 from diverse funding sources such as the U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, National Science Foundation, U.S. Forest Service, National Park Service, and the National Renewable Energy Lab. One recent grant is for the period 2011-2016 to study the *Ecology of Greater Sage-grouse in Relation to Wind Energy Development in Wyoming*. This study is being funded by the U.S. Forest Service, National Renewable Energy Lab, National Fish and Wildlife Foundation, Power Company of Wyoming (PCW), Wyoming Game and Fish Department, Bureau of Land Management, Western Association of Fish and Wildlife Agencies, and National Wind Coordinating Collaborative.

I have published 4 books and 160 peer-reviewed journal articles and book chapters. Three books are directly applicable: (1) *Models for Planning Wildlife Conservation in Large Landscapes*, 2009, Millspaugh, J.J. and F.R. Thompson, III, editors, Academic Press, 674 pages; (2) *Design and Analysis of Long-Term Ecological Monitoring Studies*, 2012, Gitzen, R.A., J.J. Millspaugh, A.B. Cooper, and D.S. Licht, editors. Cambridge University Press, 600 pages; and (3) *Wildlife Demography: Analysis of Sex, Age, and Count Data*, 2005, Skalski, J.R., K.E. Ryding, and J.J. Millspaugh, Elsevier Science, 656 pages. In addition to these publications, I have been an invited plenary speaker at national and international conferences to discuss the application of statistical techniques and models in wildlife ecology and management.

I have applied and evaluated statistical techniques and models in addressing conservation issues for a broad range of species, including mammals, avifauna, reptiles, and amphibians. For example, at the request of the Wisconsin Department of Natural Resources, I chaired an international panel of experts in evaluating data and models the agency uses to monitor and estimate white-tailed deer population demographics. Specifically, we evaluated the validity of the assumptions of their population reconstruction model, assessed adjustments made in the model by state personnel, and offered guidance on future applications. I was the senior author on a paper published in the *Journal of Wildlife Management* in 2009 that summarized our findings. A second example relates to my continued development of animal movement and habitat models. In addition to applying these statistical models to diverse taxa ranging from hellbenders to elephants, I have collaboratively developed new statistical approaches to analyzing such data and rigorously evaluated methodology. Specifically, my colleagues and I were among the first to apply discrete choice models in a wildlife context and we pioneered the development of resource utilization functions, both of which have become standard modeling tools for ecologists over the past decade. Thus, my experience and expertise are directly applicable to the analysis I was asked to perform.

III. Critical Analysis of Eagle Fatality Modeling for the Chokecherry and Sierra Madre Wind Energy Project

I was asked to perform a review and critical analysis of the U.S. Fish and Wildlife Service's Eagle Fatality Model, the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service, the data on eagles that the Service used in the Model, and the use of the Service's Model to estimate eagle fatalities on a re-designed project that excludes certain designated high eagle use areas. My opinions are based upon my training, experience, education and my expertise in the application of statistical techniques and models to address conservation issues.

A. Documents and Data Examined and Scope of Review

In my review, I examined several documents, site-specific data used in the Model, sampling methodology used to collect site-specific eagle data, and the Service's eagle fatality Model. Further, I considered my firsthand knowledge of the site, discussions with SWCA personnel, and two discussions with the Service about the Model. Below I detail the specific materials I reviewed and considered in my evaluation.

(1) Draft Eagle Conservation Plan Guidance released by the Service in January 2011 that describes a process for wind energy developers when preparing an Eagle Conservation Plan (ECP) to assess the risk of projects to eagles and assess how siting, design, and operational modifications can mitigate that risk, specifically, Appendix D, Description of the Service's Model;
(2) Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012 that updated the technical appendices in the Draft Eagle Conservation Plan Guidance;
(3) Power Company of Wyoming's Eagle Conservation Plan (August 2012);
(4) The site-specific eagle data collected at the Project site, including the sampling protocol used to select sites;
(5) Proposed re-design of the Project to include turbine no-build areas;
(6) Clipped data used as input in the Service's Model which considered the turbine no-build areas;
(7) Service's Model and the list of assumptions used by the Service in the Model;
(8) Service's Model as applied to the Project and the Project as re-designed;
(9) Discussions with SWCA about sampling designs, data collection, and data analysis (including the kernel density analysis used to identify turbine no-build areas) and two discussions with the Service about the fatality Model;
(10) Papers that were cited by the Service as support for model development and assumptions.

B. Experience with the Project and Eagle Data Collected

I am familiar with the Chokecherry and Sierra Madre Wind Energy Project, how the eagle data were collected by SWCA and how the data were analyzed by SWCA.

I am currently leading a study at the Chokecherry and Sierra Madre Wind Energy Project that investigates the ecology of male Greater sage-grouse in relation to construction of the wind energy facility. I have also been collaborating on a companion female Greater sage-grouse project on the site since the spring of 2010 and leading the habitat component of that project. Given my role in these sage-grouse projects, I have made extensive site visits across the Project area. I currently supervise two graduate students, one research associate, and the activities of several seasonal research technicians on the site in association with this sage-grouse research. I have also made a few separate trips to Denver, Colorado to meet and discuss my collaborative sage-grouse research with SWCA and PCW personnel.

Because of site visits and my research activities at the Project site, I am knowledgeable of the topography, landscape, and location where the eagle data were collected. I was accompanied by SWCA personnel during most of my time on the Project area and we discussed how and where the eagle data were collected. I also saw the radar unit in operation at the Project site and developed a model to differentiate eagle observations from the radar unit data from other species.

I reviewed the raptor survey program implemented by SWCA including the long watch raptor survey methodology.

I discussed the development of the kernel density maps with SWCA and found their approach to be appropriate and accurate, given the available data. In addition to site visits and previous discussions which made me familiar with the eagle use data and how that information was collected, I also discussed their approach in creating the kernel density maps.

These site-specific surveys and associated protocols are detailed in the Project area ECP, which I reviewed.

C. Eagle Fatality Estimates for the Project Using the Service's Eagle Fatality Model

Under the Service's Draft ECP Guidance, Stage 3 of developing an ECP involves conducting a turbine-based risk assessment and an estimate of the fatality rate of eagles for the facility. Set out below is a discussion of the Service's Eagle Fatality Model, the eagle data collected for the Project as used in the Model, the estimated fatality rate of eagles for the Project prior to re-design, and the estimated fatality rate of eagles for the Project after it was re-designed in the Stage 3 evaluation to remove turbines from certain designated high eagle use areas. For purposes of this report and analysis, no adjustments were made to the base assumptions used by the Service in the Service's Eagle Fatality Model.

1. The Service's Eagle Fatality Model

The Service uses a Bayesian model to predict the number of eagle fatalities for a wind-energy facility. The Service's Model estimates annual eagle fatalities as the product of the rate of eagle exposure to turbine hazards (exposure rate), the probability that eagle exposure will result in a collision with a turbine (collision probability), and an expansion factor that

scales the resulting fatality rate to the project-specific affected potential exposure area and time. Within a Bayesian framework, the Service defines prior distributions for the exposure rate and collision probability. The expansion factor is constant. Using site-specific data, the Service's Model calculates the exposure posterior distribution using the observed data. The number of predicted annual fatalities is estimated as the expanded product of the posterior exposure distribution and collision probability prior. See Appendix D – Stage 3, Draft ECP Guidance.

In reviewing the Model, I generated a list of model assumptions and assessed their validity and sensitivity for the Project area, I ran the Model code provided by the Service to generate the eagle fatality estimates, and I considered the validity of the Model and underlying data as applied to the Project area. I will provide a list and discussion of assumptions in a separate report.

During a conference call with the Service on August 9, 2012, we requested a list of model assumptions (which was provided on August 23, 2012). We explicitly discussed the assumption of an infinite eagle population and interpretation of the model output. The Service acknowledged there was an assumption of an open population. With this assumption, eagle fatalities do not reduce eagle abundance, in terms of the exposed population. We discussed other assumptions during a conference call on September 5, 2012.

The Model maintains several useful properties. The use of a Bayesian model is appropriate for incorporating variability in model input and output. The modeling approach is flexible and allows for modification, which is advantageous because the Model can be updated as additional information becomes available about eagle fatalities at wind energy facilities. Further, it is possible to identify model assumptions because computer code is reviewable and available.

I agree with many of the assumptions of the Model provided by the Service, but also found that other assumptions were not identified. Below is a list of several assumptions that are of concern. These will be addressed in more detail in a subsequent report.

> (1) As stated in the Service's assumptions that were provided on August 23, 2012, the Service assumes an open population in the Model. It is more accurate to state that the Model assumes an infinite number of eagles at the site, and immediate replacement of an eagle with another eagle after a fatality event, because fatality due to turbine collision does not reduce eagle abundance. The open population assumption might provide a mechanism for the assumption of an infinite population and immediate replacement due to a fatality, but what matters in the Model is that eagle abundance, or more specifically potential eagle exposure, does not decline as a result of eagle fatalities. This assumption has the practical influence of each eagle fatality resulting in immediate replacement by another eagle (i.e., the exposure rate does not change with an eagle fatality). The stated open population assumption assumes we know the process that leads to an infinite population. The implication of this assumption is that it is possible to predict more eagle fatalities on the site than eagles that exist currently on the site.

(2) The Service appropriately identifies in their list of assumptions that eagles are only at risk of colliding with turbines during daylight hours. However, it is important to further acknowledge that the current model assumes rotors are moving during all daylight hours. If rotors do not rotate during all daylight hours, there would be a subsequent reduction in the risk of eagle collisions.

(3) The Model does not account for heterogeneous use of eagle use on the site and is therefore spatially blind. Examination of maps of eagle flights demonstrates heterogeneous use of the project area by eagles. Violation of this assumption could lead to an overestimation of fatality risk in low use areas and underestimation of flight risk in high use areas.

(4) The Service correctly identifies an assumption that pre-construction eagle use data used to estimate eagle exposure are spatially and temporally representative. My review of the input data suggests that sampling focused on presumed high use eagle areas. Sampling in this manner is biased and results in an upward bias of eagle minutes and consequently, inflates the number of predicted eagle fatalities that would occur each year.

(5) The Model assumes that each count of eagle minutes per hour per km^2 is independent. In the Service's Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012, they explicitly suggest that eagle counts be conducted for 1, 2, or more hours (page 16, second full paragraph). However, the Model assumes that each count of eagle minutes per hour per km^2 is independent. It is important to recognize that the model implicitly is considering each *1 hour per* km^2 as a discrete, independent exposure event. That is, there is no accommodation for different lengths of survey periods because the Model assumes each count of eagle minutes per hour per km^2 is independent. If input data includes a count from 2 consecutive survey hours per km^2 at a sample unit, the model treats this identical to two randomly selected 1 hour per km^2 survey counts, independently selected in space and time. However, counts conducted for 2 or more hours do not result in independent eagle minutes when expressed on a per hour per km^2 in space or time. For example, hour 1 and 2 in a 2-hour long survey would be dependent and thus violate the assumptions of the Model. If input data do not meet this assumption, there will be an overly precise estimate of the distribution of the exposure rate. The magnitude of bias associated with this assumption was not addressed in this report, but could have implications to eagle fatality estimates.

(6) The Service assumes that the hazardous area is the 2-dimensional rotor-swept area around a turbine or proposed turbine. For clarification, the Service assumes that eagles are at risk for a collision if they are within 50 horizontal meters of the rotors, regardless of eagle height or rotor orientation. This assumption incorrectly means that eagles flying above or below the rotor blades are at risk of collision.

(7) Output of the Service's Model is a probability distribution of predicted eagle fatalities on an annual basis. The Service has used the 80% quantile as a basis for interpretation. During our conference call on August 9, 2012, the Service acknowledged that focus on the 80% quantile is conservative and was a policy decision. Most importantly, the interpretation of a value at the 80% quantile means there is an 80% chance that *x* number of eagles *or fewer* are predicted to be removed at the wind energy site. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities. This conservative benchmark is added on top of the already risk averse approach taken by the Service in developing the Model.

2. The Data Used by the Service to Estimate Eagle Fatalities

SWCA completed an extensive survey program on the Project area using a combination of several approaches. The long watch raptor surveys are most pertinent to our consideration of eagle fatalities and application of the Service's Model. These long watch raptor surveys were conducted at 15, 4,000-m radius plots distributed across the Project. Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage for identifying high use areas while maintaining observer confidence in species identification. Between April 2011 and April 2012, SWCA collected 2,162.5 hours of eagle use data at these 15 sites. These data were used to identify eagle use areas associated with topographic features, movement corridors, foraging areas, and nesting territories. To comply with the data requirements of the Service's Model, these survey data were truncated to include only those observations that occurred within 800-meters of each survey site. I applied these data in the Service's Model to estimate the number of eagle fatalities. This analysis is detailed in the following section.

My evaluation of the sampling locations revealed that the selected sites to survey eagles were biased because they were not selected according to the underlying assumptions of the Model. Rather, sampling sites were selected because they were presumed to be high use eagle sites. This is a fundamental sampling flaw. The Model assumes that the count of eagle minutes that updates the prior distribution on expected eagle minutes per hour per km^2 is collected randomly with respect to space and time. Therefore, if these presumed high use areas had higher eagle activity than other portions of the Project area, the sampling strategy used will inherently result in an overestimate of eagle minutes when applied to the entire Project area. The result is that eagle fatalities would be overestimated. The Model cannot account for heterogeneous use of the Project area by eagles and thus assumes eagle minute use data were collected randomly with respect to space and time (i.e., the Model is spatially blind and therefore assumes a simple random sampling protocol for eagle minutes). In this case, areas of expected high use were oversampled relative to their availability, which results in an upward bias (i.e., more eagle minutes which equates to more predicted fatalities when applied to the entire area). Future sampling design needs to more directly consider the underlying assumptions of the Service's fatality Model and to follow fundamental principles of survey sampling.

The following sections outline the results of applying the Service's Model to estimate the number of eagle fatalities based on data representing two Project configurations: (1) the

Project including areas of high eagle use; and (2) the Project as re-designed to exclude areas of high eagle use that will be designated as turbine no-build areas. Although I have summarized some issues related to the assumptions used by the Service in the Model, for the two applications of the Model set out below, I used the same assumptions used by the Service.

3. *Eagle Fatality Estimates for the Project Including Areas of High Eagle Use*

I applied the baseline Service's Model using site-specific 800-meter survey data from the Project area as collected by SWCA and described above. Specifically, I used the number of golden eagle flight minutes observed and the hour/km^2 of survey observations. The baseline 800-meter survey data, without consideration of the turbine no-build areas, recorded 731.7 eagle minutes for the Project area (which includes 2.7 minutes for unidentified eagle species). The survey effort is based on 2,162.5 survey hours. Because each survey point consisted of an 800 m (0.80 km) radius circle, survey effort equals 2162.5 observation hours * 0.80^2*3.14…km^2 = 4,348 observation hours-km^2. With 15 survey points, this is equal to:

$$\sum_{i=1}^{15}\left(\text{observation hours at survey point i} * \text{area}_{\text{plot i, km2}}\right)$$

where the plot area = $(0.80\text{ km})^2$*3.14… for all survey points. Survey minute totals are shown in Table 1. Table 2 provides the eagle minutes of eagle flight time when only the 800-meter survey data are included. Applying this information in the Service's eagle fatality estimate leads to an estimated fatality distribution with quantiles 0.50 = 29 fatalities, 0.80 = 63 fatalities, 0.90 = 87 fatalities, and 0.95 = 111 fatalities (Figure 1).

The Service uses the 80% quantile from the distribution of predicted fatalities to infer risk. This is a very conservative approach because the most likely number of fatalities, when one considers the probability distribution in Figure 1, is much lower. The resulting probability distribution should not be used to assert that there will be 63 eagle fatalities a year. These results indicate that 80% of the time, it is predicted that 63 *or fewer* eagles would be removed. Thus, it is highly unrealistic to expect 63 eagles would be removed. For example, the median estimated number of fatalities for this scenario was 29 eagle fatalities. Further, this conservative benchmark is added on top of the already risk averse approach taken by the Service in developing the Model.

4. *Eagle Fatality Estimates for the Project as Re-Designed with Eagle Turbine No-build Areas*

Based on the estimated eagle fatalities for the Project, PCW followed the ECP Draft Guidance and re-designed the Project. Using the kernel density maps, which I find accurately represent the high eagle use areas based on available data, PCW re-designed the Project to exclude turbines from certain designated high eagle use areas. A map of the re-designed Project with the turbine no-build areas is attached (Figure 2).

To evaluate the effect of this Project re-design on the estimated number of eagle fatalities, the next step involved clipping the data to eliminate the turbine no-build areas from the Project footprint. Data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the project as re-designed was clipped accurately and appropriately modified to remove eagle use data for the areas removed from the wind farm facility (turbine no-build areas).

To calculate eagle use in these areas, the number of eagle flight minutes and survey minutes were calculated using only those observations that occurred within the remaining survey buffer. As a result, eagle flight minutes per hour of survey time per km^2 was calculated and used as the input data in the Service's eagle fatality Model. Data used as model input are summarized in Tables 1 and 3.

Observed eagle minutes outside the turbine no-build area were recalculated as described above after excluding eagle minutes occurring in portions of plots within the turbine no-build area. This leads to a count of 189 eagle minutes observed in the portions of the 15 Project area survey plots outside the turbine no-build area (Table 3). These non-avoidance plot segments were surveyed for 2,162.5 total survey hours (Table 1), but because the proportion of each plot within the turbine no-build area varied, survey effort was recalculated as:

$$\sum_{i=1}^{15}\left(\text{observation hours at survey point i * area-outside-avoidance-zone}_{\text{plot i , km2}}\right)$$

producing a revised effort of 3,073.9 observation hours-km^2.

I used these revised estimates in the Service's Model to estimate eagle fatalities when incorporating the identified turbine no-build areas. Using the revised survey effort and eagle minutes outside the turbine no-build areas, the estimated fatality distribution (Figure 3) had quantiles 0.50 = 11 fatalities, 0.80 = 23 fatalities, 0.90 = 32 fatalities, and 0.95 = 41 fatalities. Thus, using the clipped data in the Model representing the Project as re-designed results in an 80% quantile estimate of 23 *or fewer* eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

The distribution in Figure 3 is based on applying the baseline Service Model, with revised eagle minutes =189 (Table 3). Because total observation hours-km^2 is calculated in the Service's CollisionModelv2.11.R file rather than the project-specific input file, we also modified the collision model file to specify "SmpHrKM2<-3073.923", which replaces the default calculation of this variable in the Model.

IV. Conclusion

In conclusion, based on my expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues, my opinions are those set out and described above and include that:

- There are a number of assumptions inherent in the Service's eagle fatality Model that should be evaluated further for the Project. Several of these assumptions will be the topic of a separate report.

- The kernel density maps prepared by SWCA are accurate, based on the available data.

- The data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the Project as re-designed was clipped accurately and appropriately modified for application in the Service's Model.

- Using the clipped data representing the Project as re-designed in the Model, without revising the assumptions used by the Service, results in an 80% quantile number estimate of 23 *or fewer* eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

- As will be described in a subsequent report, addressing the Service's assumptions used in the Model will result in an even lower estimate of eagle fatalities for the Project.

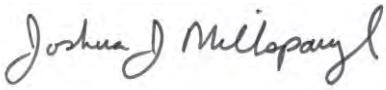

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Table 1. Survey minute totals for all sites in spring, summer, fall, and winter seasons during year two at the Project area.

Site	Spring		Summer		Fall		Winter		Total	
	Mins	Hrs	Mins	Hrs	Mins	Hrs	Mins	Hrs	Mins	Hrs
RM1	3,534	58.9	720	12.0	3,435	57.3	1,200	20.0	8,889	148.2
RM2	3,483	58.1	720	12.0	3,213	53.6	1,190	19.8	8,606	143.4
RM3	2,974	49.6	720	12.0	3,479	58.0	0*	0*	7,173	119.6
RM4	2,867	47.8	724	12.1	3,440	57.3	1,140	19.0	8,171	136.2
RM5	3,422	57.0	738	12.3	3,255	54.3	1,065	17.8	8,480	141.3
RM6	2,925	48.8	631	10.5	4,305	71.8	1,180	19.7	9,041	150.7
RM7	3,120	52.0	675	11.3	2,835	47.3	1,160	19.3	7,790	129.8
RM8	3,403	56.7	730	12.2	3,608	60.1	1,172	19.5	8,913	148.6
RM9	3,704	61.7	720	12.0	3,725	62.1	1,141	19.0	9,290	154.8
RM10	3,614	60.2	720	12.0	3,233	53.9	1,162	19.4	8,729	145.5
RM11	4,001	66.7	720	12.0	3,352	55.9	1,240	20.7	9,313	155.2
RM12	2,790	46.5	670	11.2	3,417	57.0	1,093	18.2	7,970	132.8
RM13	3,999	66.7	720	12.0	3,530	58.8	2,314	38.6	10,563	176.1
RM14	2,985	49.8	725	12.1	3,354	55.9	1,200	20.0	8,264	137.7
RM15	3,345	55.8	720	12.0	3,245	54.1	1,248	20.8	8,558	142.6
Total	50,166	836.1	10,653	177.6	51,426	857.1	17,505	291.8	129,750	**2162.5**

* Due to winter access and safety issues, surveys at RM3 were not completed during winter months.

Table 2. Minutes of eagle flight time within 800-meters of each raptor monitoring location at the Project area. These data relate to eagle fatality estimates for the Project including areas of high eagle use.

Site	Season				
	Spring	Summer	Fall	Winter	Total
RM1	23	12	6	0	41
RM2	16	8	25	10	59
RM3	0	0	13	0	13
RM4	12	9	0	0	21
RM5	23	21	17	19	80
RM6	47	0	0	0	47
RM7	0	0	0	0	0
RM8	50	0	24	4	78
RM9	0	0	11	0	11
RM10	6	0	0	7	13
RM11	59	0	55	35	149
RM12	12	0	12	8	32
RM13	11	0	24	16	51
RM14	26	21	15	37	99
RM15	5	0	25	5	35
Total	**290**	**71**	**227**	**141**	**729**

Table 3. Minutes of eagle flight time outside of turbine no-build areas within 800-meters of each raptor monitoring location at the Project area. These data relate to eagle fatality estimates for the Project as re-designed with turbine no-build areas.

Site	Season				
	Spring	Summer	Fall	Winter	Total
RM1			2		2
RM2	9	6	11	3	29
RM3			6		6
RM4	10	3			13
RM5					0
RM6					0
RM7					0
RM8	6		6	1	13
RM9			7		7
RM10	2			1	3
RM11	6		11	9	26
RM12	5		3	7	15
RM13	10		5	4	19
RM14	10	4	10	19	43
RM15	4		5	4	13
Total	**62**	**13**	**66**	**48**	**189**

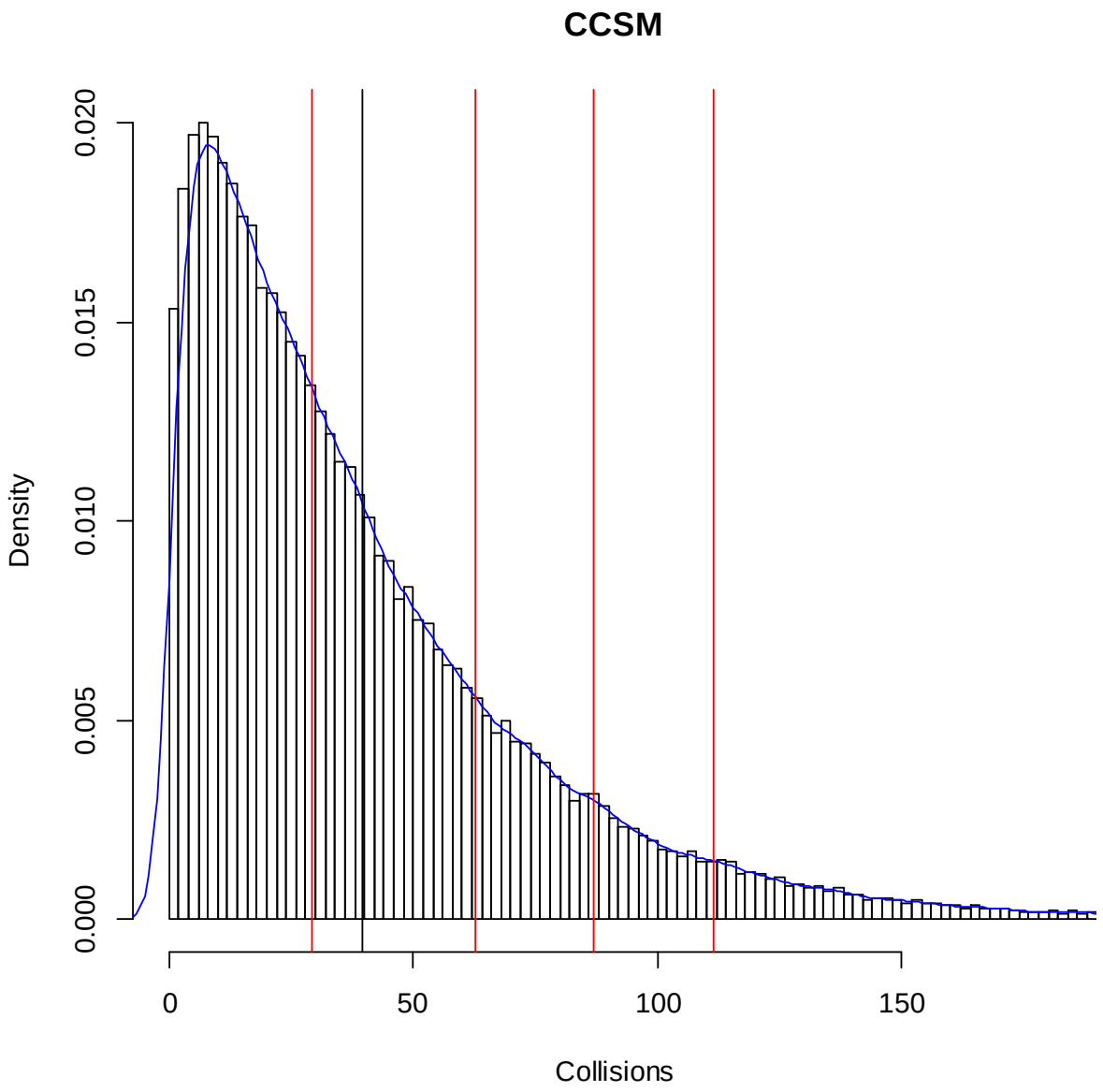

Figure 1. Eagle fatality estimates for the Project including areas of high eagle use. Fatality probability distribution for the Project area (CCSM – Chokecherry and Sierra Madre) based on observed eagle minutes and survey effort which include areas of high eagle use.

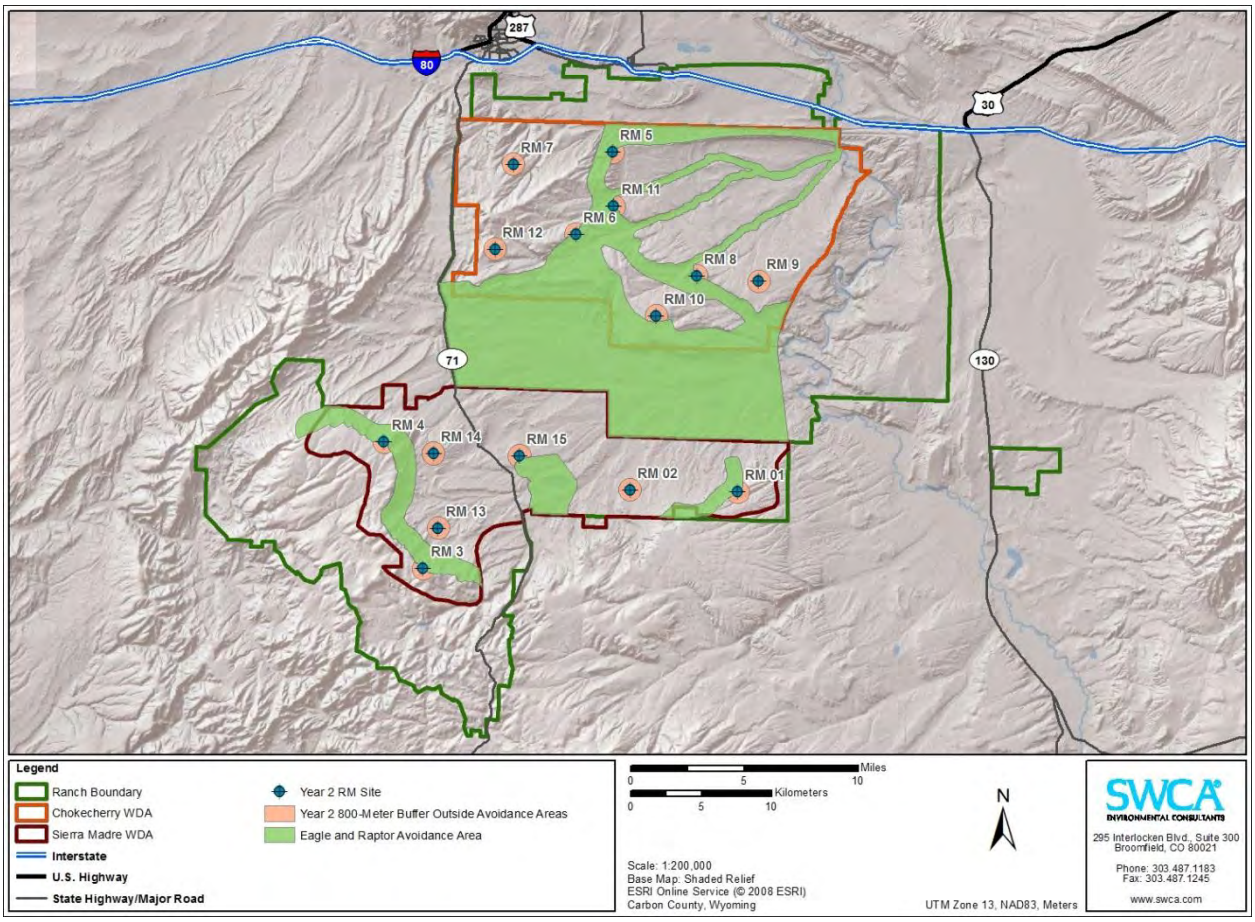

Figure 2. Identified eagle use avoidance areas and 800-meter survey perimeters outside of turbine no-build areas on the Project area.

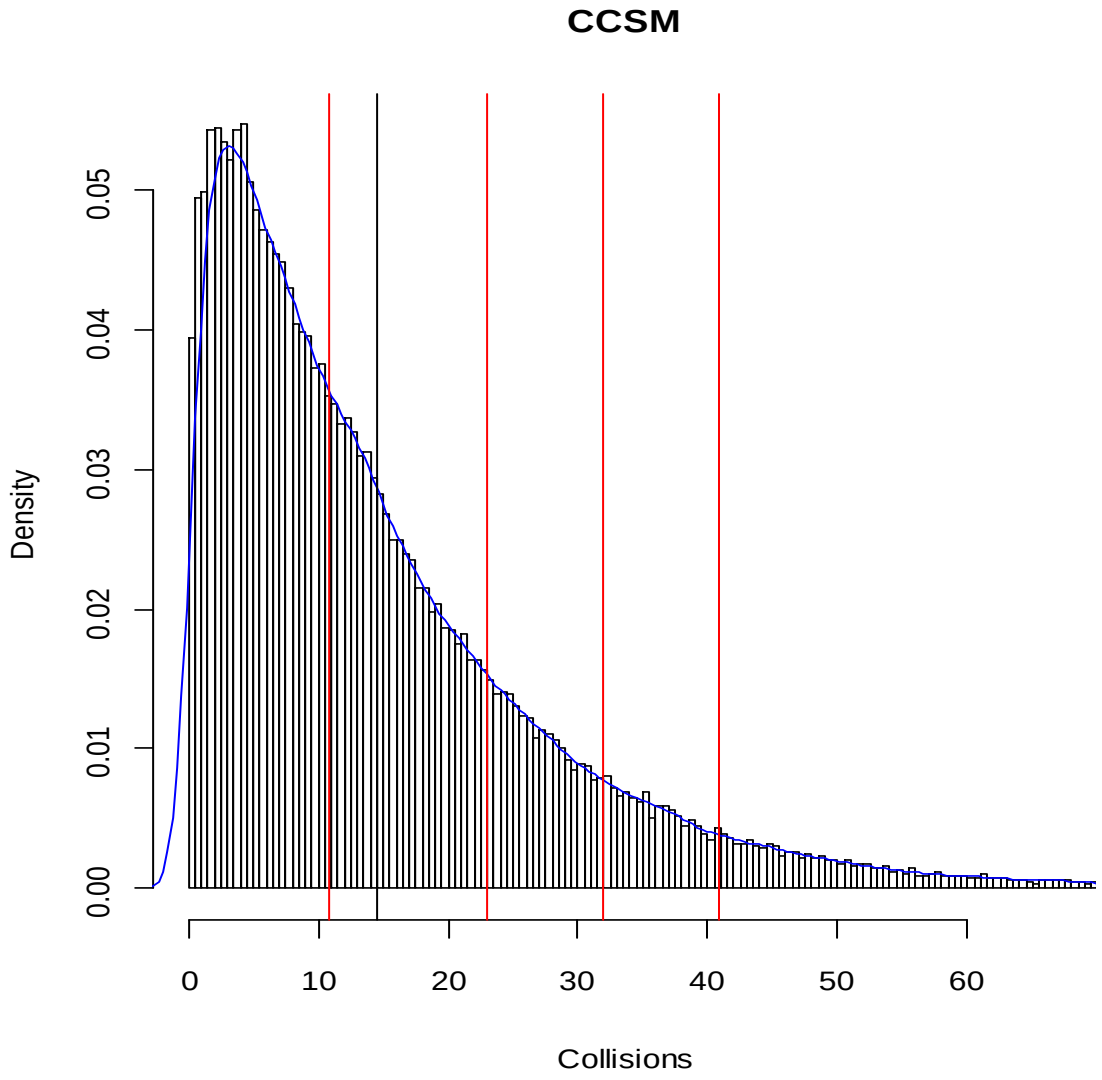

Figure 3. Eagle fatality estimates for the project as re-designed with turbine no-build areas. Fatality probability distribution for the Project area (CCSM – Chokecherry and Sierra Madre) based on observed eagle minutes and survey effort as re-designed with turbine no-build areas.

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ATTACHMENT 1

Curriculum Vitae of

Joshua J. Millspaugh, Ph.D.

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JOSHUA J. MILLSPAUGH

Pauline O'Connor Distinguished Professor of Wildlife Management

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EDUCATION

1999	Postdoctoral Studies in Quantitative Ecology. School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington
1999	Ph.D., Wildlife Ecology. College of Forest Resources, University of Washington, Seattle, Washington
1995	M.S., Wildlife Science. Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota
1991	B.S., Environmental and Forest Biology. State University of New York, College of Environmental Science and Forestry, Syracuse, New York

ACADEMIC POSITIONS

2009-present	Pauline O"Connor Distinguished Professor of Wildlife Management
1999-present	Professor of Wildlife Conservation, School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia (2009-Present); Associate Professor (2005-2009); Assistant Professor (1999-2005)
1999-2010	Director, Thomas S. Baskett Wildlife Research and Education Center, School of Natural Resources, University of Missouri, Columbia, Missouri
1999	Postdoctoral Fellow, School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington
1995-1999	Graduate Research and Teaching Assistant, College of Forest Resources, University of Washington, Seattle, Washington
1992-1995	Graduate Research Assistant, Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota

SELECTED HONORS AND AWARDS

2011	Appointed to University of Missouri Research Board
2009	Appointed as O"Connor Distinguished Professor
2009	Keynote Speaker, Game Monitoring Conference: providing a knowledge basis for sustainable hunting and biodiversity conservation, Uppsala, Sweden
2009	Missouri Governor"s Award for Excellence in Teaching
2008	U.S.D.A. National Teacher of the Year (U.S. Department of Agriculture, Excellence in College and University Teaching Award in the Agricultural Sciences)

2007	The Wildlife Society Award for Best Article (with Steve Buskirk)
2006	Superior Teaching Award from the University of Missouri Chapter of Gamma Sigma Delta
2005	Missouri Department of Conservation "Outstanding Research Collaborator of the Year"
2005	William T. Kemper Fellowship for Excellence in Teaching, University of Missouri
2003	Provost"s Outstanding Junior Faculty Teaching Award, University of Missouri
2003	College of Agriculture, Food, and Natural Resources "Golden Apple" Award for Teaching Excellence
2003	Plenary Speaker, First International Conference on Resource Selection Functions, Laramie, Wyoming
2002, 2008	Student Council "Outstanding Faculty Member", School of Natural Resources, University of Missouri

RESEARCH SCHOLARSHIP

My research focuses on vertebrate population ecology at three scales: physiological processes, individual space use and resource selection, and population-level dynamics. Many of these topics overlap within individual studies and include several themes. At each scale, my focus is on rigorous development and evaluation of field and statistical methods and application of these methods to help answer important conservation issues. My research is motivated by an interest to identify practical management solutions and provide applicable tools to solve pressing conservation problems. I work with a broad range of taxa, from salamanders to elephants, to address these applied questions.

Selected Recent Grants

I have obtained about 55 grants and contracts as either PI or Co-PI since 1999 from diverse funding sources such as the National Science Foundation, National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, U.S. Department of Energy, several state management agencies, and private industry. Total Amount in Grants since 1999 is about $13.5 million. Selected recent, representative grants shown below.

2012-2017	*Mule deer response to oil and gas development in western North Dakota* funded by the Bureau of Land Management, North Dakota Game and Fish, Mule Deer Foundation, and Oil and Gas Research Program in North Dakota. Amount: $688,000. With B. Stillings.
2011-2016	*Ecology of Greater Sage-grouse in Relation to Wind Energy Development in Wyoming* funded by the U.S. Forest Service, National Renewable Energy Lab, National Fish and Wildlife Foundation, Power Company of Wyoming, Wyoming Game and Fish Department, Bureau of Land and Management, and NWCC, Amount: $1,713,000. With M. Rumble, S. Gamo, J. Kehmeier.
2011-2016	*Ecology and management of reintroduced elk in Missouri* funded by the Missouri Department of Conservation, Amount: $1,915,000. With L. Hansen.

2011-2014 *Processes determining the abundance of terrestrial wildlife communities across large spatial scales* funded by the National Science Foundation, Amount: $1,200,000. With R. Kays, R. Costello, Z. He, and B. McShea.

2011-2014 *ABI Innovation: Computational and informatics tools for supporting collaborative wildlife monitoring and research* funded by the National Science Foundation, Amount: $845,000. With R. Kays and Z. He.

2010-2013 *Effects of commercial harvest on river turtle population dynamics* funded by the Missouri Department of Conservation, Amount: $170,659. With J. Briggler.

2007-2013 *Importance of mountain pine beetle infestations and fire as Black-backed woodpecker habitat in the Black Hills, South Dakota* funded by South Dakota Department of Game, Fish, and Parks and U.S. Forest Service, Amount: $230,713. With M. Rumble and D. Kesler.

2007-2011 *Development of a monitoring plan for the Northern Great Plains I&M Program* funded by the National Park Service, Amount: $449,000. With R. Gitzen.

2007-2016 *Evaluation of silvicultural management in Missouri oak-hickory forests: the effects of even-aged, uneven-aged, and no-harvest management on amphibian, reptile, and small mammal communities* funded by the Missouri Department of Conservation, Amount: $1,133,230. With R. Renken, R. Gitzen, and A. Smith.

2009-2014 *Predicting and monitoring impacts of climate change, disturbance and land use and management on forests and wildlife in the central hardwood region* funded by the U.S. Forest Service, Amount: $152,195. With F. Thompson and H. He.

2007-2011 *Application of wildlife habitat suitability and viability models to evaluate effects of fire and ecosystem restoration* funded by U.S. Forest Service, Amount: $114,788. With F. Thompson.

2006-2010 *Survival, movements, and resource selection of hellbenders in Missouri* funded by the Missouri Department of Conservation, Amount: $193,000. With J. Beringer and J. Briggler.

2005-2013 *Mourning dove demographics in Missouri* funded by the Missouri Department of Conservation, Amount: $331,912. With J. Schulz.

2005-2008 *DeerNet: Wireless sensor networking for wildlife monitoring* funded by the National Science Foundation, Amount: $1,050,000. With M. Fang and Z. He.

2005-2009 *Forage utilization model development and habitat impacts of free-ranging ungulates in the Black Hills, South Dakota* funded by the South Dakota Department of Game, Fish, and Parks and Custer State Park, Amount: $209,000. With G. Brundige.

Publications

I have published 4 books, ~160 peer-reviewed journal articles and book chapters. Representative publications are presented below. Complete list available upon request.

Books

Millspaugh, J. J., and J. M. Marzluff, editors. 2001. Radio Tracking and Animal Populations.

Academic Press, San Diego, California, USA. 467 pages.

Skalski, J. R., K. E. Ryding, and J. J. Millspaugh. 2005. Wildlife Demography: Analysis of Sex, Age, and Count Data. Elsevier Science, San Diego, California, USA. 656 pages.

Millspaugh, J. J., and F. R. Thompson, III, editors. 2009. Models for Planning Wildlife Conservation in Large Landscapes. Elsevier Science, San Diego, California, USA. 674 pages.

Gitzen, R. A., J. J. Millspaugh, A. B. Cooper, and D. S. Licht, editors. 2012. Design and Analysis of Long-Term Ecological Monitoring Studies. Cambridge University Press. 600 pages.

Journal Articles and Book Chapters

Belant, J. L., J. J. Millspaugh, J. Martin, and R. A. Gitzen. 2012. Multi-dimensional space use: the final frontier. Frontiers in Ecology 10:11-12.

Bodinof, C. M., J. T. Briggler, R. E. Junge, J. Beringer, M. D. Wanner, C. D. Schuette, J. Ettling, and J. J. Millspaugh. 2012. Habitat attributes associated with short-term settlement of Ozark hellbender (*Cryptobranchus alleganiensis bishopi*). Freshwater Biology 57:178-192.

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Bodinof, C. M., J. T. Briggler, R. E. Junge, T. W. Mong, J. Beringer, M. D. Wanner, C. D. Schuette, J. Ettling, and J. J. Millspaugh. 2012. Survival and body condition of captive-reared juvenile Ozark hellbenders (*Cryptobranchus alleganiensis bishopi*) following translocation to the wild. Copeia 2012:150-159.

Clawson, M. V., J. R. Skalski, and J. J. Millspaugh. 2012. Archaeological analysis of bison jumps and the implications to contemporary management of bison in North America. Natural Areas Journal: *In press*.

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Eads, D.A., D.S. Jachowski, D.E. Biggins, T.M. Livieri, M.R. Matchett, and J.J. Millspaugh. 2012. Resource selection models are useful in predicting distributions of black-footed ferrets in prairie dog colonies. Western North American Naturalist: *In press*.

Gitzen, R. A., and J. J. Millspaugh. 2012. Monitoring: the heart of the matter. Pages 10-35 *in* Design and Analysis of Long-Term Ecological Studies, edited by R. A. Gitzen, J. J. Millspaugh, A. B. Cooper, and D. S. Licht. Cambridge University Press.

Kolar, J. L., J. J. Millspaugh, T. W. Mong, and B. A. Stillings. 2012. Survival and cause-specific mortality of pronghorn in southwestern North Dakota. American Midland Naturalist 167:164-173.

Jachowski, D. S., R. Slotow, and J. J. Millspaugh. 2012. Physiological stress and refuge behavior by African elephants. PLoS ONE 7(2): e31818. doi:10.1371/journal.pone.0031818.

Lesmeister, D. B., R. S. Crowhurst, J. J. Millspaugh, and M. E. Gompper. 2012. Landscape ecology of eastern spotted skunks in habitats restored for red-cockaded woodpeckers. Restoration Ecology: *In press*.

Millspaugh, J. J., D. C. Kesler, R. W. Kays, R. A. Gitzen, J. H. Schulz, C. T. Rota, C. M. Bodinof, J. L. Belant, and B. J. Keller. 2012. Wildlife radiotelemetry and remote monitoring. Pages 258-283 *in* N. J. Silvy, editor. Wildlife Techniques Manual. Johns Hopkins Press.

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Skalski, J. R., J. J. Millspaugh, M. V. Clawson, J. L. Belant, D. R. Etter, B. J. Frawley, and P. D. Friedrich. 2011. Abundance of American martens in Michigan using statistical population reconstruction. Journal of Wildlife Management 75:1767-1773.

Walter, W. D., D. M. Baasch, S. E. Hyngtrom, B. D. Trindle, A. J. Tyre, J. J. Millspaugh, C. J. Frost, J. R. Boner, and K. C. VerCauteren. 2011. Space use of sympatric deer in a riparian ecosystem in an area where chronic wasting disease is endemic. Wildlife Biology 17:191-209.

Walter, W. D., J. Beringer, L. P. Hansen, J. J. Millspaugh, and K. C. VerCauteren. 2011. Factors affecting space use overlap of white-tailed deer in an urban setting. International Journal of Geographic Information Systems 25:379-92.

Baasch, D. M., J. W. Fisher, S. E. Hyngstrom, K. C. VerCauteren, A. J. Tyre, J. J. Millspaugh, J. W. Merchant, and J. D. Volesky. 2010. Resource selection by elk in an agro-forested landscape of northwestern Nebraska. Environmental Management DOI:10.1007/s00267-010-9559-2.

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Selected Invited Seminars and Symposia

2011 Elk ecology and management in Missouri. Presented to Missouri Conservation Commission (and presented again in 2012)

2009 Harmonizing game statistics: North American experience. Game Monitoring Conference: providing a knowledge basis for sustainable hunting and biodiversity conservation, Uppsala, Sweden, Uppsala, Sweden (*Keynote speaker*)

2009 Reconstructing historical bison demographics in the Northern Great Plains. Iowa State University, Ames, IA

2008 Population modeling and migratory birds. U.S. Fish and Wildlife Service and the Association of Fish and Wildlife Agencies, Denver, CO

2008 From elephants to hellbenders: CAFNR solving conservation problems. Missouri State Capitol. Jefferson City, MO

2007 Integrated camera and sensor system for wildlife monitoring: present and future applications. NSF sponsored workshop. Princeton University, NJ (with H. He)

2006 Quantitative advancements of wildlife space use and demographic studies. State University of New York, College of Environmental Science and Forestry, Syracuse, NY

2005 Reconstructing historical bison demographics in the Northern Great Plains. Fisheries and Wildlife Sciences seminar series, University of Missouri

2005 Reconstructing historical bison demographics in the Northern Great Plains. Ecology and evolution seminar series, Division of Biological Sciences, University of Missouri

2005 Using physiological measures to assess costs of wildlife habituation. Invited by National Park Service to present at The Wildlife Society Conference, Madison, WI

2005 Wildlife population modeling workshop. National Park Service. Badlands National Park, Interior, SD

2005 Natural herd demographics and effects of population control strategies in National Park Service bison and elk herds. National Park Service. Badlands National Park, SD

2004 Using discrete choice modeling and utilization distributions to assess resource selection. Winemiller Statistics Symposium, Department of Statistics, University of Missouri

2004 Recent quantitative advancements in wildlife habitat studies. U.S. Forest Service, Rocky Mountain Research Station, Rapid City, SD

2003 Wildlife management in South African Reserves. Kansas State University, Student Chapter of The Wildlife Society, Manhattan, KS

2003 Humans, stress, and elephants in South African Reserves. Kansas State University, Biological Sciences, Manhattan, KS

2003 Stress management of elephants in South African Reserves. State University of New York, Adirondack Ecological Center, Newcomb, NY

2003 Noninvasive assessment of stress in wild animal populations. Missouri Life Sciences Week, Conservation Biology Forum, University of Missouri

2003 What"s available? Techniques to address this problematic question in resource selection studies. First International Conference on Resource Selection Functions, University of Wyoming, Laramie, WY (*Plenary Speaker*)

2002 Assessing stress in free-ranging wildlife using noninvasive techniques. University of Minnesota, Department of Fisheries, Wildlife, and Conservation Biology, St. Paul, MN

2002 Stressed out: the effects of humans on charismatic megafauna. Dalton Cardiovascular Research Center Science Teachers Symposium, University of Missouri

2001 Wildlife conservation in South Africa National Parks. University of Missouri, Department of Fisheries and Wildlife Sciences (with M. Ryan and M. Larson)

2001 Noninvasive measurement of stress in free-ranging vertebrates. School of Life & Environmental Sciences, University of Natal, Durban, South Africa

2001 Noninvasive measurement of stress in wild animals. University of Missouri, Department of Physiology

Selected Conference Presentations and Abstracts

Since arriving at MU, my students and I have presented ~160 papers at state, regional, national, and international meetings. Some representative examples from the past 5 years are below.

Rota, C.T., J.J. Millspaugh, D.C. Kesler, C.P. Lehman, M.A. Rumble, and C. Bodinof. 2012. A Bayesian modified case-control model for estimating absolute probability of use from use-availability data. Ecological Society of America 97th Annual Conference, Portland, Oregon.

Rota, C.T., D.C. Kesler, C.P. Lehman, M.A. Rumble, and J.J. Millspaugh. 2012. Black-backed woodpecker home range size and resource selection in habitat created by mountain pine beetle infestations in the Black Hills of South Dakota. Invited Symposium, Vertebrate Responses to Bark Beetles, Laramie, Wyoming.

Ayers, C. R., J. L. Belant, J. J. Millspaugh, and C. M. Bodinof. 2011. Relating resource use to body mass change and survival of individual hellbenders (*Cryptobranchus alleganiensis*). Southeastern Association of Fish and Wildlife Agencies, Nashville, Tennessee.

Ayers, C. R., J. L. Belant, J. J. Millspaugh, D. A. Eads, and D. S. Jachowski. 2011. Effects of resource use on recruitment of black-footed ferrets. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Bonnot, T. W., F. R. Thompson, and J. J. Millspaugh. 2011. It‟s not how much to restore but where to restore it. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Gitzen, R. A., and J. J. Millspaugh. 2011. Integrating and applying quantitative recommendations about ecological monitoring. 3rd North American regional meeting of The International Environmetrics Society, La Crosse, Wisconsin.

Gitzen, R. A., J. J. Millspaugh, and B. J. Keller. 2011. Utilization distributions and resource selection. Invited presentation scheduled for the 2011 Annual Conference of the Wildlife Society, Waikoloa, Hawaii.

Jachowski, D.S., R. Slotow and J.J. Millspaugh. 2011. Physiological stress and refugia behavior by African elephants. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Keller, B, J. J. Millspaugh, G. Brundige and C. Lehman. 2011. Mechanisms affecting pronghorn resource selection in the Black Hills, SD. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Gering, Nebraska.

Keller, B, J. J. Millspaugh, G. Brundige and C. Lehman. 2011. Analysis of factors influencing spatial overlap among an ungulate assemblage in the Black Hills, SD. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Gering, Nebraska.

LeBrun, J. L., W. Thogmartin, F. Thompson, and J. Millspaugh. 2011. The effects of climate versus habitat and landscape factors on avian abundance in the Midwestern United States. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Rota, C. T., D. C. Kesler, M. A. Rumble, C. P. Lehman, and J. J. Millspaugh. 2011. Foraging behavior of Black-backed woodpeckers in burned forests and mountain pine beetle infestations. AOU Annual Meeting, Jacksonville, Florida.

Rota, C. T., D. C. Kesler, M. A. Rumble, C. P. Lehman, and J. J. Millspaugh. 2011. Do mountain pine beetle infestations provide similar foraging resources for Black-backed woodpeckers as recently burned forests? 72nd Midwest Fish and wildlife Conference, Des Moines, Iowa.

Schulz, J. H., T. W. Bonnot, and J. J. Millspaugh. 2011. Factors affecting mourning dove harvest in Missouri. 72nd Midwest Fish and wildlife Conference, Des Moines, Iowa.

Wong, S.T., J.L. Belant, J.J. Millspaugh, R.A. Gitzen, A. Heard, and J. Ross. 2011. Radiotelemetry and remote monitoring of tropical carnivores. 1st Borneo Carnivore Symposium, Kota Kinabalu, Malaysia.

Bodinof, C.M., J. T. Briggler, R. E. Junge, J. Beringer, M. D. Wanner, C. D. Schuette, and J. J. Millspaugh. 2010. General observations of captive reared Ozark hellbenders released in the North Fork of the White River, Missouri. Missouri Natural Resources Conference. Tan-Tar-A Resort, Osage Beach, Missouri.

Bonnot, T. W., F. R. Thompson, III, and J. J. Millspaugh. 2010. Extension of landscape-based population viability models to ecoregional scales. The Wildlife Society Annual Conference, Snowbird, Utah.

Jachowski, D. S., R. A. Gitzen, M. B. Grenier, B. Holmes, and J. J. Millspaugh. 2010. The importance of thinking big: Large scale prairie dog conservation drives black-footed ferret reintroduction success. 37th Annual Natural Areas Conference, Osage Beach, Missouri.

Jachowski, D. S., R. A. Gitzen, M. B. Grenier, B. Holmes, and J. J. Millspaugh. 2010. Evaluating attempts to reintroduce black-footed ferrets to North America. 90th meeting of the American Society of Mammalogists, Laramie, Wyoming.

Atwood, P., P. Zager, J. J. Millspaugh, M. D. Matocq, R. T. Bowyer, and J. G. Kie. 2009. Fecal indices in mule deer during winter: effects of competition with elk. Annual Wildlife Society Conference, Monterey, California.

Atwood, P., P. Zager, J. J. Millspaugh, M. D. Matocq, R. T. Bowyer, and J. G. Kie. 2009. Fecal indices in mule deer wintering in close proximity to elk. Western States and Provinces Deer and Elk Workshop, Spokane, Washington.

Bodinof, C. M., J. T. Briggler, R. E. Junge, J. Beringer, M. D. Wanner, C. D. Schuette, and J. J. Millspaugh. 2009. General observations of captive reared Ozark hellbenders released in the North Fork of the White River, Missouri. 4th Hellbender Symposium. Cumberland Falls State Resort Park, Kentucky.

Bodinof, C. M., J. T. Briggler, M. Duncan, J. Beringer, and J. J. Millspaugh. 2009. Historic occurrence of Chytridiomycosis in hellbenders from Missouri. 4th Hellbender Symposium. Cumberland Falls State Resort Park, Kentucky.

McGowan, C. P., J. J. Millspaugh, M. R. Ryan, C. D. Kruse, and G. Pavelka. 2009. A new method for estimating survival of unmarked pre-fledged shorebird chicks. 3rd Shorebird Science in the Western Hemisphere Meeting, Mazatlan, Mexico.

Montgomery, R. A., G. J. Roloff, and J. J. Millspaugh. 2009. Modeling the probability distribution around telemetry points to explicitly incorporate positional error into wildlife resource use studies. Annual Wildlife Society Conference, Monterey, California.

Walter, W. D., D. M. Baasch, S. E. Hygnstrom, B. D. Trindle, A. J. Tyre, J. J. Millspaugh, and K. C. Vercauteren. 2009. Space use of sympatric deer in an area endemic for chronic wasting disease. Annual Wildlife Society Conference, Monterey, CA, September, 2009.

Gitzen, R. A., and J. J. Millspaugh. 2008. Successful strategies for design and analysis of noninvasive carnivore surveys. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio, December, 2008 (*Invited*).

Gitzen, R. A., A. Symstad, and J. J. Millspaugh. 2008. All variances are not created equal: sampling design for long-term monitoring. Annual Wildlife Society Conference, Miami, FL.

Gitzen, R., S. West, K. Aubry, J. Millspaugh, and M. Kroeger. 2008. The space-time continuum and responses by small mammals to forest management experiments. Annual Meeting of the American Society of Mammalogists.

Hansen, C., J. J. Millspaugh, and M. R. Rumble. 2008. Occupancy modeling of ruffed grouse in the Black Hills, South Dakota. Annual Wildlife Society Conference, Miami, FL.

Jachowski, D., J. J. Millspaugh, D. Biggins, T. Livieri, and R. Matchett. 2008. Black-footed ferret resource selection in the Conata Basin, South Dakota. Annual Wildlife Society Conference, Miami, FL.

Jachowski, D., J. J. Millspaugh, D. Biggins, T. Livieri, and R. Matchett. 2008. Spatial dynamics of black-footed ferrets and prairie dogs in the Conata Basin, South Dakota. Annual Meeting of the American Society of Mammalogists.

Keller, B., J. J. Millspaugh, and G. C. Brundige. 2008. Resource selection of sympatric ungulates in the Black Hills, South Dakota. Annual Wildlife Society Conference, Miami, FL.

Kolar, J., J. J. Millspaugh, and B. Stillings. 2008. Movements of pronghorn in southwest North Dakota. Biennial Pronghorn Workshop, Canmore, Alberta, Canada.

Kolar, J., J. J. Millspaugh and B. Stillings. 2008. Resource selection and space use of pronghorn in southwest North Dakota. Annual Wildlife Society Conference, Miami, FL.

Lesmeister, D. B., M. E. Gompper, and J. J. Millspaugh. 2008. Denning and resting ecology of the eastern spotted skunk. Annual Meeting of the American Society of Mammalogists.

Shifley, S. R., C. D. Rittenhouse, W. D. Dijak, Z. Fan, F. R. Thompson, III, and J. J. Millspaugh. 2008. Forecasting landscape-scale, cumulative effects of forest management on forest vegetation and wildlife dynamics for the Hoosier National Forest, USA. IUFRO Landscape Ecology Conference, Chengdu, Sichuan, P.R. China.

Walter, W. D., J. Beringer, L. P. Hansen, J. W. Fischer, J. J. Millspaugh, and K. VerCauteren. 2008. Demographics and space use of a white-tailed deer population in the St. Louis Metropolitan Area. Annual Wildlife Society Conference, Miami, FL.

Washburn, B. E., J. J. Millspaugh, and R. J. Woods. 2008. Assessing endocrine status of carnivores using noninvasive techniques. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio (*Invited*).

Bonnot, T. W., M. L. Wildhaber, J. J. Millspaugh, A. J. DeLonay, R. B. Jacobson, D. M. Papoulias. 2007. Resource selection of gravid shovelnose sturgeon in the Lower Missouri River. 137th Annual American Fisheries Society Meeting, San Francisco, California (*Invited*).

Bonnot, T. W., M. L. Wildhaber, J. J. Millspaugh, A. DeLonay, R. Jacobson, and D. Papoulias. 2007. Habitat use of gravid shovelnose sturgeon. Missouri River Natural Resource Conference (*Invited*).

Gitzen, R., S. West, K. Aubry, J. Millspaugh, and M. Kroeger. 2007. The space-time continuum and responses by small mammals to forest management experiments. Annual Wildlife Society Conference, Tucson, Arizona.

Lesmeister, D., M. Gompper, and J. Millspaugh. 2007. Space use and mortality of eastern spotted skunks in the Ouachita Mountains, Arkansas. American Society of Mammalogists, 87th Annual Meeting, Albuquerque, New Mexico.

Lesmeister, D., M. Gompper, and J. Millspaugh. 2007. Space use and mortality of eastern spotted skunks in the Ouachita Mountains, Arkansas. Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Licht, D., R. Slotow, and Millspaugh, J. J. 2007. A comparison of park management in South Africa and the United States. George Wright Society, Minneapolis, MN.

Millspaugh, J. J., S. Amelon, T. Bonnot, T. Farrand, R. Gitzen, D. Licht, C. McGowan, S. Pruett, C. Rittenhouse, K. Suedkamp Wells. 2007. Natural demographics of bison in the Great Plains. George Wright Society, Minneapolis, MN.

Mong, T. W., J. H. Schulz, R. Bredesen, J. J. Millspaugh, and D. Dey. 2007. Using agroforestry and lease hunting to increase the economic viability of agricultural landscapes. Missouri Natural Resources Conference, Osage Beach, Missouri.

Rittenhouse, C. D., W. D. Dijak, F. R. Thompson, III, J. J. Millspaugh, and S. R. Shifley. 2007. A landscape-level approach to forest-wildlife planning: the Hoosier National Forest Management Plan. Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Rittenhouse, C. D., J. J. Millspaugh, M. W. Hubbard, S. L. Sheriff, and W. D. Dijak. 2007. Resource selection by translocated three-toed box turtles in Missouri. Annual Wildlife Society Conference, Tucson, Arizona.

Schulz, J. H., P. Padding, and J. J. Millspaugh. 2007. Will mourning dove crippling rates increase with nontoxic shot regulations? Missouri Natural Resources Conference, Osage Beach, Missouri.

Schulz, J. H., R. Reitz, S. Sheriff, and J. J. Millspaugh. 2007. Attitudes of Missouri small game hunters toward nontoxic shot regulations. Missouri Natural Resources Conference, Osage Beach, Missouri.

Professional and Academic Memberships

The Wildlife Society (State, Regional, National)
The Wildlife Society Biometrics Working Group
The Wildlife Society College and University Education Group
Xi Sigma Pi Academic Honor Society
Gamma Sigma Delta Academic Honor Society
Boone and Crockett Club

TEACHING SCHOLARSHIP

Teaching Experience

Courses Taught (University of Missouri)

Spring 2003-present	Animal Population Dynamics, 3 credits, undergraduate, required course for undergraduate students, every spring (except 2009)
Fall 2000-2008	Wildlife Research and Management Techniques, 4 credits, undergraduate, writing intensive (each fall from 2000-2004, then alternate years)
Winter 2000-2002	Natural Resources Practicum, 3 credits, undergraduate (with H.

	Bhullar, J. Dwyer, and D. Hammer)
Spring 2002, Fall 2007	Quantitative Fish and Wildlife Assessment, 4 credits, graduate
Fall 2004, Spring 2005	Wildlife Management and National Park Service Policy, 2 credits, graduate
Fall 2003, 2011	Resource Use and Model Selection, 3 credits, graduate
Fall 2001, 2006, 2009	Professionalism and Communications, 2-3 credits, graduate (with Mark Ryan)
Fall 2010	Energy Development and Wildlife Management, 2 credits, graduate
Spring 2012	Harvest Management, 3 credits, graduate

Student Advising

In addition to serving as Chair of graduate committees, I have served as a member on > 50 graduate student committees in several departments (Statistics, Biological Sciences) and universities (University of Washington, University of Nebraska). A total of 17 graduate students have completed their degrees with me at MU.

Dissertation or Thesis Advisor (Current)

Thomas Bonnot (Ph.D.). Dissertation topic: Ecoregional landscape population models for conservation planning in response to climate change (with F. Thompson)

Jaymi LeBrun (Ph.D.). Dissertation topic: Climate and ecosystem restoration modeling and impacts to wildlife in forested systems (with F. Thompson)

Christopher Rota (Ph.D.). Dissertation topic: Black-backed woodpecker space use and demographics in the Black Hills, South Dakota (with D. Kesler)

Amy Bleisch (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri

Stephanie Zimmer (M.S.). Thesis topic: Effect of commercial harvest on river turtle populations in Missouri

Leslie Schreiber (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming

Aleshia Fremgen (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming

Trenton Smith (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri

Undergraduate Advising and Mentoring:

I advise 20-25 undergraduate students enrolled in the Fisheries and Wildlife Sciences curriculum. I have mentored ~20 undergraduate student research projects and have employed over 150 students on my funded research projects.

Teaching Publications and Presentations

Peer-Reviewed

Millspaugh, J. J., and K. F. Millenbah. 2004. Value and structure of research experiences for undergraduate wildlife students. Wildlife Society Bulletin 32:1185-1194.

Millenbah, K. F., and J. J. Millspaugh. 2003. Using experiential learning in wildlife courses to

improve retention, problem solving, and decision making. Wildlife Society Bulletin 31:127-137.

Selected Invited Workshops and Teaching Presentations

Millspaugh, J. J. 2011. Professor‟s perspective. 4-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2011.

Ryan, M. R., and J. J. Millspaugh. 2011. Problem-based learning for undergraduates. Teaching Renewal Conference, University of Missouri, 1.5 hour workshop, May, 2011.

Millspaugh, J. J., and M. R. Ryan. 2011. Problem-based learning for undergraduates. Conservations in Teaching, University of Missouri, 1 hour workshop, April, 2011.

Millspaugh, J. J. 2010. Professor‟s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2010.

Ryan, M. R., and J. J. Millspaugh. 2010. Problem-based learning. 2 hour workshop. College Teaching of Agriculture class, University of Missouri, Winter 2010.

Ryan, M. R., and J. J. Millspaugh. 2010. Problem-based learning. 1 hour for graduate students enrolled in "Teaching of Psychology Practicum", Winter 2010.

Ryan, M. R., and J. J. Millspaugh. 2009. Problem-based learning. 2 hour workshop. College Teaching of Agriculture class, University of Missouri, Fall 2009.

Millspaugh, J. J. 2009. Professor‟s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2009.

Ryan, M. R., and J. J. Millspaugh. 2009. Problem-based learning. Dalton Cardiovascular Research Center Science Teachers Symposium, University of Missouri, February, 2009.

Millspaugh, J. J. 2009. Problem-based learning roundtable discussion (two sessions). College of Agriculture, Food, and Natural Resources Teaching Round-up. January, 2009.

Ryan, M. R., and J. J. Millspaugh. 2008. Problem-based learning: teaching with case studies. 2.5 hour workshop. College Teaching of Agriculture class, University of Missouri, Fall 2008.

Millspaugh, J. J. 2008. Professor‟s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2008.

Millspaugh, J. J. 2007. Interactive teaching strategies. 2 hour workshop. University of Missouri New Faculty Teaching Scholars Program. November, 2007.

Grigsby, M., J. Hermsen, and J. Millspaugh. 2007. "Tips from the Top: A Conversation with Exemplary Teachers". 1 hour workshop during New Faculty Orientation organized by Program for Excellence in Teaching. August, 2007.

Millspaugh, J. J. 2006. Using problem-based learning to promote critical thinking. 1 hour workshop. Conversations in college teaching seminar series, University of Missouri, May, 2006.

Millspaugh, J. J. 2005. Integrating teaching and research. 1 hour talk to Retired CAFNR Professor Group. November, 2005.

Millspaugh, J. J. 2005. Problem-based learning: teaching with case studies. 2.5 hour workshop. College Teaching of Agriculture class, University of Missouri, Fall 2005.

Ryan, M. R., H. R. Campa, and J. J. Millspaugh. 2005. Using problem-based learning to promote critical thinking. Full day workshop. College of Agriculture, Food, and Natural Resources, University of Missouri, August, 2005.

Ryan, M. R., and J. J. Millspaugh. 2004. Application of problem-based learning in the classroom. Department of Medical Pharmacology and Physiology, University of Missouri, Fall 2004.

Ryan, M. R., and J. J. Millspaugh. 2004. Integrating diverse writing assignments with problem cases. 90 minute workshop. 7th National Writing Across the Curriculum Conference, St. Louis, Missouri, Spring 2004.

Millspaugh, J. J., and M. R. Ryan. 2003. Ten myths of problem-based learning. Department of Animal Sciences, University of Nebraska-Lincoln, Fall 2003.

Ryan, M. R., and J. J. Millspaugh. 2003. It"s not about good teaching… University of Nebraska-Lincoln, Fall 2003.

Ryan, M. R., and J. J. Millspaugh. 2003. Using problem-based learning to promote critical thinking in undergraduate courses. 90 minute workshop. College of Agriculture, Food, and Natural Resources, University of Missouri, Fall 2003.

Ryan, M. R., and J. J. Millspaugh. 2003. Using problem-based learning to promote critical thinking in undergraduate courses. 120 minute workshop. Department of Animal Sciences, University of Nebraska-Lincoln, Fall 2003.

Millspaugh, J. J. 2001. Getting the most from undergraduate research projects. One-half day workshop at the Annual Conference of The Wildlife Society. At Workshop: Developing tomorrow"s professionals: teaching the skills they will need. Fall 2001.

Teaching Conference Presentations and Workshops

Spain, J., and J. Millspaugh. 2006. Co-organized CAFNR teaching round-up on "Educational Technology." University of Missouri, August, 2006.

Millspaugh, J. J., S. Amelon, T. Bonnot, T. Farrand, C. McGowan, S. Pruett, C. Rittenhouse, K. Suedkamp Wells. 2005. Combining problem-based learning and cooperative learning: a new model with high realism and application. University of Missouri, February, 2005.

Faaborg, J. E., M. R. Ryan, and J. J. Millspaugh. 2004. Academic performance in writing intensive courses: can we better prepare transfer students? 5th Biennial Conference on University Education in Natural Resources. Northern Arizona University, Flagstaff, Arizona. March, 2004.

Ryan, M. R., and J. J. Millspaugh. 2004. Using problem-based learning in natural resources curriculum to promote critical thinking. 90 minute workshop at 5th Biennial Conference on University Education in Natural Resources. Northern Arizona University, Flagstaff, Arizona. March, 2004.

Ryan, M. R., and J. J. Millspaugh. 2003. Using problem-based learning to promote critical thinking in undergraduate courses. 90 minute workshop at National Conference on Student Writing and Critical Thinking in Agriculture, Jackson, Wyoming. April, 2003.

Faaborg, J. E., J. J. Millspaugh, and M. R. Ryan. 2002. Comparison of academic statistics of 2-year college transfer and native fisheries and wildlife students at the University of Missouri. 4th Biennial Conference on University Education in Natural Resources. Forestry Department, North Carolina State University, Raleigh, North Carolina.

Millenbah, K., and J. J. Millspaugh. 2002. Infusing experiential learning into a wildlife curriculum: two models for one course. 4th Biennial Conference on University Education in Natural Resources. Forestry Department, North Carolina State University, Raleigh,

North Carolina. March, 2002.

Dwyer, J. P., and J. J. Millspaugh. 2000. The role of a team leader in a natural resources capstone course. 3rd Biennial Conference on University Education in Natural Resources, University of Missouri, Columbia, Missouri. March, 2000.

SERVICE AND PROFESSIONAL ACTIVITIES

Selected Major Professional Service

2010	Science Review Team, Review of Pronghorn Monitoring Plan for University of Wyoming Cooperative Fish and Wildlife Research Unit
2009-present	Associate Editor, Journal of Wildlife Management
2007-2010	Associate Editor, Ecological Applications
2007	Ecological Biology Program Advisory Panel, National Science Foundation
2007-2008	Associate Editor for the book Neotropical Cervidology (hormone chapter)
2005-2007	Chair and Panel Member, Review of White-tailed Deer Population Estimates and Management, Wisconsin Department of Natural Resources
2005-2006	Member of Science Review Team, Wind Cave National Park, South Dakota
2005-2009	Member of Peninsular Bighorn Sheep Recovery Team, U.S. Fish and Wildlife Service, California
2005-2007	Member of Science Review Team, Theodore Roosevelt National Park, ND
2004-2006	Associate Editor, Wildlife Society Bulletin
2004-2006	Secretary, University Education Working Group, The Wildlife Society
2003-2004	Secretary, Biometrics Working Group, The Wildlife Society
2002-2003	Wildlife Program Chair for 64th Midwest Fish and Wildlife Conference and Executive Committee Member, Kansas City, MO
2000-present	Chair, Missouri Chapter of The Wildlife Society Education Committee
1997-present	Reviewed papers for ~ 55 professional journals and review regularly for national and international grants (NSF, National Geographic, etc.)

University of Missouri

2011-present	Appointed to University of Missouri Research Board
2010-2012	Chair, Promotion and Tenure Committee, School of Natural Resources
2010	Member "Celebration of Teaching and Learning Planning Committee" for university-wide teaching conference
1999-2010	Director, Thomas S. Baskett Wildlife Research and Education Area, School of Natural Resources
2009-present	CAFNR Graduate Education Committee
2005-2012	Director of Graduate Studies, Department of Fisheries and Wildlife Sciences, University of Missouri
2005-2012	Chair, Graduate Programs Committee, Fisheries and Wildlife Sciences
2006-present	Member, College of College of Agriculture, Food, and Natural Resources, International Programs Committee

2005-2007	Chair, College of College of Agriculture, Food, and Natural Resources, Learning Improvement Committee
2005-2006	CAFNR Week Steering Committee, Faculty Advisor
2003-2006	Graduate Fellowship Coordinator, Conservation Biology Program
2002-2004, 2005-2006	Faculty Advisor for Univ. of Missouri Student Chapter of The Wildlife Society
2000-present	Co-Coordinator, Undergraduate Fisheries and Wildlife Scholarships
2000-2003	Conservation Biology Program Secretary and Executive Committee

Representative Media and Community Outreach

2011	Quoted in USA Today regarding pronghorn migrations and Discovery Channel about deer-vehicle collisions
2010	Bloomberg Business News interview about deer-vehicle collisions
2009	Participated in History Channel expedition and production about feral dogs in St. Louis
2008	Participated in History Channel expedition and production about feral hogs
2007	On April 30, 2007, we offered a live, standards-based, interactive session to middle school and high school students from urban and rural areas of Missouri. Programs were available via videoconference, online streaming, and, in limited areas, cable television. We captured a deer live during the broadcast, equipped it with a camera, and answered questions from students, as we conducted our field research
2006	My research was highlighted in National Science Foundation Special Report, "Secret Lives of Wild Animals" (www.nsf.gov/news/special_reports/animals/)
2006	Interview on CBS Evening News about deer and vehicle collisions (26 Feb 2006)
2006	PBS interview about Wisconsin deer population estimation
2005	Live interview on NBC Today show (29 October) about "Deercam" project; Additional news coverage and interviews included the following: Front page, Science Section, New York Times; Discovery channel; and hundreds of newspapers across country
2002	Article about my elephant research appeared in USA Today Magazine (August 2002, Vol. 131, Issue 2687)
2002	Interview on elk and human activities appeared in *Science* (296:1784-1785)

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Tel 303.298.1000
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VIA EMAIL: Tyler_Abbott@fws.gov

September 13, 2012

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Tyler:

Attached is a second Expert Report prepared by Dr. Joshua J. Millspaugh, O'Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, concerning his review and analysis of the assumptions used by the Service in the U.S. Fish and Wildlife Service's Eagle Fatality Model as applied to the Chokecherry and Sierra Madre Wind Energy Project as re-designed to include Turbine No-Build Areas.

As you know, Dr. Millspaugh's first expert report dated September 7, 2012, applied the Service's Model - using the Service's assumptions - to the Project as re-designed to evaluate the potential for take of eagles. Dr. Millspaugh concluded that applying the Model to the Project as re-designed results in an 80% quantile number estimate of 23 *or fewer* eagle fatalities. According to Dr. Millspaugh, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities. Therefore, based upon the Service's Model, PCW's Project re-design resulted in a 63.5% reduction in predicted eagle fatalities compared to the Service's model run that did not consider the Project as re-designed with Turbine No-Build Areas.

Dr. Millspaugh also opined that the Model run using the re-designed Project still likely overstates the impacts of the Project because the Model does not account for population abundance, turbine daylight operating hours, eagle flight height, and survey sampling bias. As indicated, Dr. Millspaugh prepared a second report addressing some of these assumptions contained in the Model when applied at the Project area.

In his second report, Dr. Millspaugh opines that:

- There are a number of assumptions inherent in the Service's eagle fatality Model that are questionable for the Project site and modification of these assumptions as used in the

Model results in a more realistic estimate of eagle fatalities because the modifications more realistically reflect Project conditions. In particular, the Service's Model assumes (1) that there is an infinite population of eagles exposed on the site; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not considering the validity of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project.

- The Service's Model can be modified to reflect more realistic assumptions for the Project site. Doing so maintains the structure and general approach taken by the Service in developing and applying the Model. However, doing so makes the Model a more realistic reflection of Project conditions.

- When considering the Project re-design, which excludes certain high eagle use areas deemed turbine no-build areas, Dr. Millspaugh estimates that when (1) accounting for the assumption of an infinite population, the estimated number of eagle fatalities would be reduced to 16 *or fewer* per year (median value of 9); (2) modifying the assumption that turbines do not rotate all day, the estimated number of eagle fatalities would be reduced to 22 *or fewer* per year (median value of 10); (3) accounting for the proportion of time eagles fly at rotor height, the estimated number of eagle fatalities would be reduced to 9 *or fewer* per year (median value of 4); and (4) when all assumptions are considered in the Model, he estimates that 8 *or fewer* eagle fatalities would occur annually (median value of 4).

- By modifying the Service's Model to account for three questionable assumptions, based on the Project re-design, which excludes certain designated high eagle use areas or turbine no-build areas, Dr. Millspaugh predicts 8 or fewer eagle fatalities per year at the 80% quantile of the probability distribution. The median estimated number of annual fatalities for this scenario was 4.

- Even just considering the Project as re-designed and modifying only one assumption, the proportion of time eagles fly at rotor height, reduces the estimated number of fatalities at the 80% quantile to 9 or fewer eagles annually. The median estimated number of annual fatalities for this scenario was 4.

- These results indicate that eagle fatality estimates are reduced greatly when the Project is re-designed and the Model is modified to more realistically reflect project conditions. Dr. Millspaugh's opinion is that Model estimates when assumptions are modified results in a more realistic estimate of eagle fatalities for the Project.

Dr. Millspaugh's report dated September 12, 2012, is attached. Dr. Millspaugh, Jon Kehmeier and I will be happy to discuss this with you and your colleagues. Please let me know if you would like to arrange a meeting or conference call.

Sincerely,

/s/ Garry L. Miller

Garry L. Miller
Vice President, Land and Environmental Affairs

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MISSOURI COOPERATIVE FISH AND WILDLIFE
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U.S. GEOLOGICAL SURVEY
MISSOURI DEPARTMENT OF CONSERVATION
UNIVERSITY OF MISSOURI-COLUMBIA
WILDLIFE MANAGEMENT INSTITUTE
EDWARD K. LOVE FOUNDATION

Date: September 12, 2012

To: Garry Miller, Vice President, Land and Environmental Affairs, Power Company of Wyoming LLC, 555 Seventeenth Street, Suite 2400, Denver, CO 80202

From: Dr. Joshua J. Millspaugh, O'Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, 302 Natural Resources Building, Columbia, MO 65211

Subject: Expert Report – Assumptions of the U.S. Fish and Wildlife Service's Eagle Fatality Model

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I. Executive Summary and Expert Opinions

I was asked to perform a review and critical analysis of the assumptions of U.S. Fish and Wildlife Service's Eagle Fatality Model and the eagle fatality estimates derived by the Service for the Chokecherry and Sierra Madre Wind Energy Project. Given issues I identified with assumptions of the Service's Model, as applied to the Project site, which were first outlined in my report dated September 7, 2012, I modified the Service's Model to make the assumptions more realistic for the Project site and to provide a more realistic estimate of eagle fatalities. I compared these eagle fatality estimates from the modified Model to previous estimates based on the Project design that included high eagle use areas and on a re-designed Project that excluded certain designated high eagle use areas or turbine no-build areas. My opinions are based upon my training, experience, education, and expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues. In sum, my opinions are:

The Service's Eagle Fatality Model maintains a number of questionable assumptions when applied to the Project. My examination has shown that the Model assumes: (1) an infinite population of eagles exposed on the site; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not verifying the validity and reasonableness of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. I focused on these 3 assumptions because (1) they are questionable; (2) data are available to address these assumptions; and (3) the Service's Model requires only slight modification to account for these assumptions.

My assessment of the Service's Model and assumptions indicated that the Model is a highly conservative prediction tool which errs on the side of over-predicting the number of eagle fatalities. By repeatedly deriving model assumptions with a high emphasis of being risk averse rather than on hypothesized biological reality, the Service's predictions are known to be highly conservative, but for which the degree of conservativeness is unknown. The degree of risk that is tolerable should be made transparent when evaluating alternatives based on objective prediction about consequences of alternatives, not embedded repeatedly in the building of a model to predict outcomes. It is a basic principle in transparent decision-making that predictions about potential consequences of a decision alternative should be based on facts and best available science, and should be separated from subsequent consideration of values and risk tolerance. It is important to avoid confusing best scientific practices with policy when developing a model.

Using the Service's Model as a basis for estimating annual eagle fatalities, I modified the Service's Model to make the assumptions more realistic for the Project site and therefore provide a more realistic estimate of eagle fatalities. I maintained the structure and general approach taken by the Service in developing the Model, but made biologically reasonable and supportable modifications to modify these assumptions. To address these assumptions, and to develop a more realistic reflection of the Project conditions, I did the following: (1) to account for the infinite population assumption, I modified the Service's Model to directly account for abundance on the site (the number of fatalities is a function of the number of eagles at risk of death); (2) to account for turbines not operating during all daylight hours, I adjusted the daylight hour expansion by considering the proportion of daylight hours turbines are expected to rotate at the Project site; and (3) to account for eagle flights above or below the rotors, I adjusted the area expansion to consider the proportion of time eagles flew at rotor height within the Project site.

I produced eagle fatality estimates both by modifying assumptions one at a time and by modifying all assumptions simultaneously. I then compared Model output when assumptions were made more realistic for the Project site to previous eagle fatality estimates that I generated using the Model with the Service's assumptions under the previous Project design with high eagle use areas included and the Project as re-designed to exclude certain eagle high use areas (turbine no-build areas). As outlined in my first report dated September 7, 2012, I previously determined that using the Service's Model without modification and without any re-design of the Project, the 80% quantile estimate was 63 *or fewer* eagle fatalities. The median estimated number of annual fatalities for this scenario was 29. When considering the Project re-design, which excludes certain designated high eagle use areas, deemed turbine no-build areas, I previously determined the 80% quantile number estimate was 23 *or fewer* eagle fatalities. The median estimated number of annual fatalities for this scenario was 11.

The modeling results detailed below are based on the data for the Project as re-designed and with modified assumptions. Further, eagle fatality numbers below are at the 80% quantile, which is used by the Service to estimate risk to eagles. The median number of estimated fatalities is also provided. The interpretation of a value at the 80% quantile means there is an 80% chance that *x* number of eagles *or fewer* are predicted to be removed at the wind energy

site each year. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities that will occur each year. Reliance on the 80% quantile value is very conservative and model results suggest the actual number of eagle fatalities is likely to be fewer than the 80% quantile value in most model runs. This conservative benchmark is added on top of the already risk-averse approach taken to develop the Model.

When I modified just the assumption in the Model that considers eagle abundance at the site (i.e., specifying a finite population), the 80% quantile estimate was 16 *or fewer* eagle fatalities. The median estimated number of annual fatalities for this scenario was 9. I assumed a mean abundance of 30 eagles on the site which was an appropriate number based on survey work conducted by SWCA Environmental Consultants (SWCA). I demonstrated that application of the Service's Model without modification for a finite population is equivalent to assuming there is an infinite number of eagles on the Project site.

When I modified just the assumption in the Model to account for turbines not rotating all day and all year at the Project site, the 80% quantile value was 22 *or fewer* eagle fatalities. The median estimated number of annual fatalities for this scenario was 10.

When I modified just the assumption in the Model to consider only the proportion of time eagles fly at rotor height at the Project site, the 80% quantile estimate was 9 *or fewer* eagle fatalities. The median estimated number of annual fatalities for this scenario was 4.

When all 3 assumptions were modified to more realistically reflect Project conditions, the 80% quantile estimate was 8 *or fewer* eagle fatalities. The median estimated number of annual fatalities for this scenario was 4. The table below summarizes these results.

Scenario	Description	Number of eagles at 80% quantile	Median value	Figure
1	Service baseline	63	29	1
2	Turbine No-Build Areas excluded only – Service's assumptions used	23	11	2
3	Finite population*	16	9	4
4	Turbines do not rotate all day*	22	10	5
5	Proportion of time eagles fly at rotor height*	9	4	6
6	Finite population, turbines not rotating all day, proportion of time eagles fly at rotor height*	8	4	7

*These Model results assume that the Project has been re-designed to exclude certain designated high eagle use areas deemed turbine no-build areas.

When considering data for the Project as re-designed and modifying the Service's Model to account for 3 questionable assumptions, the estimated number of eagle fatalities using the

Service's Model, the 80% quantile estimate is 8 *or fewer* eagle fatalities each year. The median estimated number of annual fatalities for this scenario was 4. The estimates derived from the Service's Model are only as reliable as the data and assumptions upon which it is based. In my opinion, model estimates when assumptions are modified to reflect Project conditions results in a more realistic estimate of eagle fatalities for the Project site.

II. Relevant Experience and Expertise

My experience and expertise are in wildlife ecology and the application of statistical techniques and models to address conservation issues. I have attached my Curriculum Vitae (see Attachment 1), but am providing a summary here of my relevant experience and expertise. Currently, I am a full professor and the Pauline O'Connor Distinguished Professor of Wildlife Management in the School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri. I have a Ph.D. in Wildlife Ecology from the College of Forest Resources, University of Washington, Seattle. I did postdoctoral studies in quantitative ecology at the School of Aquatic and Fishery Sciences, University of Washington. Selected honors and awards are detailed on my C.V., however, they include a 2008 award from the U.S. Department of Agriculture for National Teacher of the Year, a 2007 award from the Wildlife Society for Best Article (with Steve Buskirk), and a 2005 award from the Missouri Department of Conservation for "Outstanding Research Collaborator of the Year."

I have obtained about 55 grants and contracts as either PI or Co-PI since starting my faculty position in 1999 from diverse funding sources such as the U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, National Science Foundation, U.S. Forest Service, National Park Service, and the National Renewable Energy Lab. One recent grant is for the period 2011-2016 to study the *Ecology of Greater Sage-grouse in Relation to Wind Energy Development in Wyoming*. This study is being funded by the U.S. Forest Service, National Renewable Energy Lab, National Fish and Wildlife Foundation, Power Company of Wyoming (PCW), Wyoming Game and Fish Department, Bureau of Land Management, Western Association of Fish and Wildlife Agencies, and National Wind Coordinating Collaborative.

I have published 4 books and 160 peer-reviewed journal articles and book chapters. Three books are directly applicable: (1) *Models for Planning Wildlife Conservation in Large Landscapes*, 2009, Millspaugh, J.J. and F.R. Thompson, III, editors, Academic Press, 674 pages; (2) *Design and Analysis of Long-Term Ecological Monitoring Studies*, 2012, Gitzen, R.A., J.J. Millspaugh, A.B. Cooper, and D.S. Licht, editors. Cambridge University Press, 600 pages; and (3) *Wildlife Demography: Analysis of Sex, Age, and Count Data*, 2005, Skalski, J.R., K.E. Ryding, and J.J. Millspaugh, Elsevier Science, 656 pages. In addition to these publications, I have been an invited plenary speaker at national and international conferences to discuss the application of statistical techniques and models in wildlife ecology and management.

I have applied and evaluated statistical techniques and models in addressing conservation issues for a broad range of species, including mammals, avifauna, reptiles, and amphibians. For example, at the request of the Wisconsin Department of Natural Resources, I chaired an international panel of experts in evaluating data and models the agency uses to monitor and estimate white-tailed deer population demographics. Specifically, we evaluated the validity of the assumptions of their population reconstruction model, assessed adjustments made in the model by state personnel, and offered guidance on future applications. I was the senior author on a paper published in the *Journal of Wildlife Management* in 2009 that summarized our findings. A second example relates to my continued development of animal movement and habitat models. In addition to applying these statistical models to diverse taxa ranging from hellbenders to elephants, I have collaboratively developed new statistical approaches to analyzing such data and rigorously evaluated methodology. Specifically, my colleagues and I were among the first to apply discrete choice models in a wildlife context and we pioneered the development of resource utilization functions, both of which have become standard modeling tools for ecologists over the past decade. Thus, my experience and expertise are directly applicable to the analysis I was asked to perform.

III. Review and Critical Analysis of the Assumptions of the Eagle Fatality Modeling for the Chokecherry and Sierra Madre Wind Energy Project

I was asked to perform a review and critical analysis of the assumptions of U.S. Fish and Wildlife Service's Eagle Fatality Model and the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service. Given issues I identified with assumptions of the Service's Model, as applied to the Project site, I modified the Service's Model to make these assumptions more realistic and reflective of Project conditions to estimate eagle fatalities. I compared these eagle fatality estimates from the modified Model to previous estimates based on the Model using the Service's assumptions for the original Project design including high eagle use areas and on a re-designed Project that excluded certain designated high eagle use areas or turbine no-build areas. My opinions are based upon my training, experience, education and my expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues.

A. Documents and Data Examined and Scope of Review

In my review, I examined several documents, site-specific data used in the Model, sampling methodology used to collect site-specific eagle data, and the Service's Model. Further, I considered my firsthand knowledge of the site, discussions with SWCA personnel, and two discussions with the Service about the Model. Below I detail the specific materials I reviewed and considered in my evaluation.

(1) Draft Eagle Conservation Plan Guidance released by the Service in January 2011 that describes a process for wind energy developers when preparing an Eagle Conservation Plan (ECP) to assess the risk of projects to eagles and assess how siting, design, and operational modifications can mitigate that risk, specifically, Appendix D, Description of the Service's Model;

(2) Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012 that updated the technical appendices in the Draft Eagle Conservation Plan Guidance;
(3) Power Company of Wyoming's Eagle Conservation Plan (August 2012);
(4) The site-specific eagle data collected at the Project site, including the sampling protocol used to select sites;
(5) Proposed re-design of the Project to include turbine no-build areas;
(6) Clipped data used as input in the Service's Model which considered the turbine no-build areas;
(7) Service's Model and the list of assumptions used by the Service in the Model;
(8) Service's Model as applied to the Project and the Project as re-designed;
(9) Discussions with SWCA about sampling designs, data collection, and data analysis (including the kernel analysis used to identify turbine no-build areas) and two discussions with the Service about the fatality Model;
(10) Papers that were cited by the Service as support for model development and assumptions; and
(11) A report from AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy.

B. Experience with the Project and Eagle Data Collected

I am familiar with the Chokecherry and Sierra Madre Wind Energy Project, how the eagle data were collected by SWCA and how the data were analyzed by SWCA.

I am currently leading a study at the Chokecherry and Sierra Madre Wind Energy Project that investigates the ecology of male Greater sage-grouse in relation to construction of the wind energy facility. I have also been collaborating on a companion female Greater sage-grouse project on the site since the spring of 2010 and leading the habitat component of that project. Given my role in these sage-grouse projects, I have made extensive site visits across the Project site. I currently supervise two graduate students, one research associate, and the activities of several seasonal research technicians on the site in association with this sage-grouse research. I have also made a few separate trips to Denver, Colorado to meet and discuss my collaborative sage-grouse research with SWCA and PCW personnel.

Because of site visits and my research activities at the Project site, I am knowledgeable of the topography, landscape, and location where the eagle data were collected. I was accompanied by SWCA personnel during most of my time on the Project site and we discussed how and where the eagle data were collected. I also saw the radar unit in operation at the Project site and developed a model to differentiate eagle observations from the radar unit data from other species.

I reviewed the raptor survey program implemented by SWCA including the long watch raptor survey methodology.

I discussed the development of the kernel density maps with SWCA and found their approach to be appropriate and accurate, given the available data. In addition to site visits and previous discussions which made me familiar with the eagle use data and how that information was collected, I also discussed their approach in creating the kernel density maps.

These site-specific surveys and associated protocols are detailed in the Project site ECP, which I reviewed.

C. Description of and Assumptions Used in the Service's Eagle Fatality Model

Under the Service's Draft ECP Guidance, Stage 3 of developing an ECP involves conducting a turbine-based risk assessment and an estimate of the fatality rate of eagles for the facility. Set out below is a discussion of the Service's Eagle Fatality Model and the assumptions of the Model as provided by the Service. I discuss a few of these assumptions and compare my interpretation of them to the Service's description of assumptions and briefly discuss the implications (if known) of violating these assumptions, and their relevance to the Project. This section identifies modifications to the Service's Model that are required to ensure the Model is more realistically applied to the Project.

1. The Service's Eagle Fatality Model

The Service uses a Bayesian model to predict the number of eagle fatalities for a wind-energy facility. The Service's Model estimates annual eagle fatalities as the product of the rate of eagle exposure to turbine hazards (exposure rate), the probability that eagle exposure will result in a collision with a turbine (collision probability), and an expansion factor that scales the resulting fatality rate to the project-specific affected potential exposure area and time. Within a Bayesian framework, the Service defines prior distributions for the exposure rate and collision probability. The expansion factor is constant. Using site-specific data, the Service's Model calculates the exposure posterior distribution using the observed data. The number of predicted annual fatalities is estimated as the expanded product of the posterior exposure distribution and collision probability prior. See Appendix D – Stage 3, Draft ECP Guidance.

In reviewing the Model, I generated a list of model assumptions and assessed their validity for the Project site, I ran the Model code provided by the Service to generate the eagle fatality estimates, and I considered the validity of the Model and underlying data as applied to the Project site. My review of the validity of the underlying data as applied to the Project before and after the designation of turbine no-build areas has been detailed in a separate report dated September 7, 2012, which is incorporated as if set out fully by this reference.

During a conference call with the Service on August 9, 2012, we[1] requested a list of model assumptions (which was provided on August 23, 2012). We explicitly discussed the

[1] Also participating in the call were Garry Miller of Power Company of Wyoming LLC and Jon Kehmeier from SWCA Environmental Consultants.

assumption of an infinite eagle population and interpretation of the model output. The Service acknowledged there was an assumption of an open population. With this assumption, eagle fatalities do not reduce eagle abundance, in terms of the exposed population. We discussed this and other assumptions during a conference call on September 5, 2012.

The Model maintains several useful properties. The use of a Bayesian model is appropriate for incorporating variability in model input and output. The modeling approach is flexible and allows for modification, which is advantageous because the Model can be updated as additional information becomes available about eagle fatalities at wind energy facilities. Further, it is possible to identify model assumptions because computer code is reviewable and available.

2. Assumptions of the Service's Eagle Fatality Model

The Service's Model makes a number of assumptions when estimating eagle fatalities that might occur at a wind facility site. Below is the list of assumptions received from the Service on August 23, 2012.

- All eagle collisions with wind turbines are fatal.
- Eagles are only at risk of colliding with turbines during daylight hours (flight in proximity to turbines does not occur during non-daylight hours). This can be specified further on a project-by-project basis where there are supporting data.
- Open population – eagles move between project site and surrounding areas, therefore the removal of an eagle does not result in a permanent change in eagle abundance.

Exposure

- Pre-construction eagle use data used to estimate eagle exposure are spatially and temporally representative of the stratum (or project if strata are not identified). Eagle exposure is eagle flight time in the project footprint per unit area per unit time.
- There is a predictable relationship between pre-construction eagle exposure and subsequent fatalities with a given amount of hazardous area around turbines. The project footprint is the minimum-convex hull that encompasses the wind-project area inclusive of the hazardous area around all turbines and any associated utility infrastructure.
- The prior distribution Gamma (0.97, 2.76) is appropriate for describing exposure rate and includes the range of possible exposure rates at potential sites.
- Eagle flight minutes observed in the project footprint follow a Poisson or similar distribution. This could be modified where appropriate given the data.
- Eagle exposure rate is uniform across a stratum (or project if strata are not identified).

Collision Probability

- There is a predictable relationship between the hazardous area around a turbine and subsequent fatalities given an exposure rate. Hazardous area is the 2-dimensional rotor-swept area around a turbine or proposed turbine.

- The prior collision probability Beta (1.2, 176.7) is appropriate for collision probability and includes the range of possible collision probabilities across sites and various risk scenarios.
- The collision probability is uniform for all hazardous area and among turbines within a stratum (or project if strata are not identified).

Fatality Rate

- The fatality rate is constant for all hazardous area within a given stratum (or project if strata are not identified).
- The fatality rate is constant for a temporal/seasonal stratum (or all time periods if strata are not identified).

Prior to receiving the list of assumptions from the Service, I generated a list of assumptions I determined were associated with the Service's Model. I developed this list of assumptions after reading the Service's documentation of the Model, running and evaluating the Model code, and after discussing the Model with the Service on August 9, 2012. The assumptions I identified were being used by the Service in the Model were mostly consistent with the list later provided by the Service; however, in this section I discuss a few of these assumptions and compare my interpretation of them to the Service's description of assumptions. I also briefly discuss the implications (if known) of applying the assumptions in the Model, their relevance to the Project, and how they compare with the Service's list of assumptions.

(1) *There is an infinite population of eagles exposed on the site*. As stated in the Service's assumptions that were provided on August 23, 2012, the Service assumes an open population in the Model. It is more accurate to state that the Model assumes an infinite number of eagles at the site, and immediate replacement of an eagle with another eagle after a fatality event, because in the Model fatality due to turbine collision does not reduce eagle abundance. The open population assumption might provide a mechanism for the assumption of an infinite population, and immediate replacement due to a fatality, but what matters in the Model is that eagle abundance, or more specifically potential eagle exposure, does not decline as a result of eagle fatalities. This assumption has the practical influence of each eagle fatality resulting in immediate replacement by another eagle (i.e., the exposure rate does not change with an eagle fatality). The stated open population assumption assumes we know the process that leads to an infinite population and immediate replacement due to an eagle fatality. The implication of this assumption is that it is possible to predict more eagle fatalities on the site than eagles that exist currently on the site.

(2) *Eagles are assumed to be at risk for a collision if they are within 50 horizontal meters of the rotors, regardless of eagle height or rotor orientation*. The Service assumes that the hazardous area is the 2-dimensional rotor-swept area around a turbine or proposed turbine (see above). For clarification, the Service assumes that eagles are at risk for a collision if they are within 50 horizontal meters of the rotors, regardless of eagle height or rotor orientation. This assumption incorrectly means that eagles flying above or below the rotor blades are at risk of collision. Thus, the estimate of hazardous area used in the Model is questionable. Inclusion of this assumption in the Model will result in an overestimate of fatality risk of eagles.

(3) *Turbine blades are rotating during all daylight hours, 365 days a year*. The Service appropriately identifies in their list of assumptions that eagles are only at risk of colliding with turbines during daylight hours. However, it is important to further acknowledge that the Service's Model assumes the turbine blades are moving during all daylight hours. If turbine blades do not rotate during all daylight hours, there would be a subsequent reduction in the risk of eagle collisions. Therefore, inclusion of this assumption in the Model when turbine blades will not rotate during all daylight hours will result in an overestimate of the predicted number of eagle fatalities.

(4) *Each count of eagle minutes per hour per km^2 is independent*. At the Project site, counts of eagle minutes were conducted over an approximately 2 km^2 for several hours at the same site. Thus, counts of eagle minutes when expressed on a per hour per km^2 basis in the Model are not independent in space or time. Therefore, this assumption will lead to overly precise estimates of the distribution of the exposure rate.

In the Service's Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012, the Service suggests that eagle counts be conducted for 1, 2, or more hours (page 16, second full paragraph). However, the Model assumes that each count of eagle minutes per hour per km^2 is independent. It is important to recognize that the Model implicitly is considering each *1 hour per km^2* as a discrete, independent exposure event. That is, there is no accommodation for different lengths of survey periods because the Model assumes each count of eagle minutes per hour per km^2 is independent. If input data includes a count from 2 consecutive survey hours per km^2 at a sample unit, the model treats this identical to 2 randomly selected 1 hour per km^2 survey counts, independently selected in space and time. However, counts conducted for 2 or more hours do not result in independent eagle minutes when expressed on a per hour per km^2 in space or time. For example, hour 1 and 2 in a 2-hour long survey would be dependent and thus violate the assumptions of the Model. If input data do not meet this assumption, there will be an overly precise estimate of the distribution of the exposure rate. The magnitude of bias associated with this assumption is not addressed in this report, but could have implications to eagle fatality estimates.

(5) *The count of eagle minutes that updates the prior distribution on expected eagle minutes per hour per km^2 is collected randomly with respect to space and time. Further, it is assumed that the number of eagle minutes is evenly distributed in space and time*. If the first part of this assumption is violated, a model that assumes random sampling both spatially and temporally (e.g., assuming a Poisson model for counts of eagle minutes) will produce biased estimates. The second part of this assumption, related to eagle minutes being evenly distributed in space and time, is not met. Examination of eagle flight path data collected by SWCA shows heterogeneous use of the Project site by eagles. Additionally, we might expect flight paths to differ by season. Therefore, this assumption could lead to an overestimation of fatality risk in low use areas and underestimation of flight risk in high use areas.

My evaluation of the sampling locations revealed that the selected sites to survey eagles were biased because they were not selected according to the underlying assumptions of the Model.

Rather, sampling sites were selected because they were presumed to be high use eagle sites. The Model assumes that the count of eagle minutes that updates the prior distribution on expected eagle minutes per hour per km^2 is collected randomly with respect to space and time. Therefore, if these presumed high use areas had higher eagle activity than other portions of the Project site, the sampling strategy used will inherently result in an overestimate of eagle minutes when applied to the entire Project. The result is that eagle fatalities would be overestimated. The Model cannot account for heterogeneous use of the Project by eagles and thus assumes eagle minute use data were collected randomly with respect to space and time – the Model is spatially blind and therefore assumes a simple random sampling protocol for eagle minutes. In this case, areas of expected high use were oversampled relative to their availability, which results in an upward bias (i.e., more eagle minutes which equates to more predicted fatalities when applied to the entire area). Future sampling design needs to more directly consider the underlying assumptions of the Service's Model and to follow fundamental principles of survey sampling.

(6) As noted by the Service, *it is assumed that eagle minutes per hour per km^2 is a Poisson random variable*. The Service also appropriately acknowledges that this assumption could be modified should data be available. Examination of counts of eagle minutes on the Project site is zero-inflated and overdispersed relative to a theoretical Poisson model. Violation of this assumption will lead to biased estimates of the distribution of the exposure rate. The direction and magnitude of this bias has not been investigated here.

(7) *The collision probability is constant for all eagles*. The Service's Model assumes that all eagles are equally vulnerable to collision with wind turbines. However, if one segment of the population (e.g., juveniles) is more susceptible to collision than another (e.g., adults), this assumption would be violated. Violation of this assumption might lead to an overestimation of fatality risk for groups of birds less prone to collision and underestimate fatality risk for groups of birds that are more prone to collision. If the proportion of individuals in each group is not equal, violations of this assumption will not equal out.

(8) *The Service assumes that the 80% quantile is an appropriate measure of the risk of eagle fatalities on a site*. Output of the Service's Model is a probability distribution of predicted eagle fatalities on an annual basis. The Service has used the 80% quantile as a basis for interpretation. During our conference call on August 9, 2012, the Service acknowledged that focus on the 80% quantile is conservative and was a policy decision. Most importantly, the interpretation of a value at the 80% quantile means there is an 80% chance that x number of eagles *or fewer* are predicted to be removed at the wind energy site. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities. This conservative benchmark is added on top of the already risk averse approach taken by the Service in developing the Model.

Given the assumptions and approach taken to build the Model, it is a highly conservative prediction tool which errs on the side of over-predicting the number of likely eagle fatalities. By repeatedly deriving model assumptions with a high emphasis of being risk averse rather than on hypothesized biological reality, the Service ends up with predictions known to be highly conservative, but for which the degree of conservativeness is unknown. This

strategy may be far more risk averse than the Service intended, and includes a risk valuation that is not transparent. The degree of risk that is tolerable should be made transparent when evaluating alternatives based on objective prediction about consequences of alternatives, not embedded repeatedly in the building of a model to predict outcomes. This modeling philosophy is emphasized in the literature on structured decision making. It is a basic principle in transparent decision-making that predictions about potential consequences of a decision alternative should be based on facts and best available science, and should be separated from subsequent consideration of values and risk tolerance (R. Gregory et al. 2012, Structured decision making: A practical guide to environmental management choices, Wiley-Blackwell). The best scientific practice would be to develop the most realistic model possible, apply the model, and explain to the policy makers how to interpret and use model output as they determine the acceptable degree of risk. It is important to avoid confusing best scientific practices with policy when developing a model.

In conclusion, my examination of the Service's Eagle Fatality Model revealed that a number of the assumptions are questionable when applied to the Project. This report, however, focuses on 3 specific assumptions made by the Service's Model (1) that there is an infinite population of eagles exposed on the site each year; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not verifying the validity and reasonableness of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. I focused on these 3 assumptions because (1) they are questionable; (2) data are available to address these assumptions; and (3) the Service's Model requires only slight modification to account for these assumptions so that they more realistically reflect the Project conditions, resulting in a more realistic estimate of eagle fatalities for the Project.

IV. Eagle Fatality Modeling for the Chokecherry and Sierra Madre Wind Energy Project: Consideration of Assumptions

Given the discussion above about model assumptions, I used the Service's Model as a basis for estimating annual eagle fatalities, but I produced fatality estimates both by modifying questionable assumptions one at a time and by modifying all assumptions simultaneously. I maintained the structure and general approach taken by the Service in developing the Model, but made biologically reasonable and supportable modifications to address these assumptions.

A. Overview, Scope of Analysis and Background

I focused on the following 3 specific assumptions made by the Service's Model (1) that there is an infinite population of eagles exposed on the site each year; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not verifying the validity and reasonableness of these assumptions, the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. I focused on these 3 assumptions because (1) they are questionable; (2) data are available to address these assumptions; and (3) the Service's Model requires only

slight modification to account for these assumptions so that they more realistically reflect the Project conditions, resulting in a more realistic estimate of eagle fatalities for the Project.

To address these assumptions, I did the following: (1) to account for the infinite population assumption, I modified the Service's Model to directly account for abundance on the site (the number of fatalities is a function of the number of eagles at risk of death); (2) to account for turbines not operating during all daylight hours, I adjusted the daylight hour expansion by considering the proportion of daylight hours turbines are expected to rotate; and (3) to account for differential flights of eagles, I adjusted the area expansion to consider the proportion of time eagles flew at rotor height in the Project. I compared Model output when assumptions were modified one at a time and when assumptions were simultaneously modified to previous eagle fatality estimates that I generated under the Project before and after consideration of turbine no-build areas that excluded certain designated high eagle use areas.

As background, I previously determined that using the Service's Model without modification to the Service's assumptions and without any re-design of the Project, the 80% quantile estimate was 63 *or fewer* eagle fatalities (Figure 1). The output of the Service's Model is a probability distribution representing a range of fatality estimates. This Model output should not be used to assert that there will be 63 eagle fatalities per year. Reliance on the 63 eagle fatality value is very conservative and Model results suggest the actual number of eagle fatalities is likely to be far fewer. For example, the median estimated number of annual fatalities for this scenario was 29. This conservative benchmark is added on top of the already risk averse approach taken in developing the Model.

When considering the Project re-design, which excludes certain designated high eagle use areas, or turbine no-build areas, I previously estimated the 80% quantile number estimate of 23 *or fewer* eagle fatalities (Figure 2). Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of annual fatalities for this scenario was 11.

The modeling results discussed below are based on the Project as re-designed to exclude certain designated high eagle use areas, deemed Turbine No-Build Areas.

B. Data Used in Eagle Fatality Estimates

SWCA completed an extensive survey program on the Project site using a combination of several approaches. The long watch raptor surveys are most pertinent to our consideration of eagle fatalities and application of the Service's Model. These long watch raptor surveys were conducted at 15, 4,000-m radius plots distributed across the Project. Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage for identifying high use areas while maintaining observer confidence in species identification. Between April 2011 and April 2012, SWCA collected 2,162.5 hours of eagle use data at these 15 sites. These data were used to identify eagle use areas associated with topographic features, movement corridors, foraging areas, and nesting territories. To comply with the data requirements of the Service's Model, these survey data were truncated to include only those

observations that occurred within 800-meters of each survey site. I applied these data in the Service's Model, with the modifications described below, to estimate the number of eagle fatalities.

These data were appropriately clipped and applied in the Service's Model to account for the Project re-design which excluded designated high eagle use areas (Figure 3). The methods of analysis are detailed in Appendix A. These are the data that I used in the Model modifications described subsequently.

C. Eagle Fatality Estimates

Beyond the two model runs that were applied (1) without modification to the Model's assumptions and before Project re-design and (2) without modification to the Model's assumptions but after the Project was re-designed to include turbine no-build areas, which excluded certain high eagle use areas, I completed 4 additional model runs that modified the 3 assumptions described above. All of these simulations identified below assume that the turbine no-build areas are excluded. I compared model output when assumptions were modified one at a time and by modifying all assumptions simultaneously. These included:

(1) A model that assumed a finite population of eagles;
(2) A model which assumed turbines do not rotate all day;
(3) A model that considered the proportion of time eagles flew at rotor height; and
(4) A model which modified all 3 assumptions.

1. Eagle Fatality Estimates for the Project Accounting for a Finite Population of Eagles

To account for the infinite population assumption, the Service's Model was directly modified to directly consider abundance. More specifically, the Service's Model was made to explicitly make the number of fatalities a function of the number of eagles at risk of death. Variables used are defined as follows

λ = the expected number of eagle minutes per hour per km^2
C = collision probability per eagle minute spent in hazardous areas
A = abundance of eagles in the project site
DH = the total number of daylight hours in a year
HA = the total hazardous area in units of km^2
F = number of eagle fatalities
π = proportion of time turbines are rotating
α = proportion of time flying at rotor height

Both λ and C are specified by the same distributions outlined in Appendix D – Stage 3 document of the Draft ECP Guidance. A can be specified as a distribution or as a constant. For purposes of this report, I have assumed a mean abundance of 30 eagles, which was estimated by SWCA during their monitoring program.

The probability a single eagle collides with a turbine per eagle-minute spent in hazardous areas is:

$$\gamma = 1 - (1 - C)^{\frac{\lambda}{A}}.$$

Note that the expected number of eagle minutes per hour per km^2 is divided by the total abundance so the collision probability is represented on a per-eagle basis. Assuming the collision probability is constant across space and time, the annual probability of a single eagle colliding with a wind turbine is:

$$\psi = 1 - (1 - \gamma)^{DH \times HA}.$$

Finally, assuming a constant annual collision probability across all eagles:

$$F \sim binomial(A, \psi).$$

In addition to other assumptions made in the Service's Model, our binomial model assumes that eagle minutes are evenly spread among all eagles in the Project site. The abundance is assumed to be known or is known with some level of certainty. Specifying an unreasonably large abundance (e.g., infinite population) will overestimate fatality risk, while specifying an unreasonably small abundance (e.g., 1 eagle) will underestimate fatality risk.

In summary, this approach is identical to the Service's Model but this modification allows an explicit representation of the number of eagles at risk of death. Using the Service's Model which assumes an infinite number of trials, it was modified as an equivalent binomial model without altering any other aspect of the Service's Model except for the mean abundance which is made explicit. Such an approach allows for the evaluation of the effect of a more realistic value of abundance on estimated eagle fatalities rather than assuming an infinite population of eagles exposed on the site and immediate replacement of an eagle with another eagle after a fatality event.

When assuming a mean population abundance of 30, application of this modified model results in an estimated 16 *or fewer* eagle fatalities at the 80% quantile (Figure 4). The median estimated number of annual fatalities for this scenario was 9.

Appendix B, which is attached,demonstrates that when you input an eagle abundance of 1 million into the modified model (i.e., when you approach ∞), results match the distribution predicted by the Service's baseline model. Thus, application of the Service's Model without modification for a finite population is equivalent to assuming there is an infinite number of eagles on the Project site.

2. Eagle Fatality Estimates for the Project When Turbines Do Not Rotate All Day

Wind turbines are not expected to operate during all daylight hours. To account for reduced risk of collisions when turbines are not operating, we adjusted the daylight hour (*DH*) expansion (which represents the total number of daylight hours in a year) as:

$$DH_{adjusted} = DH \times \pi.$$

Where the π represents the monthly generation, the proportion of daylight hours turbines are expected to rotate. The parameter π was estimated from a report prepared by AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy. It was estimated that the annual average percentage of daylight hours that the Chokecherry and Sierra Madre Project site is expected to generate energy is 97.1%. This value was obtained from the report from AWS Truepower. See Attachment 2, AWS Truepower Report dated 9-05-2012.

Applying this modification to the model reduced the predicted eagle fatalities to 22 *or fewer* fatalities per year at the 80% quantile (Figure 5). The median estimated number of annual fatalities for this scenario was 10.

3. Eagle Fatality Estimates for the Project Accounting for Proportion of Time Spent Flying at Rotor Height

Eagles must fly at the height of rotating turbines to be at risk of collision. To account for reduced risk of collisions when flying above or below rotating turbines, we adjusted the hazard area (*HA*) expansion (which is defined as the total hazardous area in units of km^2) as:

$$HA_{adjusted} = HA \times \alpha.$$

The parameter α is estimated from observations of golden eagle flight heights at the Project site. SWCA recorded 40.7% of their eagle minute observations in the 30-150 m height category which is the height of rotors and height where eagles are at risk of collision. SWCA recorded 25.4% of their observations in the 0-30 m category and 33.9% in the 150+ m category.

Applying this modification to the Model reduced the predicted eagle fatalities to 9 *or fewer* fatalities per year at the 80% quantile (Figure 6). The median estimated number of annual fatalities for this scenario was 4.

4. Eagle Fatality Estimates for the Project Assuming All Assumptions Modified

Last, I ran a model that incorporated all of the modifications above. This simulation resulted in an estimated fatality of 8 *or fewer* eagles at the 80% quantile (Figure 7). The median estimated number of annual fatalities for this scenario was 4.

A summary of these results is below:

Scenario	Description	Number of eagles at 80% quantile	Median value	Figure
1	Service baseline	63	29	1
2	Turbine No-Build Areas excluded only – Service's assumptions used	23	11	2
3	Finite population*	16	9	4
4	Turbines do not rotate all day*	22	10	5
5	Proportion of time eagles fly at rotor height*	9	4	6
6	Finite population, turbines not rotating all day, proportion of time eagles fly at rotor height*	8	4	7

*These Model results assume that the Project has been re-designed to exclude certain designated high eagle use areas deemed turbine no-build areas.

V. Conclusion

In conclusion, it is my opinion that:

- There are a number of assumptions inherent in the Service's eagle fatality Model that are questionable for the Project site and modification of these assumptions as used in the Model results in a more realistic estimate of eagle fatalities because the modifications more realistically reflect Project conditions. In particular, the Service's Model assumes (1) that there is an infinite population of eagles exposed on the site; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not considering the validity of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project.

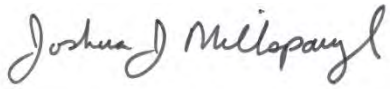
- The Service's Model can be modified to reflect more realistic assumptions for the Project site. Doing so maintains the structure and general approach taken by the Service in developing and applying the Model. However, doing so makes the Model a more realistic reflection of Project conditions.

- When considering the Project re-design, which excludes certain high eagle use areas deemed turbine no-build areas, I estimate that when (1) accounting for the assumption of an infinite population, the estimated number of eagle fatalities would be reduced to 16 *or fewer* per year (median value of 9); (2) modifying the assumption that turbines do not rotate all day, the estimated number of eagle fatalities would be reduced to 22 *or fewer* per year (median value of 10); (3) accounting for the proportion of time eagles fly at rotor height, the estimated number of eagle fatalities would be reduced to 9 *or fewer* per year (median value of 4); and (4) when all assumptions are considered in the Model, I estimate that 8 *or fewer* eagle fatalities would occur annually (median value of 4).

- By modifying the Service's Model to account for three questionable assumptions, based on the Project re-design, which excludes certain designated high eagle use areas or turbine no-build areas, I predict 8 *or fewer* eagle fatalities per year at the 80% quantile of the probability distribution. The median estimated number of annual fatalities for this scenario was 4.

- Even just considering the Project as re-designed and modifying only one assumption, the proportion of time eagles fly at rotor height, reduces the estimated number of fatalities at the 80% quantile to 9 *or fewer* eagles annually. The median estimated number of annual fatalities for this scenario was 4.

- These results indicate that eagle fatality estimates are reduced greatly when the Project is re-designed and the Model is modified to more realistically reflect project conditions. My opinion is that Model estimates when assumptions are modified results in a more realistic estimate of eagle fatalities for the Project.



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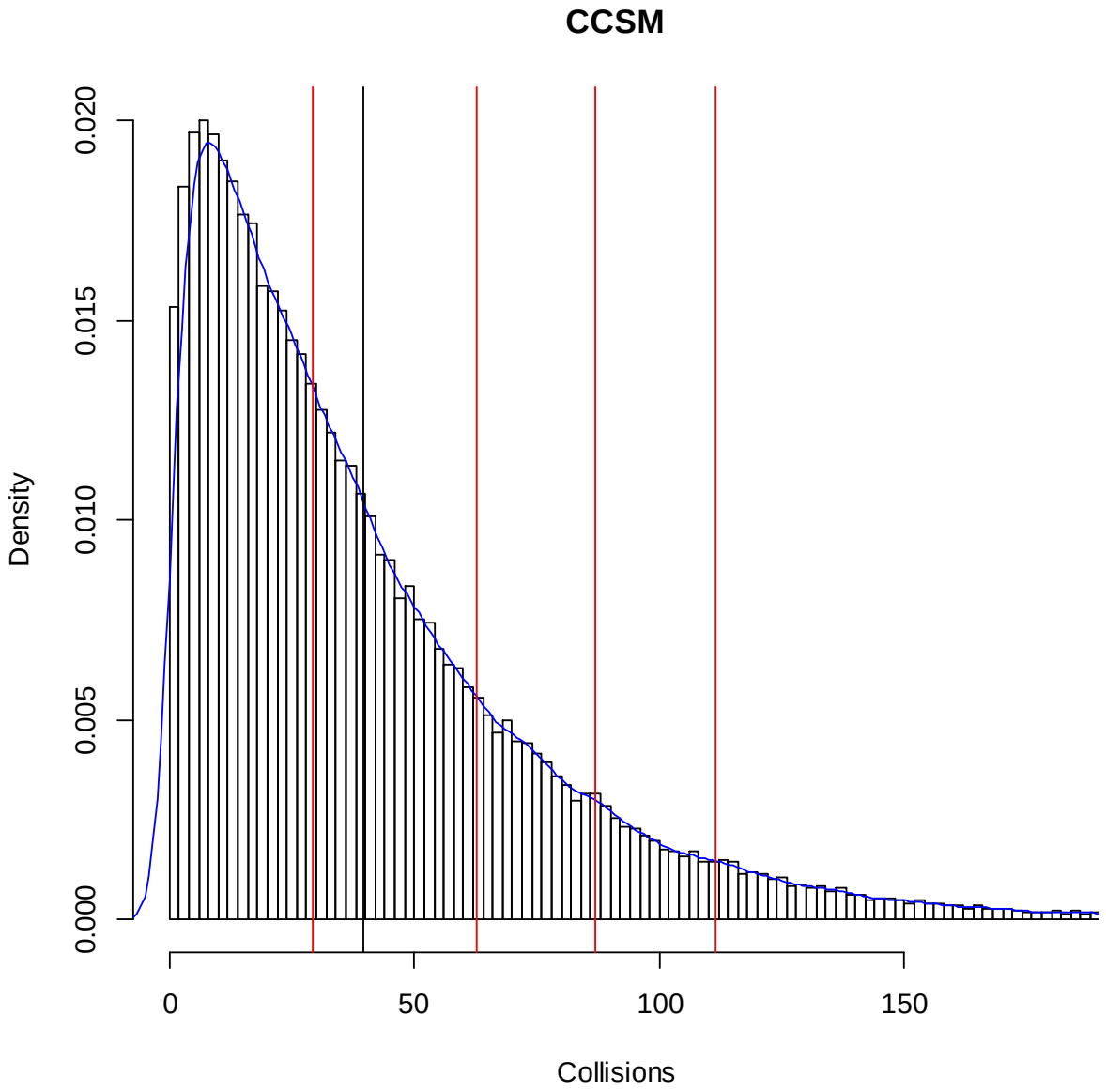


Figure 1. Probability distribution of eagle fatality estimates for the Project including areas of high eagle use. This fatality probability distribution for the Project site (CCSM – Chokecherry and Sierra Madre) was based on observed eagle minutes and survey effort which include areas of high eagle use.

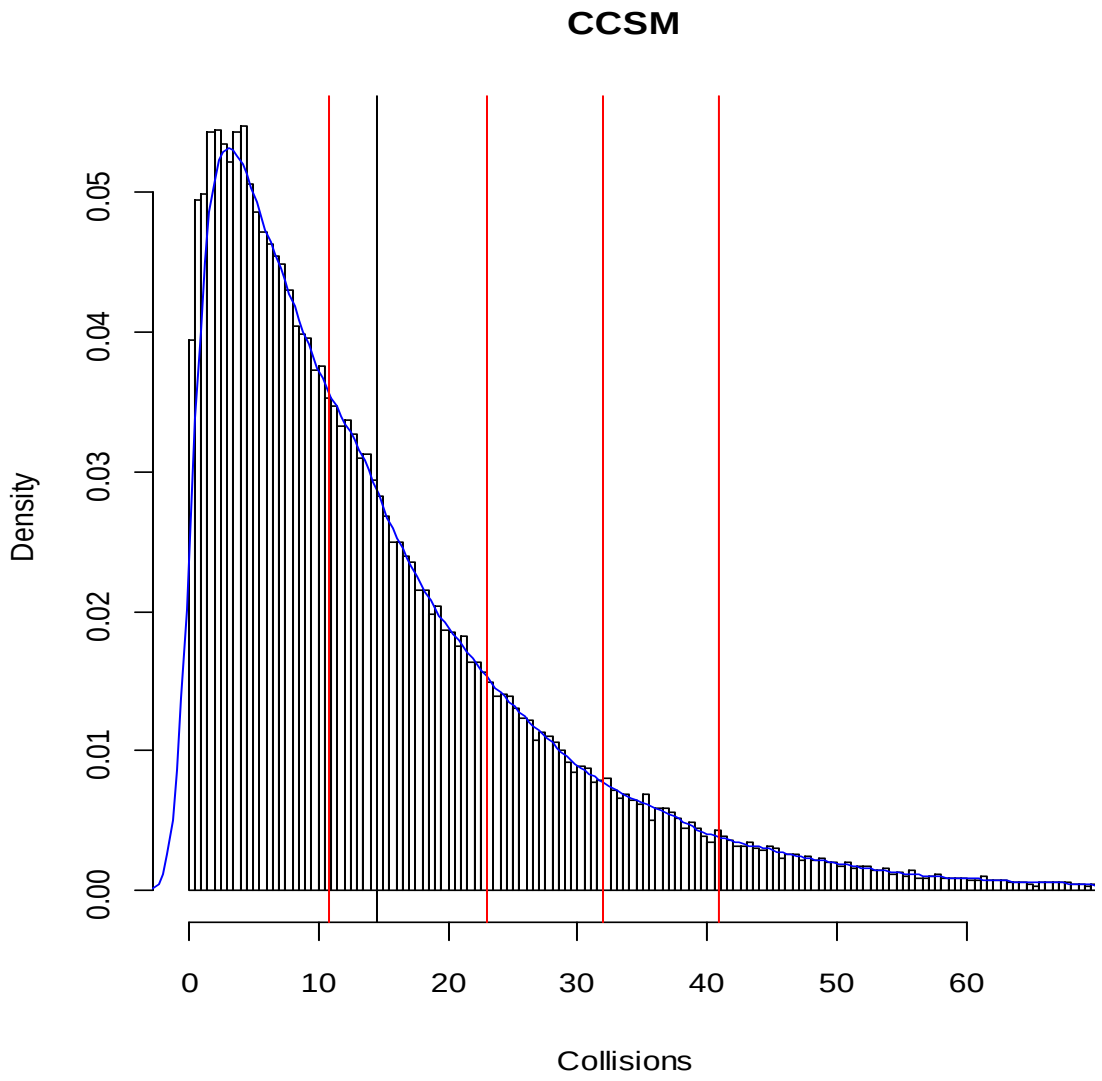


Figure 2. Probability distribution of eagle fatality estimates for the project as re-designed with turbine no-build areas. This fatality probability distribution for the Project site (CCSM – Chokecherry and Sierra Madre) was based on observed eagle minutes and survey effort as re-designed with turbine no-build areas.

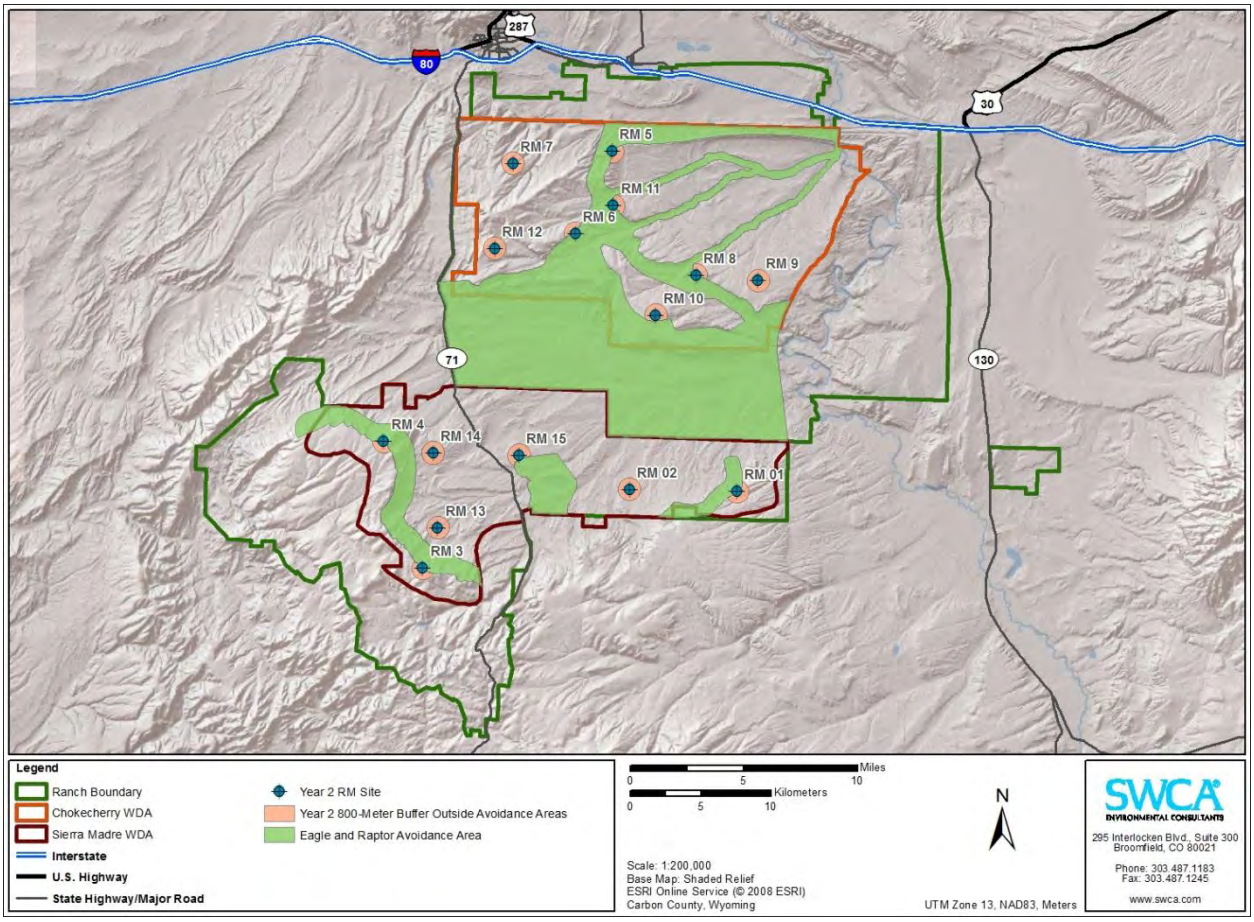


Figure 3. Identified high eagle use areas and 800-meter survey perimeters outside of turbine no-build areas on the Project site.

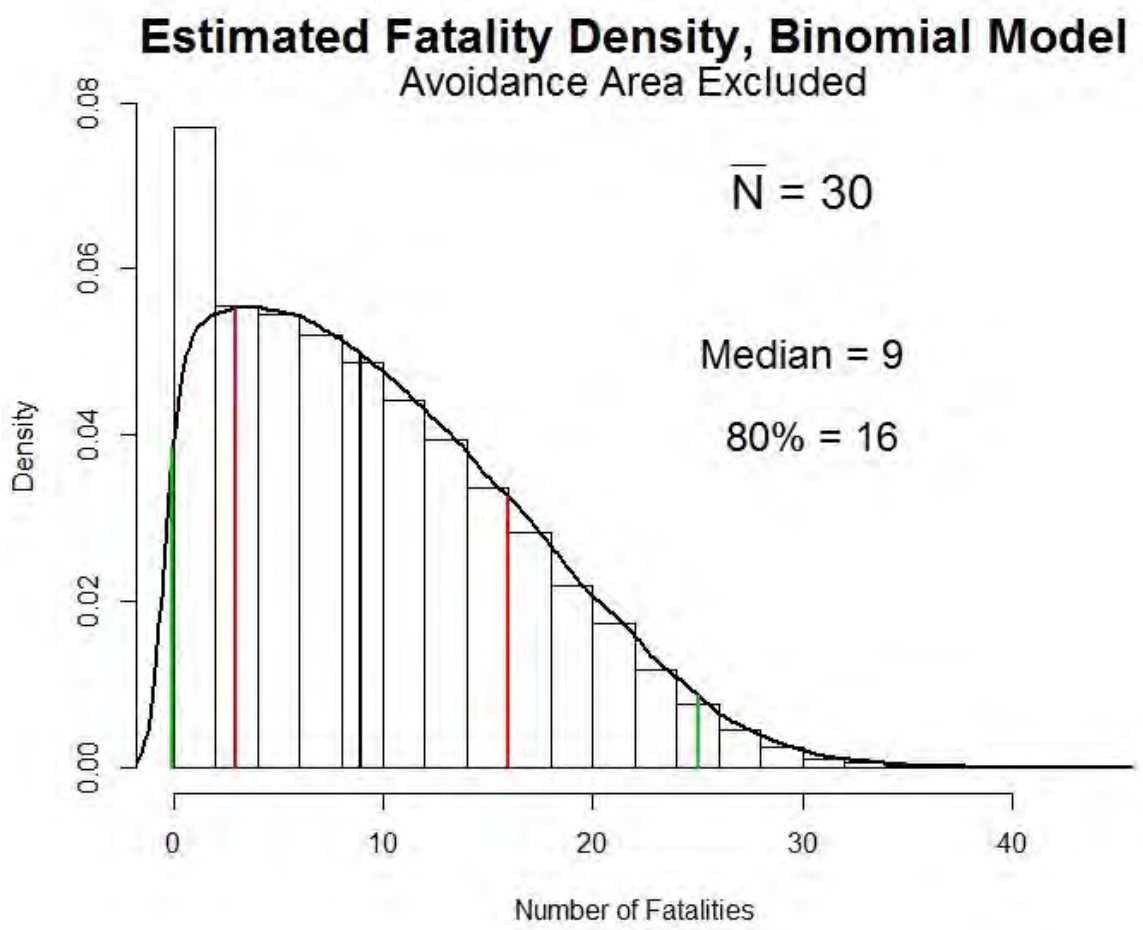


Figure 4. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas and assuming a finite population of eagles. These simulations assumed a mean population size of 30 eagles on the site. $\bar{N}$ represents the mean abundance over all simulations.

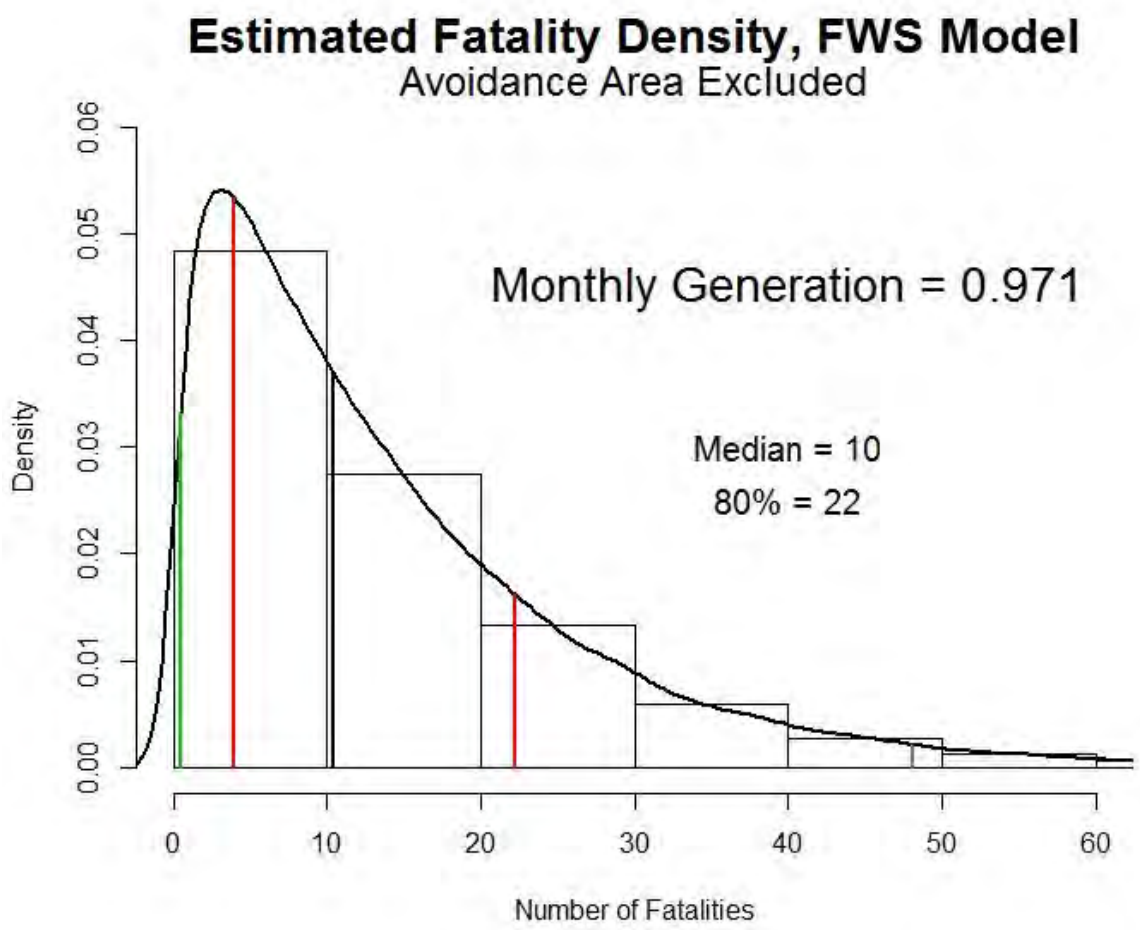


Figure 5. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas and accounting for turbines not rotating all day. Monthly generation was the proportion of daylight hours turbines are expected to rotate. This value was estimated from a report from AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy.

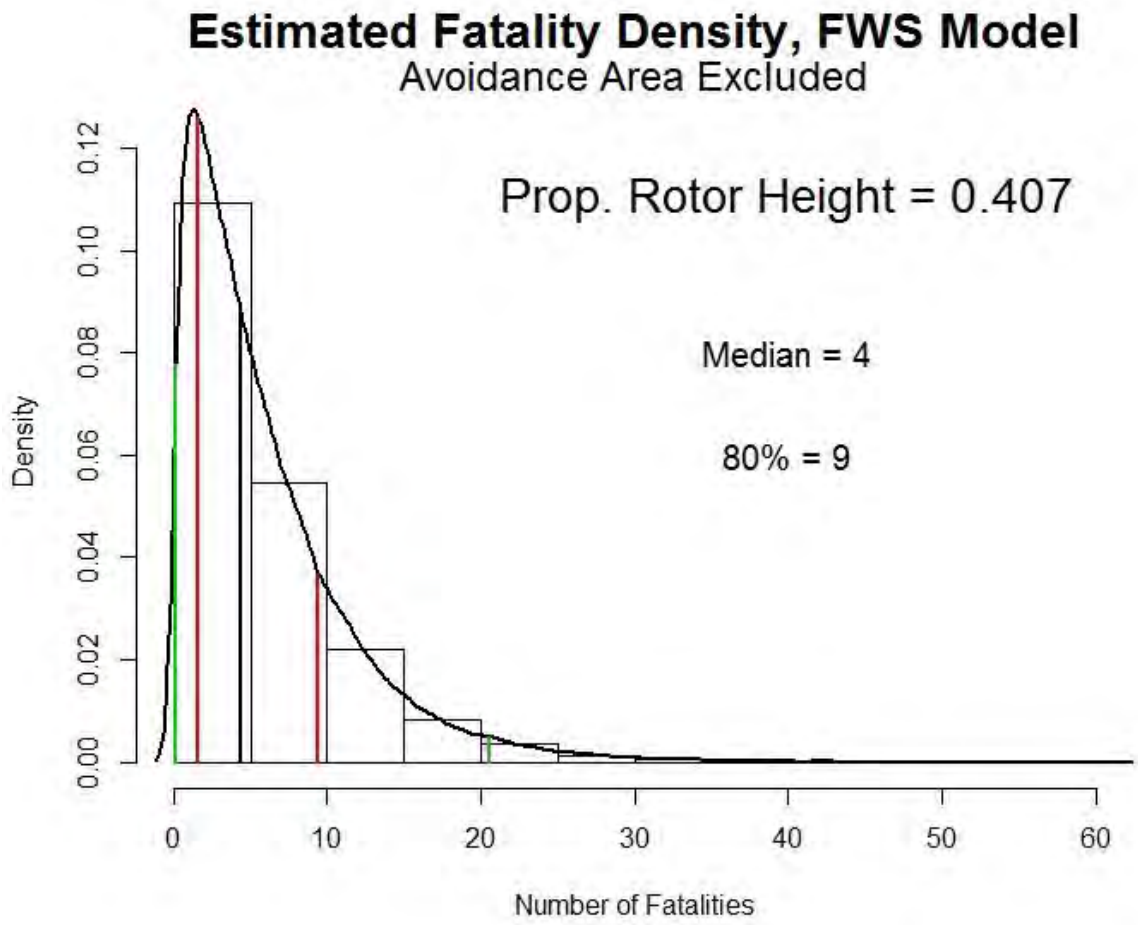


Figure 6. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas and accounting for the proportion of time eagles spent flying at rotor height in the Project site. To account for reduced risk of collisions when flying above or below rotating turbines, we adjusted the hazard area expansion (the total hazardous area in units of km^2). SWCA recorded 40.7% (Prop. Rotor Height = 0.407) of their eagle minute observations in the 30-150 meter height category, which is the height of rotors and height where eagles are at risk of collision.

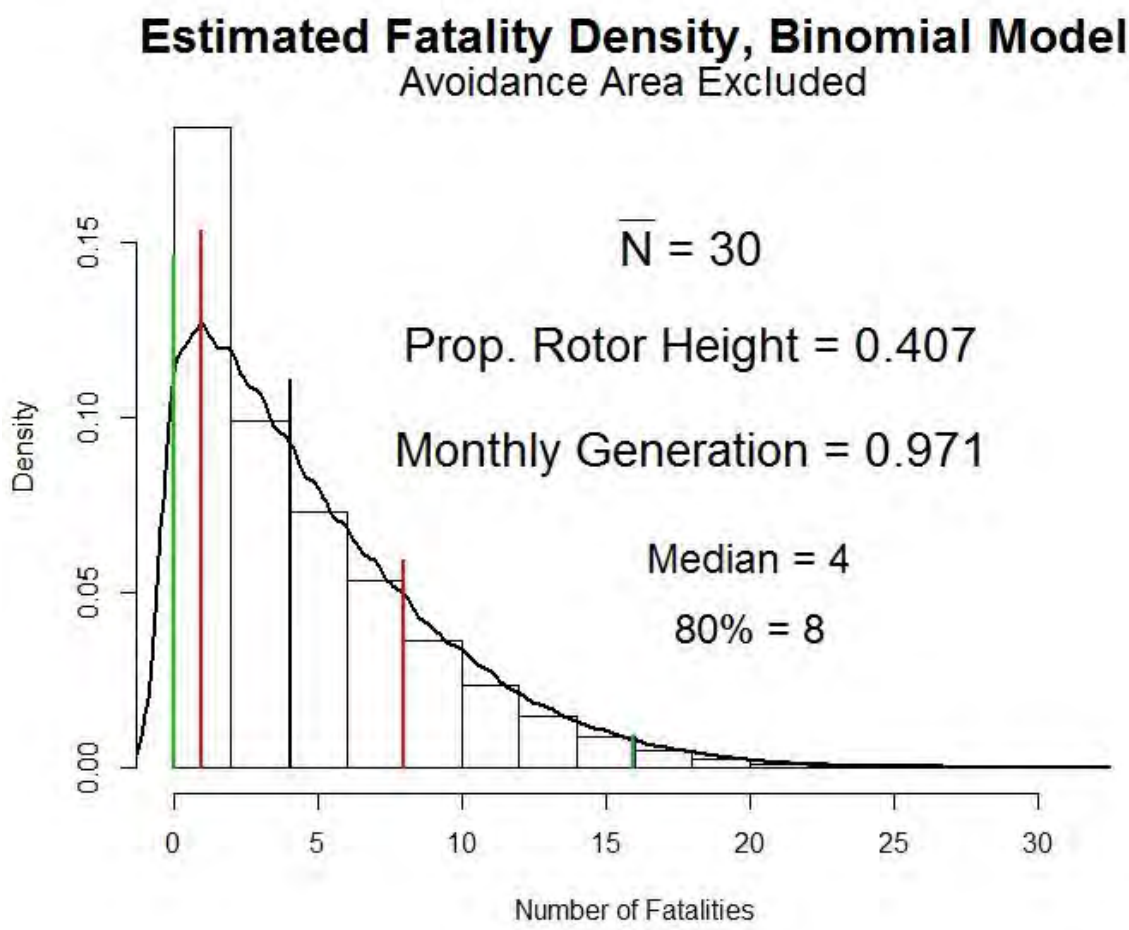


Figure 7. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas, assuming a mean population size of 30 eagles, accounting for turbines not rotating all day, and accounting for the proportion of time eagles spent flying at rotor height in the Project site. These simulations assumed a mean population size of 30 eagles on the site. $\overline{N}$ represents the mean abundance over all simulations. Monthly generation was the proportion of daylight hours turbines are expected to rotate. This value was estimated from a report from AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy. To account for reduced risk of collisions when flying above or below rotating turbines, we adjusted the hazard area expansion (the total hazardous area in units of km^2). SWCA recorded 40.7% (Prop. Rotor Height = 0.407) of their eagle minute observations in the 30-150 meter height category, which is the height of rotors and height where eagles are at risk of collision.

Appendix A: Eagle fatality estimates for the Project including areas of high eagle use and for the Project as re-designed with turbine no-build areas, which excludes turbines from certain designated high eagle use areas. These methods and results were provided in a separate report, but are provided here in support of material presented in this report.

1. *Eagle Fatality Estimates for the Project Including Areas of High Eagle Use*

I applied the baseline Service's Model using site-specific 800-meter survey data from the Project site as collected by SWCA and described above. Specifically, we used the number of golden eagle flight minutes observed and the hour/km^2 of survey observations. The baseline 800-meter survey data, without consideration of the turbine no-build areas, recorded 731.7 eagle minutes for the Project site (which includes 2.7 minutes for unidentified eagle species). The survey effort is based on 2,162.5 survey hours. Because each survey point consisted of an 800 m (0.80 km) radius circle, survey effort equals 2162.5 observation hours * 0.80^2*3.14…km^2 = 4,348 observation hours-km^2. With 15 survey points, this is equal to:

$$\sum_{i=1}^{15}\left(\text{observation hours at survey point i * area}_{\text{plot i, km2}}\right)$$

where the plot area = $(0.80\text{ km})^2$*3.14… for all survey points. Survey minute totals are shown in Table 1. Table 2 provides the eagle minutes of eagle flight time when only the 800-meter survey data are included. Applying this information in the Service's eagle fatality estimate leads to an estimated fatality distribution with quantiles 0.50 = 29 fatalities, 0.80 = 63 fatalities, 0.90 = 87 fatalities, and 0.95 = 111 fatalities (Figure 1).

The Service uses the 80% quantile from the distribution of predicted fatalities to infer risk. This is a very conservative approach because the most likely number of fatalities, when one considers the probability distribution in Figure 1, is much lower. The resulting probability distribution should not be used to assert that there will be 63 eagle fatalities a year. These results indicate that 80% of the time, it is predicted that 63 *or fewer* eagles would be removed. Thus, it is unrealistic to expect 63 eagles would be removed. For example, the median estimated number of fatalities for this scenario was 29 annual eagle fatalities. Further, this conservative benchmark is added on top of the already risk averse approach taken to develop the Model.

2. Eagle Fatality Estimates for the Project as Re-Designed with Eagle Turbine No-build Areas

Based on the estimated eagle fatalities for the Project, PCW followed the ECP Draft Guidance and re-designed the Project. Using the kernel density maps, which I find accurately represent the high eagle use areas based on available data, PCW re-designed the Project to exclude turbines from certain designated high eagle use areas. A map of the re-designed Project with the turbine no-build areas is attached (Figure 3).

To evaluate the effect of this Project re-design on the estimated number of eagle fatalities, the next step involved clipping the data to eliminate the turbine no-build areas from the Project

footprint. Data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the project as re-designed was clipped accurately and appropriately modified to remove eagle use data for the areas removed from the wind farm facility (turbine no-build areas).

To calculate eagle use in these areas, the number of eagle flight minutes and survey minutes were calculated using only those observations that occurred within the remaining survey buffer. As a result, eagle flight minutes per hour of survey time per km^2 was calculated and used as the input data in the Service's eagle fatality Model. Data used as model input are summarized in Tables 1 and 3.

Observed eagle minutes outside the turbine no-build area were recalculated as described above after excluding eagle minutes occurring in portions of plots within the turbine no-build area. This leads to a count of 189 eagle minutes observed in the portions of the 15 Project site survey plots outside the turbine no-build area (Table 3). These non-avoidance plot segments were surveyed for 2,162.5 total survey hours (Table 1), but because the proportion of each plot within the turbine no-build area varied, survey effort was recalculated as:

$$\sum_{i=1}^{15}\left(\text{observation hours at survey point i * area-outside-avoidance-zone}_{\text{plot i , km2}}\right)$$

producing a revised effort of 3,073.9 observation hours-km^2.

I used these revised estimates in the Service's Model to estimate eagle fatalities when incorporating the identified turbine no-build areas. Using the revised survey effort and eagle minutes outside the turbine no-build areas, the estimated fatality distribution (Figure 2) had quantiles 0.50 = 11 fatalities, 0.80 = 23 fatalities, 0.90 = 32 fatalities, and 0.95 = 41 fatalities. Thus, using the clipped data in the Model representing the Project as re-designed results in an 80% quantile estimate of 23 *or fewer* eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of annual fatalities for this scenario was 11.

The distribution in Figure 2 is based on applying the baseline Service Model, with revised eagle minutes =189 (Table 3). Because total observation hours-km^2 is calculated in the Service's CollisionModelv2.11.R file rather than the project-specific input file, we also modified the collision model file to specify "SmpHrKM2<-3073.923", which replaces the default calculation of this variable in the Model.

Table 1. Survey minute totals for all sites in spring, summer, fall, and winter seasons during year two at the Project site.

Site	Spring		Summer		Fall		Winter		Total	
	Mins	Hrs	Mins	Hrs	Mins	Hrs	Mins	Hrs	Mins	Hrs
RM1	3,534	58.9	720	12.0	3,435	57.3	1,200	20.0	8,889	148.2
RM2	3,483	58.1	720	12.0	3,213	53.6	1,190	19.8	8,606	143.4
RM3	2,974	49.6	720	12.0	3,479	58.0	0*	0*	7,173	119.6
RM4	2,867	47.8	724	12.1	3,440	57.3	1,140	19.0	8,171	136.2
RM5	3,422	57.0	738	12.3	3,255	54.3	1,065	17.8	8,480	141.3
RM6	2,925	48.8	631	10.5	4,305	71.8	1,180	19.7	9,041	150.7
RM7	3,120	52.0	675	11.3	2,835	47.3	1,160	19.3	7,790	129.8
RM8	3,403	56.7	730	12.2	3,608	60.1	1,172	19.5	8,913	148.6
RM9	3,704	61.7	720	12.0	3,725	62.1	1,141	19.0	9,290	154.8
RM10	3,614	60.2	720	12.0	3,233	53.9	1,162	19.4	8,729	145.5
RM11	4,001	66.7	720	12.0	3,352	55.9	1,240	20.7	9,313	155.2
RM12	2,790	46.5	670	11.2	3,417	57.0	1,093	18.2	7,970	132.8
RM13	3,999	66.7	720	12.0	3,530	58.8	2,314	38.6	10,563	176.1
RM14	2,985	49.8	725	12.1	3,354	55.9	1,200	20.0	8,264	137.7
RM15	3,345	55.8	720	12.0	3,245	54.1	1,248	20.8	8,558	142.6
Total	50,166	836.1	10,653	177.6	51,426	857.1	17,505	291.8	129,750	**2162.5**

* Due to winter access and safety issues, surveys at RM3 were not completed during winter months.

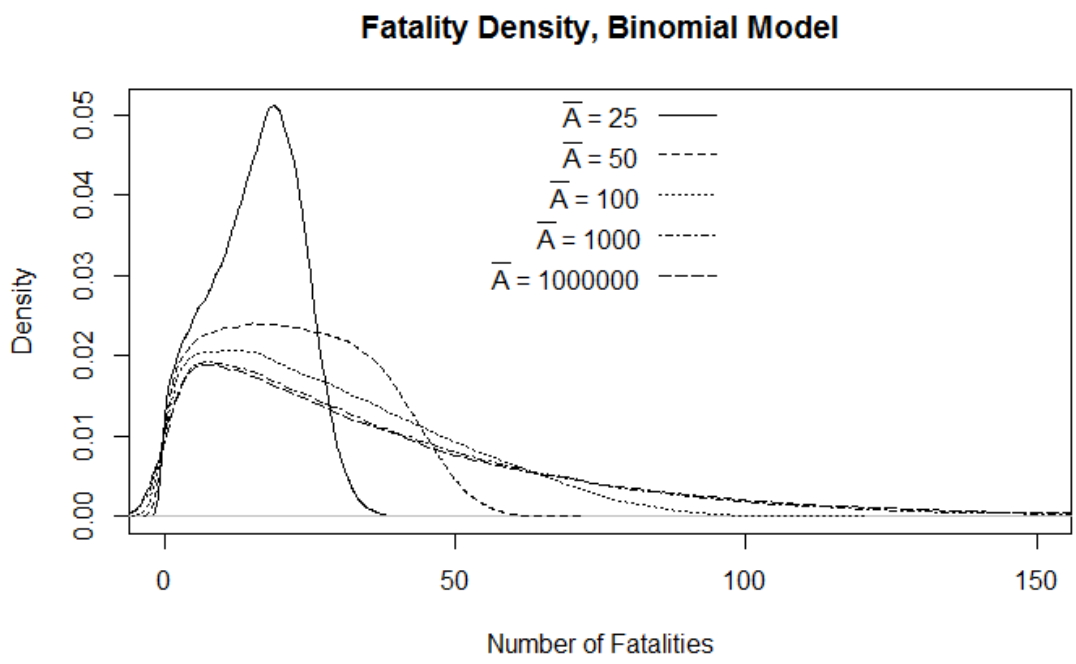
Table 2. Minutes of eagle flight time within 800-meters of each raptor monitoring location at the Project site. These data relate to eagle fatality estimates for the Project including areas of high eagle use.

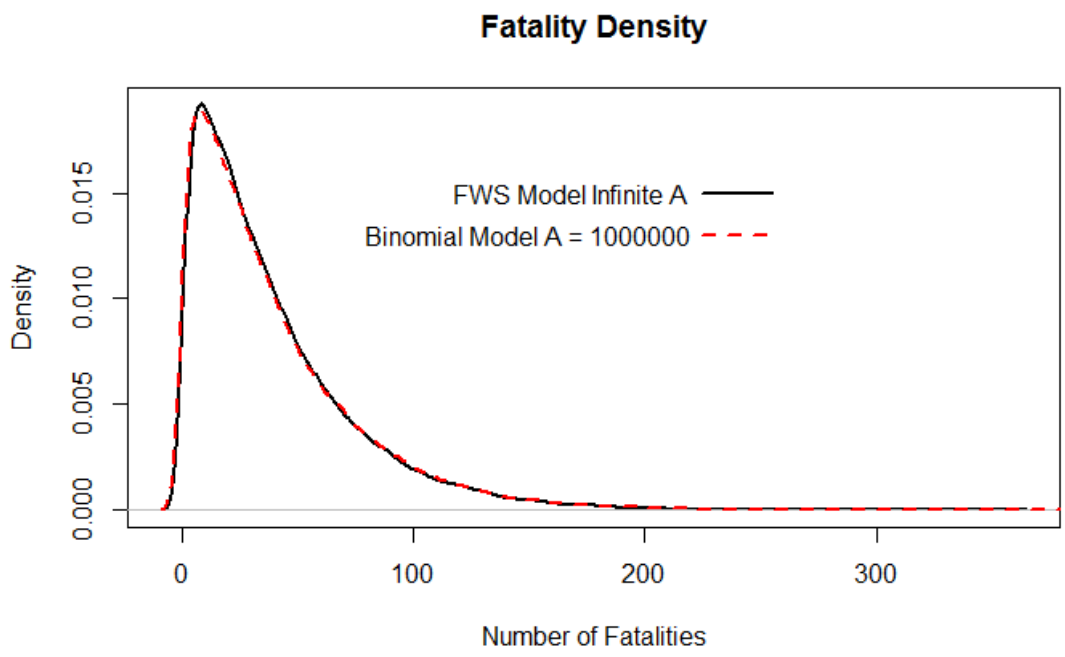
Site	Season				
	Spring	Summer	Fall	Winter	Total
RM1	23	12	6	0	41
RM2	16	8	25	10	59
RM3	0	0	13	0	13
RM4	12	9	0	0	21
RM5	23	21	17	19	80
RM6	47	0	0	0	47
RM7	0	0	0	0	0
RM8	50	0	24	4	78
RM9	0	0	11	0	11
RM10	6	0	0	7	13
RM11	59	0	55	35	149
RM12	12	0	12	8	32
RM13	11	0	24	16	51
RM14	26	21	15	37	99
RM15	5	0	25	5	35
Total	**290**	**71**	**227**	**141**	**729**

Table 3. Minutes of eagle flight time outside of avoidance areas within 800-meters of each raptor monitoring location at the Project site. These data relate to eagle fatality estimates for the Project as re-designed with Turbine No-Build Areas.

Site	Season				
	Spring	Summer	Fall	Winter	Total
RM1			2		2
RM2	9	6	11	3	29
RM3			6		6
RM4	10	3			13
RM5					0
RM6					0
RM7					0
RM8	6		6	1	13
RM9			7		7
RM10	2			1	3
RM11	6		11	9	26
RM12	5		3	7	15
RM13	10		5	4	19
RM14	10	4	10	19	43
RM15	4		5	4	13
Total	**62**	**13**	**66**	**48**	**189**

Appendix B. To illustrate how the assumption of a finite population (i.e., binomial model) affects the probability distribution of eagle fatalities, we ran the model using several different assumed abundance values of eagles (i.e., 25, 50, 100, 1,000, and 1,000,000). The finite population model converges to the Service's fatality Model as abundance → ∞ (i.e., 1 million). Application of the Service's Model without modification for a finite population is equivalent to assuming there is an infinite number of eagles available for exposure on the Project site.





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ATTACHMENT 1

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JOSHUA J. MILLSPAUGH

Pauline O'Connor Distinguished Professor of Wildlife Management

School of Natural Resources, Department of Fisheries and Wildlife Sciences, 302 Natural Resources Building, University of Missouri, Columbia, Missouri 65211

Phone: (573) 882-9423; Fax: (573) 884-5070; E-mail: MillspaughJ@missouri.edu

EDUCATION

1999	Postdoctoral Studies in Quantitative Ecology. School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington
1999	Ph.D., Wildlife Ecology. College of Forest Resources, University of Washington, Seattle, Washington
1995	M.S., Wildlife Science. Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota
1991	B.S., Environmental and Forest Biology. State University of New York, College of Environmental Science and Forestry, Syracuse, New York

ACADEMIC POSITIONS

2009-present	Pauline O"Connor Distinguished Professor of Wildlife Management
1999-present	Professor of Wildlife Conservation, School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia (2009-Present); Associate Professor (2005-2009); Assistant Professor (1999-2005)
1999-2010	Director, Thomas S. Baskett Wildlife Research and Education Center, School of Natural Resources, University of Missouri, Columbia, Missouri
1999	Postdoctoral Fellow, School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington
1995-1999	Graduate Research and Teaching Assistant, College of Forest Resources, University of Washington, Seattle, Washington
1992-1995	Graduate Research Assistant, Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota

SELECTED HONORS AND AWARDS

2011	Appointed to University of Missouri Research Board
2009	Appointed as O"Connor Distinguished Professor
2009	Keynote Speaker, Game Monitoring Conference: providing a knowledge basis for sustainable hunting and biodiversity conservation, Uppsala, Sweden
2009	Missouri Governor"s Award for Excellence in Teaching
2008	U.S.D.A. National Teacher of the Year (U.S. Department of Agriculture, Excellence in College and University Teaching Award in the Agricultural Sciences)

2007	The Wildlife Society Award for Best Article (with Steve Buskirk)
2006	Superior Teaching Award from the University of Missouri Chapter of Gamma Sigma Delta
2005	Missouri Department of Conservation "Outstanding Research Collaborator of the Year"
2005	William T. Kemper Fellowship for Excellence in Teaching, University of Missouri
2003	Provost"s Outstanding Junior Faculty Teaching Award, University of Missouri
2003	College of Agriculture, Food, and Natural Resources "Golden Apple" Award for Teaching Excellence
2003	Plenary Speaker, First International Conference on Resource Selection Functions, Laramie, Wyoming
2002, 2008	Student Council "Outstanding Faculty Member", School of Natural Resources, University of Missouri

RESEARCH SCHOLARSHIP

My research focuses on vertebrate population ecology at three scales: physiological processes, individual space use and resource selection, and population-level dynamics. Many of these topics overlap within individual studies and include several themes. At each scale, my focus is on rigorous development and evaluation of field and statistical methods and application of these methods to help answer important conservation issues. My research is motivated by an interest to identify practical management solutions and provide applicable tools to solve pressing conservation problems. I work with a broad range of taxa, from salamanders to elephants, to address these applied questions.

Selected Recent Grants

I have obtained about 55 grants and contracts as either PI or Co-PI since 1999 from diverse funding sources such as the National Science Foundation, National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, U.S. Department of Energy, several state management agencies, and private industry. Total Amount in Grants since 1999 is about $13.5 million. Selected recent, representative grants shown below.

2012-2017	*Mule deer response to oil and gas development in western North Dakota* funded by the Bureau of Land Management, North Dakota Game and Fish, Mule Deer Foundation, and Oil and Gas Research Program in North Dakota. Amount: $688,000. With B. Stillings.
2011-2016	*Ecology of Greater Sage-grouse in Relation to Wind Energy Development in Wyoming* funded by the U.S. Forest Service, National Renewable Energy Lab, National Fish and Wildlife Foundation, Power Company of Wyoming, Wyoming Game and Fish Department, Bureau of Land and Management, and NWCC, Amount: $1,713,000. With M. Rumble, S. Gamo, J. Kehmeier.
2011-2016	*Ecology and management of reintroduced elk in Missouri* funded by the Missouri Department of Conservation, Amount: $1,915,000. With L. Hansen.

2011-2014 *Processes determining the abundance of terrestrial wildlife communities across large spatial scales* funded by the National Science Foundation, Amount: $1,200,000. With R. Kays, R. Costello, Z. He, and B. McShea.

2011-2014 *ABI Innovation: Computational and informatics tools for supporting collaborative wildlife monitoring and research* funded by the National Science Foundation, Amount: $845,000. With R. Kays and Z. He.

2010-2013 *Effects of commercial harvest on river turtle population dynamics* funded by the Missouri Department of Conservation, Amount: $170,659. With J. Briggler.

2007-2013 *Importance of mountain pine beetle infestations and fire as Black-backed woodpecker habitat in the Black Hills, South Dakota* funded by South Dakota Department of Game, Fish, and Parks and U.S. Forest Service, Amount: $230,713. With M. Rumble and D. Kesler.

2007-2011 *Development of a monitoring plan for the Northern Great Plains I&M Program* funded by the National Park Service, Amount: $449,000. With R. Gitzen.

2007-2016 *Evaluation of silvicultural management in Missouri oak-hickory forests: the effects of even-aged, uneven-aged, and no-harvest management on amphibian, reptile, and small mammal communities* funded by the Missouri Department of Conservation, Amount: $1,133,230. With R. Renken, R. Gitzen, and A. Smith.

2009-2014 *Predicting and monitoring impacts of climate change, disturbance and land use and management on forests and wildlife in the central hardwood region* funded by the U.S. Forest Service, Amount: $152,195. With F. Thompson and H. He.

2007-2011 *Application of wildlife habitat suitability and viability models to evaluate effects of fire and ecosystem restoration* funded by U.S. Forest Service, Amount: $114,788. With F. Thompson.

2006-2010 *Survival, movements, and resource selection of hellbenders in Missouri* funded by the Missouri Department of Conservation, Amount: $193,000. With J. Beringer and J. Briggler.

2005-2013 *Mourning dove demographics in Missouri* funded by the Missouri Department of Conservation, Amount: $331,912. With J. Schulz.

2005-2008 *DeerNet: Wireless sensor networking for wildlife monitoring* funded by the National Science Foundation, Amount: $1,050,000. With M. Fang and Z. He.

2005-2009 *Forage utilization model development and habitat impacts of free-ranging ungulates in the Black Hills, South Dakota* funded by the South Dakota Department of Game, Fish, and Parks and Custer State Park, Amount: $209,000. With G. Brundige.

Publications

I have published 4 books, ~160 peer-reviewed journal articles and book chapters. Representative publications are presented below. Complete list available upon request.

Books

Millspaugh, J. J., and J. M. Marzluff, editors. 2001. Radio Tracking and Animal Populations.

Academic Press, San Diego, California, USA. 467 pages.

Skalski, J. R., K. E. Ryding, and J. J. Millspaugh. 2005. Wildlife Demography: Analysis of Sex, Age, and Count Data. Elsevier Science, San Diego, California, USA. 656 pages.

Millspaugh, J. J., and F. R. Thompson, III, editors. 2009. Models for Planning Wildlife Conservation in Large Landscapes. Elsevier Science, San Diego, California, USA. 674 pages.

Gitzen, R. A., J. J. Millspaugh, A. B. Cooper, and D. S. Licht, editors. 2012. Design and Analysis of Long-Term Ecological Monitoring Studies. Cambridge University Press. 600 pages.

Journal Articles and Book Chapters

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Kolar, J. L., J. J. Millspaugh, T. W. Mong, and B. A. Stillings. 2012. Survival and cause-specific mortality of pronghorn in southwestern North Dakota. American Midland Naturalist 167:164-173.

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Schulz, J. H., A. J. Bermudez, and J. J. Millspaugh. 2005. Monitoring presence and annual variation of trichmoniasis in mourning doves. Avian Diseases 49:387-389.

Schulz, J. H., J. J. Millspaugh, B. E. Washburn, A. J. Bermudez, J. L. Tomlinson, T. W. Mong, and Z. He. 2005. Physiological effects of radio transmitters on mourning doves. Wildlife Society Bulletin 33:1092-1100.

Skalski, J. R., J. J. Millspaugh, and R. D. Spencer. 2005. Population estimation and biases in paint-ball mark-resight surveys of elk. Journal of Wildlife Management 69:1043-1052.

Beringer, J., J. J. Millspaugh, J. Sartwell, and R. Woeck. 2004. Real-time video recording of food selection by captive white-tailed deer. Wildlife Society Bulletin 32:648-654.

Larson, M. A., F. R. Thompson, III, J. J. Millspaugh, W. D. Dijak, and S. R. Shifley. 2004. Linking population viability, habitat suitability, and landscape simulation models for conservation planning. Ecological Modelling 180:103-118.

Marzluff, J. M., J. J. Millspaugh, P. Hurvitz, and M. S. Handcock. 2004. Resource utilization of an avian nest predator: relating resources to a probabilistic measure of animal use. Ecology 85:1411-1427.

Millspaugh, J. J., and K. F. Millenbah. 2004. Value and structure of research experiences for undergraduate wildlife students. Wildlife Society Bulletin 32:1185-1194.

Millspaugh, J. J., and B. E. Washburn. 2004. Use of fecal glucocorticoid metabolite measures in conservation biology research: considerations for application and interpretation. General and Comparative Endocrinology 138:189-199.

Millspaugh, J. J., R. A. Gitzen, B. J. Kernohan, M. Larson, and C. Clay. 2004. Comparability of three analytical techniques to assess joint space use. Wildlife Society Bulletin 32:148-157.

Millspaugh, J. J., G. C. Brundige, K. J. Raedeke, and R. A. Gitzen. 2004. Herd organization of Rocky Mountain elk, *Cervus elaphus nelsoni*, in South Dakota. Wildlife Society Bulletin 32:506-514.

Washburn, B. E., D. Tempel, J. J. Millspaugh, R. J. Gutiérrez, and M. Seamans. 2004. Factors related to fecal estrogens and fecal testosterone in California Spotted Owls. Condor 106:567-579.

Beringer, J., L. P. Hansen, J. J. Millspaugh, and T. Meyer. 2003. A statewide surveillance effort for detecting chronic wasting disease in wild white-tailed deer in Missouri. Wildlife Society Bulletin 31:873-881.

Suedkamp, K. M., B. E. Washburn, J. J. Millspaugh, M. R. Ryan, and M. Hubbard. 2003. Effects of radiotransmitters on fecal glucocorticoid levels in captive dickcissels. Condor 105:805-810.

Washburn, B. E., J. J. Millspaugh, J. H. Schulz, S. B. Jones, and T. W. Mong. 2003. Using fecal glucocorticoids for stress assessment in mourning doves. Condor 105:696-706.

Beringer, J., K. C. Vercauteren, and J. J. Millspaugh. 2003. Evaluation of an animal-activated scarecrow and a monofilament fence at reducing deer use of soybean fields. Wildlife Society Bulletin 31:492-498.

Gitzen, R. A., and J. J. Millspaugh. 2003. Evaluation of least squares cross validation bandwidth selection options for kernel estimation. Wildlife Society Bulletin 31:823-831.

Millenbah, K. F., and J. J. Millspaugh. 2003. Using experiential learning in wildlife courses to improve retention, problem solving, and decision making. Wildlife Society Bulletin 31:127-137.

Millspaugh, J. J., and B. E. Washburn. 2003. Within-sample variation in fecal glucocorticoid measurements. General and Comparative Endocrinology 132:21-26.

Millspaugh, J. J., B. E. Washburn, M. A. Milanick. R. Slotow, and G. van Dyk. 2003. Effects of heat and chemical treatments on fecal glucocorticoid measurements: implications for sample transport. Wildlife Society Bulletin 31:399-406.

Millspaugh, J. J., B. E. Washburn, M. A. Milanick, J. Beringer, L. Hansen, and T. Meyer. 2002. Noninvasive techniques for stress assessment in white-tailed deer. Wildlife Society Bulletin 30:899-907.

Washburn, B. E., and J. J. Millspaugh. 2002. Effects of simulated environmental conditions on fecal glucocorticoid measurements. General and Comparative Endocrinology 127:217-222.

Washburn, B. E., D. L. Morris, J. J. Millspaugh, J. R. Faaborg, and J. H. Schulz. 2002. Using a commercially available radioimmunoassay to quantify corticosterone in small volume avian plasma samples. Condor 104:558-563.

Skalski, J. R., and J. J. Millspaugh. 2002. Generic variance expressions, precision, and sampling optimization for the sex-age-kill model of population reconstruction. Journal of Wildlife Management 66:1308-1316.

Herter, D. R., L. L. Hicks, H. C. Stabins, J. J. Millspaugh, A. J. Renkert, and L. C. Melampy. 2002. Roost site characteristics of Northern Spotted owls in the nonbreeding season. Forest Science 48:437-444.

Marzluff, J. M., J. J. Millspaugh, K. Ceder, C. D. Oliver, J. Withey, J. B. McCarter, C. L. Mason, and J. Comnick. 2002. Modeling changes in wildlife habitat and economic return in response to timber management at the landscape scale. Forest Science 48:191-202.

Schulz, J. H., J. J. Millspaugh, B. E. Washburn, G. R. Wester, J. T. Lanigan, and J. C. Franson. 2002. Assessing spent shot availability on areas managed for mourning doves. Wildlife Society Bulletin 30:112-120.

Raedeke, K. J., J. J. Millspaugh, and P. E. Clark. 2002. Population characteristics. Pages 449-491 *in* D. E. Toweill and J. W. Thomas, editors. North American Elk: Ecology and Management. Wildlife Management Institute, Smithsonian Institution Press, Washington, D.C., USA.

Millspaugh, J. J., R. J. Woods, K. Hunt, K. J. Raedeke, B. E. Washburn, G. C. Brundige, and S. K. Wasser. 2001. Using fecal glucocorticoids to quantify the physiological stress response of free-ranging elk. Wildlife Society Bulletin 29:899-907.

Roloff, G. J., J. J. Millspaugh, R. A. Gitzen, and G. C. Brundige. 2001. Verification of a spatially explicit habitat model for Rocky Mountain elk. Journal of Wildlife Management 65:899-914.

Cooper, A. B., and J. J. Millspaugh. 2001. Accounting for variation in resource availability and animal behavior in resource selection studies. Pages 243-274 *in* J. J. Millspaugh and J. M. Marzluff, editors. Radio Tracking and Animal Populations. Academic Press, San Diego, California, USA.

Kernohan, B. J., R. A. Gitzen, and J. J. Millspaugh. 2001. Analysis of animal space use and movements. Pages 125-166 *in* J. J. Millspaugh and J. M. Marzluff, editors. Radio Tracking and Animal Populations. Academic Press, San Diego, California, USA.

Marzluff, J. M., S. Knick, and J. J. Millspaugh. 2001. High-tech behavioral ecology: modeling the distribution of animal activities to better understand animal space use. Pages 309-328 *in* J. J. Millspaugh and J. M. Marzluff, editors. Radio Tracking and Animal Populations. Academic Press, San Diego, California, USA.

Merwin, D. S., J. J. Millspaugh, G. C. Brundige, D. Schultz, and C. L. Tyner. 2000. Immobilization of free-ranging Rocky Mountain Bighorn ewes with Telazol and xylazine hydrochloride. Canadian Field-Naturalist 114:471-475.

Millspaugh, J. J., M. A. Coleman, P. J. Bauman, K. J. Raedeke, and G. C. Brundige. 2000. Differences in serum profiles of Rocky Mountain elk, *Cervus elaphus nelsoni*, captured

by three methods in the Black Hills, South Dakota. The Canadian Field-Naturalist 114:196-200.

Millspaugh, J. J., K. J. Raedeke, G. C. Brundige, and R. A. Gitzen. 2000. Elk and hunter space use sharing in the Southern Black Hills, South Dakota. Journal of Wildlife Management 64:994-1003.

Wasser, S. K., K. E. Hunt, J. L. Brown, K. Cooper, C. M. Crockett, U. Bechert, J. J. Millspaugh, S. Larson, and S. L. Monfort. 2000. A generalized fecal glucocorticoid assay for use in a diverse array of non-domestic mammalian and avian species. General and Comparative Endocrinology 120:260-275.

Cooper, A. B. and J. J. Millspaugh. 1999. The application of discrete choice models to wildlife resource selection studies. Ecology 80:566-575.

Seaman, D. E., J. J. Millspaugh, B. J. Kernohan, G. C. Brundige, K. J. Raedeke, and R. A. Gitzen. 1999. Effects of sample size on kernel home range estimates. Journal of Wildlife Management 63:739-747.

Kernohan, B. J., J. J. Millspaugh, J. A. Jenks, and D. E. Naugle. 1998. Use of home range estimators in a GIS environment to identify habitat use patterns. Journal of Environmental Management 53:83-89.

Millspaugh, J. J., J. R. Skalski, B. J. Kernohan, G. C. Brundige, K. J. Raedeke, and A. B. Cooper. 1998. Some comments on spatial independence in studies of resource selection. Wildlife Society Bulletin 26:232-236.

Kernohan, B. J., J. A. Jenks, D. E. Naugle, and J. J. Millspaugh. 1996. Predicting 24-hour use habitat use patterns of white-tailed deer from diurnal use. Journal of Environmental Management 48: 299-303.

Millspaugh, J. J., G. C. Brundige, J. A. Jenks, C. L. Tyner, and D. R. Hustead. 1995. Immobilization of Rocky Mountain Elk with Telazol and xylazine hydrochloride and antagonism with yohimbine hydrochloride. Journal of Wildlife Diseases 31:259-262.

Millspaugh, J. J., G. C. Brundige, and J. A. Jenks. 1994. Summer elk trapping in South Dakota. The Prairie Naturalist 26:125-129.

Selected Invited Seminars and Symposia

2011 Elk ecology and management in Missouri. Presented to Missouri Conservation Commission (and presented again in 2012)

2009 Harmonizing game statistics: North American experience. Game Monitoring Conference: providing a knowledge basis for sustainable hunting and biodiversity conservation, Uppsala, Sweden, Uppsala, Sweden (*Keynote speaker*)

2009 Reconstructing historical bison demographics in the Northern Great Plains. Iowa State University, Ames, IA

2008 Population modeling and migratory birds. U.S. Fish and Wildlife Service and the Association of Fish and Wildlife Agencies, Denver, CO

2008 From elephants to hellbenders: CAFNR solving conservation problems. Missouri State Capitol. Jefferson City, MO

2007 Integrated camera and sensor system for wildlife monitoring: present and future applications. NSF sponsored workshop. Princeton University, NJ (with H. He)

2006 Quantitative advancements of wildlife space use and demographic studies. State University of New York, College of Environmental Science and Forestry, Syracuse, NY

2005 Reconstructing historical bison demographics in the Northern Great Plains. Fisheries and Wildlife Sciences seminar series, University of Missouri

2005 Reconstructing historical bison demographics in the Northern Great Plains. Ecology and evolution seminar series, Division of Biological Sciences, University of Missouri

2005 Using physiological measures to assess costs of wildlife habituation. Invited by National Park Service to present at The Wildlife Society Conference, Madison, WI

2005 Wildlife population modeling workshop. National Park Service. Badlands National Park, Interior, SD

2005 Natural herd demographics and effects of population control strategies in National Park Service bison and elk herds. National Park Service. Badlands National Park, SD

2004 Using discrete choice modeling and utilization distributions to assess resource selection. Winemiller Statistics Symposium, Department of Statistics, University of Missouri

2004 Recent quantitative advancements in wildlife habitat studies. U.S. Forest Service, Rocky Mountain Research Station, Rapid City, SD

2003 Wildlife management in South African Reserves. Kansas State University, Student Chapter of The Wildlife Society, Manhattan, KS

2003 Humans, stress, and elephants in South African Reserves. Kansas State University, Biological Sciences, Manhattan, KS

2003 Stress management of elephants in South African Reserves. State University of New York, Adirondack Ecological Center, Newcomb, NY

2003 Noninvasive assessment of stress in wild animal populations. Missouri Life Sciences Week, Conservation Biology Forum, University of Missouri

2003 What"s available? Techniques to address this problematic question in resource selection studies. First International Conference on Resource Selection Functions, University of Wyoming, Laramie, WY (*Plenary Speaker*)

2002 Assessing stress in free-ranging wildlife using noninvasive techniques. University of Minnesota, Department of Fisheries, Wildlife, and Conservation Biology, St. Paul, MN

2002 Stressed out: the effects of humans on charismatic megafauna. Dalton Cardiovascular Research Center Science Teachers Symposium, University of Missouri

2001 Wildlife conservation in South Africa National Parks. University of Missouri, Department of Fisheries and Wildlife Sciences (with M. Ryan and M. Larson)

2001 Noninvasive measurement of stress in free-ranging vertebrates. School of Life & Environmental Sciences, University of Natal, Durban, South Africa

2001 Noninvasive measurement of stress in wild animals. University of Missouri, Department of Physiology

Selected Conference Presentations and Abstracts

Since arriving at MU, my students and I have presented ~160 papers at state, regional, national, and international meetings. Some representative examples from the past 5 years are below.

Rota, C.T., J.J. Millspaugh, D.C. Kesler, C.P. Lehman, M.A. Rumble, and C. Bodinof. 2012. A Bayesian modified case-control model for estimating absolute probability of use from use-availability data. Ecological Society of America 97th Annual Conference, Portland, Oregon.

Rota, C.T., D.C. Kesler, C.P. Lehman, M.A. Rumble, and J.J. Millspaugh. 2012. Black-backed woodpecker home range size and resource selection in habitat created by mountain pine beetle infestations in the Black Hills of South Dakota. Invited Symposium, Vertebrate Responses to Bark Beetles, Laramie, Wyoming.

Ayers, C. R., J. L. Belant, J. J. Millspaugh, and C. M. Bodinof. 2011. Relating resource use to body mass change and survival of individual hellbenders (*Cryptobranchus alleganiensis*). Southeastern Association of Fish and Wildlife Agencies, Nashville, Tennessee.

Ayers, C. R., J. L. Belant, J. J. Millspaugh, D. A. Eads, and D. S. Jachowski. 2011. Effects of resource use on recruitment of black-footed ferrets. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Bonnot, T. W., F. R. Thompson, and J. J. Millspaugh. 2011. It‟s not how much to restore but where to restore it. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Gitzen, R. A., and J. J. Millspaugh. 2011. Integrating and applying quantitative recommendations about ecological monitoring. 3rd North American regional meeting of The International Environmetrics Society, La Crosse, Wisconsin.

Gitzen, R. A., J. J. Millspaugh, and B. J. Keller. 2011. Utilization distributions and resource selection. Invited presentation scheduled for the 2011 Annual Conference of the Wildlife Society, Waikoloa, Hawaii.

Jachowski, D.S., R. Slotow and J.J. Millspaugh. 2011. Physiological stress and refugia behavior by African elephants. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Keller, B, J. J. Millspaugh, G. Brundige and C. Lehman. 2011. Mechanisms affecting pronghorn resource selection in the Black Hills, SD. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Gering, Nebraska.

Keller, B, J. J. Millspaugh, G. Brundige and C. Lehman. 2011. Analysis of factors influencing spatial overlap among an ungulate assemblage in the Black Hills, SD. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Gering, Nebraska.

LeBrun, J. L., W. Thogmartin, F. Thompson, and J. Millspaugh. 2011. The effects of climate versus habitat and landscape factors on avian abundance in the Midwestern United States. 18th Annual Wildlife Society Conference, Waikoloa, Hawaii.

Rota, C. T., D. C. Kesler, M. A. Rumble, C. P. Lehman, and J. J. Millspaugh. 2011. Foraging behavior of Black-backed woodpeckers in burned forests and mountain pine beetle infestations. AOU Annual Meeting, Jacksonville, Florida.

Rota, C. T., D. C. Kesler, M. A. Rumble, C. P. Lehman, and J. J. Millspaugh. 2011. Do mountain pine beetle infestations provide similar foraging resources for Black-backed woodpeckers as recently burned forests? 72nd Midwest Fish and wildlife Conference, Des Moines, Iowa.

Schulz, J. H., T. W. Bonnot, and J. J. Millspaugh. 2011. Factors affecting mourning dove harvest in Missouri. 72nd Midwest Fish and wildlife Conference, Des Moines, Iowa.

Wong, S.T., J.L. Belant, J.J. Millspaugh, R.A. Gitzen, A. Heard, and J. Ross. 2011. Radiotelemetry and remote monitoring of tropical carnivores. 1st Borneo Carnivore Symposium, Kota Kinabalu, Malaysia.

Bodinof, C.M., J. T. Briggler, R. E. Junge, J. Beringer, M. D. Wanner, C. D. Schuette, and J. J. Millspaugh. 2010. General observations of captive reared Ozark hellbenders released in the North Fork of the White River, Missouri. Missouri Natural Resources Conference. Tan-Tar-A Resort, Osage Beach, Missouri.

Bonnot, T. W., F. R. Thompson, III, and J. J. Millspaugh. 2010. Extension of landscape-based population viability models to ecoregional scales. The Wildlife Society Annual Conference, Snowbird, Utah.

Jachowski, D. S., R. A. Gitzen, M. B. Grenier, B. Holmes, and J. J. Millspaugh. 2010. The importance of thinking big: Large scale prairie dog conservation drives black-footed ferret reintroduction success. 37th Annual Natural Areas Conference, Osage Beach, Missouri.

Jachowski, D. S., R. A. Gitzen, M. B. Grenier, B. Holmes, and J. J. Millspaugh. 2010. Evaluating attempts to reintroduce black-footed ferrets to North America. 90th meeting of the American Society of Mammalogists, Laramie, Wyoming.

Atwood, P., P. Zager, J. J. Millspaugh, M. D. Matocq, R. T. Bowyer, and J. G. Kie. 2009. Fecal indices in mule deer during winter: effects of competition with elk. Annual Wildlife Society Conference, Monterey, California.

Atwood, P., P. Zager, J. J. Millspaugh, M. D. Matocq, R. T. Bowyer, and J. G. Kie. 2009. Fecal indices in mule deer wintering in close proximity to elk. Western States and Provinces Deer and Elk Workshop, Spokane, Washington.

Bodinof, C. M., J. T. Briggler, R. E. Junge, J. Beringer, M. D. Wanner, C. D. Schuette, and J. J. Millspaugh. 2009. General observations of captive reared Ozark hellbenders released in the North Fork of the White River, Missouri. 4th Hellbender Symposium. Cumberland Falls State Resort Park, Kentucky.

Bodinof, C. M., J. T. Briggler, M. Duncan, J. Beringer, and J. J. Millspaugh. 2009. Historic occurrence of Chytridiomycosis in hellbenders from Missouri. 4th Hellbender Symposium. Cumberland Falls State Resort Park, Kentucky.

McGowan, C. P., J. J. Millspaugh, M. R. Ryan, C. D. Kruse, and G. Pavelka. 2009. A new method for estimating survival of unmarked pre-fledged shorebird chicks. 3rd Shorebird Science in the Western Hemisphere Meeting, Mazatlan, Mexico.

Montgomery, R. A., G. J. Roloff, and J. J. Millspaugh. 2009. Modeling the probability distribution around telemetry points to explicitly incorporate positional error into wildlife resource use studies. Annual Wildlife Society Conference, Monterey, California.

Walter, W. D., D. M. Baasch, S. E. Hygnstrom, B. D. Trindle, A. J. Tyre, J. J. Millspaugh, and K. C. Vercauteren. 2009. Space use of sympatric deer in an area endemic for chronic wasting disease. Annual Wildlife Society Conference, Monterey, CA, September, 2009.

Gitzen, R. A., and J. J. Millspaugh. 2008. Successful strategies for design and analysis of noninvasive carnivore surveys. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio, December, 2008 (*Invited*).

Gitzen, R. A., A. Symstad, and J. J. Millspaugh. 2008. All variances are not created equal: sampling design for long-term monitoring. Annual Wildlife Society Conference, Miami, FL.

Gitzen, R., S. West, K. Aubry, J. Millspaugh, and M. Kroeger. 2008. The space-time continuum and responses by small mammals to forest management experiments. Annual Meeting of the American Society of Mammalogists.

Hansen, C., J. J. Millspaugh, and M. R. Rumble. 2008. Occupancy modeling of ruffed grouse in the Black Hills, South Dakota. Annual Wildlife Society Conference, Miami, FL.

Jachowski, D., J. J. Millspaugh, D. Biggins, T. Livieri, and R. Matchett. 2008. Black-footed ferret resource selection in the Conata Basin, South Dakota. Annual Wildlife Society Conference, Miami, FL.

Jachowski, D., J. J. Millspaugh, D. Biggins, T. Livieri, and R. Matchett. 2008. Spatial dynamics of black-footed ferrets and prairie dogs in the Conata Basin, South Dakota. Annual Meeting of the American Society of Mammalogists.

Keller, B., J. J. Millspaugh, and G. C. Brundige. 2008. Resource selection of sympatric ungulates in the Black Hills, South Dakota. Annual Wildlife Society Conference, Miami, FL.

Kolar, J., J. J. Millspaugh, and B. Stillings. 2008. Movements of pronghorn in southwest North Dakota. Biennial Pronghorn Workshop, Canmore, Alberta, Canada.

Kolar, J., J. J. Millspaugh and B. Stillings. 2008. Resource selection and space use of pronghorn in southwest North Dakota. Annual Wildlife Society Conference, Miami, FL.

Lesmeister, D. B., M. E. Gompper, and J. J. Millspaugh. 2008. Denning and resting ecology of the eastern spotted skunk. Annual Meeting of the American Society of Mammalogists.

Shifley, S. R., C. D. Rittenhouse, W. D. Dijak, Z. Fan, F. R. Thompson, III, and J. J. Millspaugh. 2008. Forecasting landscape-scale, cumulative effects of forest management on forest vegetation and wildlife dynamics for the Hoosier National Forest, USA. IUFRO Landscape Ecology Conference, Chengdu, Sichuan, P.R. China.

Walter, W. D., J. Beringer, L. P. Hansen, J. W. Fischer, J. J. Millspaugh, and K. VerCauteren. 2008. Demographics and space use of a white-tailed deer population in the St. Louis Metropolitan Area. Annual Wildlife Society Conference, Miami, FL.

Washburn, B. E., J. J. Millspaugh, and R. J. Woods. 2008. Assessing endocrine status of carnivores using noninvasive techniques. 69th Midwest Fish and Wildlife Conference, Columbus, Ohio (*Invited*).

Bonnot, T. W., M. L. Wildhaber, J. J. Millspaugh, A. J. DeLonay, R. B. Jacobson, D. M. Papoulias. 2007. Resource selection of gravid shovelnose sturgeon in the Lower Missouri River. 137th Annual American Fisheries Society Meeting, San Francisco, California (*Invited*).

Bonnot, T. W., M. L. Wildhaber, J. J. Millspaugh, A. DeLonay, R. Jacobson, and D. Papoulias. 2007. Habitat use of gravid shovelnose sturgeon. Missouri River Natural Resource Conference (*Invited*).

Gitzen, R., S. West, K. Aubry, J. Millspaugh, and M. Kroeger. 2007. The space-time continuum and responses by small mammals to forest management experiments. Annual Wildlife Society Conference, Tucson, Arizona.

Lesmeister, D., M. Gompper, and J. Millspaugh. 2007. Space use and mortality of eastern spotted skunks in the Ouachita Mountains, Arkansas. American Society of Mammalogists, 87th Annual Meeting, Albuquerque, New Mexico.

Lesmeister, D., M. Gompper, and J. Millspaugh. 2007. Space use and mortality of eastern spotted skunks in the Ouachita Mountains, Arkansas. Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Licht, D., R. Slotow, and Millspaugh, J. J. 2007. A comparison of park management in South Africa and the United States. George Wright Society, Minneapolis, MN.

Millspaugh, J. J., S. Amelon, T. Bonnot, T. Farrand, R. Gitzen, D. Licht, C. McGowan, S. Pruett, C. Rittenhouse, K. Suedkamp Wells. 2007. Natural demographics of bison in the Great Plains. George Wright Society, Minneapolis, MN.

Mong, T. W., J. H. Schulz, R. Bredesen, J. J. Millspaugh, and D. Dey. 2007. Using agroforestry and lease hunting to increase the economic viability of agricultural landscapes. Missouri Natural Resources Conference, Osage Beach, Missouri.

Rittenhouse, C. D., W. D. Dijak, F. R. Thompson, III, J. J. Millspaugh, and S. R. Shifley. 2007. A landscape-level approach to forest-wildlife planning: the Hoosier National Forest Management Plan. Midwest Fish and Wildlife Conference, Madison, Wisconsin.

Rittenhouse, C. D., J. J. Millspaugh, M. W. Hubbard, S. L. Sheriff, and W. D. Dijak. 2007. Resource selection by translocated three-toed box turtles in Missouri. Annual Wildlife Society Conference, Tucson, Arizona.

Schulz, J. H., P. Padding, and J. J. Millspaugh. 2007. Will mourning dove crippling rates increase with nontoxic shot regulations? Missouri Natural Resources Conference, Osage Beach, Missouri.

Schulz, J. H., R. Reitz, S. Sheriff, and J. J. Millspaugh. 2007. Attitudes of Missouri small game hunters toward nontoxic shot regulations. Missouri Natural Resources Conference, Osage Beach, Missouri.

Professional and Academic Memberships

The Wildlife Society (State, Regional, National)
The Wildlife Society Biometrics Working Group
The Wildlife Society College and University Education Group
Xi Sigma Pi Academic Honor Society
Gamma Sigma Delta Academic Honor Society
Boone and Crockett Club

TEACHING SCHOLARSHIP

Teaching Experience

Courses Taught (University of Missouri)

Spring 2003-present	Animal Population Dynamics, 3 credits, undergraduate, required course for undergraduate students, every spring (except 2009)
Fall 2000-2008	Wildlife Research and Management Techniques, 4 credits, undergraduate, writing intensive (each fall from 2000-2004, then alternate years)
Winter 2000-2002	Natural Resources Practicum, 3 credits, undergraduate (with H.

	Bhullar, J. Dwyer, and D. Hammer)
Spring 2002, Fall 2007	Quantitative Fish and Wildlife Assessment, 4 credits, graduate
Fall 2004, Spring 2005	Wildlife Management and National Park Service Policy, 2 credits, graduate
Fall 2003, 2011	Resource Use and Model Selection, 3 credits, graduate
Fall 2001, 2006, 2009	Professionalism and Communications, 2-3 credits, graduate (with Mark Ryan)
Fall 2010	Energy Development and Wildlife Management, 2 credits, graduate
Spring 2012	Harvest Management, 3 credits, graduate

Student Advising

In addition to serving as Chair of graduate committees, I have served as a member on > 50 graduate student committees in several departments (Statistics, Biological Sciences) and universities (University of Washington, University of Nebraska). A total of 17 graduate students have completed their degrees with me at MU.

Dissertation or Thesis Advisor (Current)

Thomas Bonnot (Ph.D.). Dissertation topic: Ecoregional landscape population models for conservation planning in response to climate change (with F. Thompson)

Jaymi LeBrun (Ph.D.). Dissertation topic: Climate and ecosystem restoration modeling and impacts to wildlife in forested systems (with F. Thompson)

Christopher Rota (Ph.D.). Dissertation topic: Black-backed woodpecker space use and demographics in the Black Hills, South Dakota (with D. Kesler)

Amy Bleisch (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri

Stephanie Zimmer (M.S.). Thesis topic: Effect of commercial harvest on river turtle populations in Missouri

Leslie Schreiber (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming

Aleshia Fremgen (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming

Trenton Smith (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri

Undergraduate Advising and Mentoring:

I advise 20-25 undergraduate students enrolled in the Fisheries and Wildlife Sciences curriculum. I have mentored ~20 undergraduate student research projects and have employed over 150 students on my funded research projects.

Teaching Publications and Presentations

Peer-Reviewed

Millspaugh, J. J., and K. F. Millenbah. 2004. Value and structure of research experiences for undergraduate wildlife students. Wildlife Society Bulletin 32:1185-1194.

Millenbah, K. F., and J. J. Millspaugh. 2003. Using experiential learning in wildlife courses to

improve retention, problem solving, and decision making. Wildlife Society Bulletin 31:127-137.

Selected Invited Workshops and Teaching Presentations

Millspaugh, J. J. 2011. Professor‟s perspective. 4-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2011.

Ryan, M. R., and J. J. Millspaugh. 2011. Problem-based learning for undergraduates. Teaching Renewal Conference, University of Missouri, 1.5 hour workshop, May, 2011.

Millspaugh, J. J., and M. R. Ryan. 2011. Problem-based learning for undergraduates. Conservations in Teaching, University of Missouri, 1 hour workshop, April, 2011.

Millspaugh, J. J. 2010. Professor‟s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2010.

Ryan, M. R., and J. J. Millspaugh. 2010. Problem-based learning. 2 hour workshop. College Teaching of Agriculture class, University of Missouri, Winter 2010.

Ryan, M. R., and J. J. Millspaugh. 2010. Problem-based learning. 1 hour for graduate students enrolled in "Teaching of Psychology Practicum", Winter 2010.

Ryan, M. R., and J. J. Millspaugh. 2009. Problem-based learning. 2 hour workshop. College Teaching of Agriculture class, University of Missouri, Fall 2009.

Millspaugh, J. J. 2009. Professor‟s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2009.

Ryan, M. R., and J. J. Millspaugh. 2009. Problem-based learning. Dalton Cardiovascular Research Center Science Teachers Symposium, University of Missouri, February, 2009.

Millspaugh, J. J. 2009. Problem-based learning roundtable discussion (two sessions). College of Agriculture, Food, and Natural Resources Teaching Round-up. January, 2009.

Ryan, M. R., and J. J. Millspaugh. 2008. Problem-based learning: teaching with case studies. 2.5 hour workshop. College Teaching of Agriculture class, University of Missouri, Fall 2008.

Millspaugh, J. J. 2008. Professor‟s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2008.

Millspaugh, J. J. 2007. Interactive teaching strategies. 2 hour workshop. University of Missouri New Faculty Teaching Scholars Program. November, 2007.

Grigsby, M., J. Hermsen, and J. Millspaugh. 2007. "Tips from the Top: A Conversation with Exemplary Teachers". 1 hour workshop during New Faculty Orientation organized by Program for Excellence in Teaching. August, 2007.

Millspaugh, J. J. 2006. Using problem-based learning to promote critical thinking. 1 hour workshop. Conversations in college teaching seminar series, University of Missouri, May, 2006.

Millspaugh, J. J. 2005. Integrating teaching and research. 1 hour talk to Retired CAFNR Professor Group. November, 2005.

Millspaugh, J. J. 2005. Problem-based learning: teaching with case studies. 2.5 hour workshop. College Teaching of Agriculture class, University of Missouri, Fall 2005.

Ryan, M. R., H. R. Campa, and J. J. Millspaugh. 2005. Using problem-based learning to promote critical thinking. Full day workshop. College of Agriculture, Food, and Natural Resources, University of Missouri, August, 2005.

Ryan, M. R., and J. J. Millspaugh. 2004. Application of problem-based learning in the classroom. Department of Medical Pharmacology and Physiology, University of Missouri, Fall 2004.

Ryan, M. R., and J. J. Millspaugh. 2004. Integrating diverse writing assignments with problem cases. 90 minute workshop. 7th National Writing Across the Curriculum Conference, St. Louis, Missouri, Spring 2004.

Millspaugh, J. J., and M. R. Ryan. 2003. Ten myths of problem-based learning. Department of Animal Sciences, University of Nebraska-Lincoln, Fall 2003.

Ryan, M. R., and J. J. Millspaugh. 2003. It"s not about good teaching… University of Nebraska-Lincoln, Fall 2003.

Ryan, M. R., and J. J. Millspaugh. 2003. Using problem-based learning to promote critical thinking in undergraduate courses. 90 minute workshop. College of Agriculture, Food, and Natural Resources, University of Missouri, Fall 2003.

Ryan, M. R., and J. J. Millspaugh. 2003. Using problem-based learning to promote critical thinking in undergraduate courses. 120 minute workshop. Department of Animal Sciences, University of Nebraska-Lincoln, Fall 2003.

Millspaugh, J. J. 2001. Getting the most from undergraduate research projects. One-half day workshop at the Annual Conference of The Wildlife Society. At Workshop: Developing tomorrow"s professionals: teaching the skills they will need. Fall 2001.

Teaching Conference Presentations and Workshops

Spain, J., and J. Millspaugh. 2006. Co-organized CAFNR teaching round-up on "Educational Technology." University of Missouri, August, 2006.

Millspaugh, J. J., S. Amelon, T. Bonnot, T. Farrand, C. McGowan, S. Pruett, C. Rittenhouse, K. Suedkamp Wells. 2005. Combining problem-based learning and cooperative learning: a new model with high realism and application. University of Missouri, February, 2005.

Faaborg, J. E., M. R. Ryan, and J. J. Millspaugh. 2004. Academic performance in writing intensive courses: can we better prepare transfer students? 5th Biennial Conference on University Education in Natural Resources. Northern Arizona University, Flagstaff, Arizona. March, 2004.

Ryan, M. R., and J. J. Millspaugh. 2004. Using problem-based learning in natural resources curriculum to promote critical thinking. 90 minute workshop at 5th Biennial Conference on University Education in Natural Resources. Northern Arizona University, Flagstaff, Arizona. March, 2004.

Ryan, M. R., and J. J. Millspaugh. 2003. Using problem-based learning to promote critical thinking in undergraduate courses. 90 minute workshop at National Conference on Student Writing and Critical Thinking in Agriculture, Jackson, Wyoming. April, 2003.

Faaborg, J. E., J. J. Millspaugh, and M. R. Ryan. 2002. Comparison of academic statistics of 2-year college transfer and native fisheries and wildlife students at the University of Missouri. 4th Biennial Conference on University Education in Natural Resources. Forestry Department, North Carolina State University, Raleigh, North Carolina.

Millenbah, K., and J. J. Millspaugh. 2002. Infusing experiential learning into a wildlife curriculum: two models for one course. 4th Biennial Conference on University Education in Natural Resources. Forestry Department, North Carolina State University, Raleigh,

North Carolina. March, 2002.

Dwyer, J. P., and J. J. Millspaugh. 2000. The role of a team leader in a natural resources capstone course. 3rd Biennial Conference on University Education in Natural Resources, University of Missouri, Columbia, Missouri. March, 2000.

SERVICE AND PROFESSIONAL ACTIVITIES

Selected Major Professional Service

2010	Science Review Team, Review of Pronghorn Monitoring Plan for University of Wyoming Cooperative Fish and Wildlife Research Unit
2009-present	Associate Editor, Journal of Wildlife Management
2007-2010	Associate Editor, Ecological Applications
2007	Ecological Biology Program Advisory Panel, National Science Foundation
2007-2008	Associate Editor for the book Neotropical Cervidology (hormone chapter)
2005-2007	Chair and Panel Member, Review of White-tailed Deer Population Estimates and Management, Wisconsin Department of Natural Resources
2005-2006	Member of Science Review Team, Wind Cave National Park, South Dakota
2005-2009	Member of Peninsular Bighorn Sheep Recovery Team, U.S. Fish and Wildlife Service, California
2005-2007	Member of Science Review Team, Theodore Roosevelt National Park, ND
2004-2006	Associate Editor, Wildlife Society Bulletin
2004-2006	Secretary, University Education Working Group, The Wildlife Society
2003-2004	Secretary, Biometrics Working Group, The Wildlife Society
2002-2003	Wildlife Program Chair for 64th Midwest Fish and Wildlife Conference and Executive Committee Member, Kansas City, MO
2000-present	Chair, Missouri Chapter of The Wildlife Society Education Committee
1997-present	Reviewed papers for ~ 55 professional journals and review regularly for national and international grants (NSF, National Geographic, etc.)

University of Missouri

2011-present	Appointed to University of Missouri Research Board
2010-2012	Chair, Promotion and Tenure Committee, School of Natural Resources
2010	Member "Celebration of Teaching and Learning Planning Committee" for university-wide teaching conference
1999-2010	Director, Thomas S. Baskett Wildlife Research and Education Area, School of Natural Resources
2009-present	CAFNR Graduate Education Committee
2005-2012	Director of Graduate Studies, Department of Fisheries and Wildlife Sciences, University of Missouri
2005-2012	Chair, Graduate Programs Committee, Fisheries and Wildlife Sciences
2006-present	Member, College of College of Agriculture, Food, and Natural Resources, International Programs Committee

2005-2007	Chair, College of College of Agriculture, Food, and Natural Resources, Learning Improvement Committee
2005-2006	CAFNR Week Steering Committee, Faculty Advisor
2003-2006	Graduate Fellowship Coordinator, Conservation Biology Program
2002-2004, 2005-2006	Faculty Advisor for Univ. of Missouri Student Chapter of The Wildlife Society
2000-present	Co-Coordinator, Undergraduate Fisheries and Wildlife Scholarships
2000-2003	Conservation Biology Program Secretary and Executive Committee

Representative Media and Community Outreach

2011	Quoted in USA Today regarding pronghorn migrations and Discovery Channel about deer-vehicle collisions
2010	Bloomberg Business News interview about deer-vehicle collisions
2009	Participated in History Channel expedition and production about feral dogs in St. Louis
2008	Participated in History Channel expedition and production about feral hogs
2007	On April 30, 2007, we offered a live, standards-based, interactive session to middle school and high school students from urban and rural areas of Missouri. Programs were available via videoconference, online streaming, and, in limited areas, cable television. We captured a deer live during the broadcast, equipped it with a camera, and answered questions from students, as we conducted our field research
2006	My research was highlighted in National Science Foundation Special Report, "Secret Lives of Wild Animals" (www.nsf.gov/news/special_reports/animals/)
2006	Interview on CBS Evening News about deer and vehicle collisions (26 Feb 2006)
2006	PBS interview about Wisconsin deer population estimation
2005	Live interview on NBC Today show (29 October) about "Deercam" project; Additional news coverage and interviews included the following: Front page, Science Section, New York Times; Discovery channel; and hundreds of newspapers across country
2002	Article about my elephant research appeared in USA Today Magazine (August 2002, Vol. 131, Issue 2687)
2002	Interview on elk and human activities appeared in *Science* (296:1784-1785)

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ATTACHMENT 2

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To: Ryan Jacobson, Power Company of Wyoming, LLC
From: Dan Michaud, Meteorologist, AWS Truepower, LLC
Email: dmichaud@awstruepower.com
Cc: Dan Bernadett, Chief Engineer, AWS Truepower, LLC
Jason Dubois, Senior Meteorologist, AWS Truepower, LLC
Date: September 5, 2012
Re: Annual Average Daylight Production Percentage for the Chokecherry and Sierra Madre Wind Project

INTRODUCTION

The Power Company of Wyoming, LLC (PCW) has asked AWS Truepower, LLC, to evaluate the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy. The proposed Chokecherry and Sierra Madre Wind Project is located approximately 20 km south of Rawlins, Wyoming and about 210 km west-northwest of Cheyenne, Wyoming. The gross energy production of the plant was simulated by the ***openWind®***[1] software's time series energy capture module using 8,760 hourly datasets of observed meteorological data from a representative number of onsite meteorological masts. This memo summarizes the methodology that was used to derive the annual average percentage for the project from this simulated production data.

EXPLANATION OF METHODOLOGY

For the purpose of this analysis, the Chokecherry and Sierra Madre Wind Project was divided into 14 sub-regions of turbines, based on the wind resource characteristics they are expected to experience. The project area contains 34 monitoring mast locations; however it was determined that one representative mast from each sub-region was sufficient to resolve the intent of this analysis. The 2011 calendar year was chosen for this study since it is currently the only 12-month period when each of the selected 14 representative masts are in operation at the same time.

10-minute average wind speed, wind direction, turbulence intensity, and temperature data for the 1 January – 31 December 2011 time period from the 14 representative masts were validated to remove any erroneous values caused by icing, equipment failures, and tower shadow. Each dataset was then hourly averaged and any omitted hourly records were reconstructed using ***windTrends***. windTrends is a simulated hourly time series developed using Mesoscale Atmospheric Simulation System (MASS) model output. It is essentially a controlled regional reanalysis dataset developed by AWS Truepower that differs from conventional reanalysis data because it is computed at a finer resolution (20 km) and it relies on fixed observational data (rawinsonde).[2] The model output can be interpolated to the exact location of a meteorological mast. Once a complete 8,760 time series (every hourly record for a full year) was established for each of the 14 masts, the wind speed data were extrapolated to hub height using instantaneous shear values and the temperature data were extrapolated to hub height using the standard atmospheric lapse rate of 6.5 K per 1000 m. The wind speed data were then scaled to each

[1] openWind is a software program developed by AWS Truepower as an aid for the design, optimization, and assessment of wind power projects. Its energy capture and wake losses have been validated with those from the WindFarmer model developed by Garrad Hassan.

[2] Taylor, Mark, et al., "Using Simulated Wind Data from a Mesoscale Model in MCP", Proceedings of WindPower 2009, May 2009.

mast's expected long-term wind speed. The resulting hub height wind speed, wind direction, turbulence intensity, and temperature data time series for each mast were then input into the openWind software along with the wind resource grid and details of the project design such as the turbine locations, hub height, power curve, and thrust coefficients. Specific power curve and thrust coefficient information for this analysis was based on the Vestas V112 3.0-MW 84-m hub height turbine. The cut-in speed for the Vestas V112 is 3 m/s, which is similar to cut-in speeds for other commercial turbines. openWind's time series energy capture process was then used to produce an 8,760 hourly gross energy production time series for each of the 14 predefined sub-regions of the project. Each of the resulting time series was representative of the gross energy production of a single turbine in the respective sub-region over the one-year timeframe of the inputted mast data.

Using the 14 gross energy production time series and time estimates for sunrise and sunset for each month (rounded to the nearest half hour), the amount of time throughout the year that energy was being produced within each sub-region during daylight hours was calculated. Energy production is being used as a proxy for rotating turbines; no energy is produced if the wind speed is below cut-in or above cut-out, during which times the turbines would not rotate. The exception would be at low speeds below cut-in, when the turbines may rotate slightly but produce no energy; these times are not included in this analysis due to the very low speed of rotation. The annual total number of hours in each sub-region when the turbines are producing energy during daylight hours was then divided by the total number of possible daylight hours. The results for the sub-regions range from 96.0% to 98.7%. The project-wide average was then calculated by weighting the individual sub-region results by the number of turbines within each sub-region. The resulting annual average percentage of daylight hours that the Chokecherry and Sierra Madre Wind Project is expected to generate energy is 97.1%.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

In Reply Refer To:
06E13000/WY12CPA0203

SEP 20 2012

Mr. Garry L. Miller
Vice President, Land and Environmental Affairs
Power Company of Wyoming LLC
555 Seventeenth Street, Suite 2400
Denver, Colorado 80202

Dear Mr. Miller:

On August 14, 2012, we received an updated eagle conservation plan (ECP) from the Power Company of Wyoming (PCW) for the Chokecherry and Sierra Madre Wind Energy Project in Carbon County, Wyoming (Project). If a project proponent submits an application for a Federal permit for non-purposeful eagle take (50 CFR 22.26), the ECP serves as an attachment to the application package. Consequently, the ECP should include a level of information and detail necessary for the U.S. Fish and Wildlife Service (Service) to give the permit application full consideration. The Service's Land-based Wind Energy Guidelines (2012) and Draft Eagle Conservation Plan Guidance (2011) help inform the development of the ECP. Moreover, close and consistent communication with the Service is imperative. We reviewed the ECP from August 14, 2012, and find it begins to address a number of important topics, however we identify numerous deficiencies in the ECP that should be addressed in order for the Service to fully assess the proposed project. Even though our review of the ECP is incomplete, the Service articulates several major concerns below. The following issues should be addressed prior to submitting an application for a programmatic eagle take permit (50 CFR 22.26).

At the outset, the Service feels the cover letter does not correctly describe the relationship between the Service's decision on the August 14, 2012, ECP and the BLM's action to issue a Record of Decision (ROD) for the "project-landscape level" final environmental impact statement (FEIS). As we understand the BLM instructional memorandum, IM-2010-156, the BLM cannot issue a "Notice to Proceed" without a decision by the Service on the avian protection plan[1] (also known as a bird and bat conservation strategy or BBCS). For this Project,

[1] While the IM specifically mentions an avian protection plan—and PCW has indicated that one will be developed for this Project—the avian protection plan will be supplemented with an ECP due to the high likelihood of eagle take associated with the Project.

however, the ROD does not serve as a notice to proceed; instead, the BLM will tier additional NEPA review (e.g., environmental assessments) for each site-specific plan of development to the FEIS and ROD. After completion of the additional NEPA on the site-specific plans of development, the BLM would then be in a position to issue a notice to proceed.

Major Points of Concern

- The Service believes that there are additional opportunities to avoid and minimize impacts to eagles and other migratory birds that have yet to be included in the ECP or fully explained as to why they are either unnecessary or that they cannot be implemented.

- Data collection efforts to date provide minimal spatial coverage of the project footprint. The Service's Eagle Conservation Plan Guidance Version 2 Appendices (2012) recommends at least 30% of the area within 1 km of turbines be considered as the total km^2 area to be covered by 800-m radius point count plots (with a sample area for each plot of 2 km^2).

- Although the Service understands that this project-landscape level ECP cannot provide final eagle fatality estimates for several reasons, please be advised that all subsequent site-specific ECP's submitted with any eagle take permit applications must include final eagle fatality predictions. Site-specific ECP's also must include separate fatality predictions for both golden eagles and bald eagles.

- The Service understands that this project-landscape level ECP cannot provide a detailed analysis that demonstrates how predicted eagle fatalities will be offset through compensatory mitigation. However, all future site-specific ECP's submitted with any eagle take permit application must include a thorough analysis including the efficacy and extent of compensatory mitigation necessary to completely offset predicted golden eagle fatalities, as well as firm commitments to implement the compensatory mitigations and a demonstrated ability to do so.

- The current ECP does not anticipate the need for or propose compensatory mitigation (e.g., power pole retrofits) until after eagles have been killed and not until "anticipated impact levels [e.g., fatalities] are exceeded" which is inconsistent with Service policy and regulations.

- The ECP lacks a full assessment of potential impacts to bald eagles.

Avoidance and Minimization

On August 10, 2012, the Service issued a letter to PCW that identified locations within the Project area that the Service believes are potential high eagle use areas. The proposed avoidance areas in the ECP include some areas of high eagle use but do not include or address all areas identified in the Service's letter. For example, the ECP would allow numerous turbines to be built adjacent to an active golden eagle nest in the southwest corner of Sierra Madre portion of the Project. Currently, the ECP does not propose avoidance and minimization measures for this

nest; therefore, the risk for eagle fatalities and nest abandonment is extremely high. This and several additional examples presented in the Service's August 10, 2012, letter should be addressed by the ECP. The Service believes that there are additional opportunities to avoid and minimize impacts to eagles and other migratory birds that have yet to be included in the ECP. If PCW believes that any of the specific eagle and migratory bird concerns raised by the Service—including related recommendations to avoid and minimize potential impacts—are unfounded, then PCW should provide specific information as to why this is the case. Similarly, if PCW believes that avoidance and minimization is not possible and that associated take is unavoidable, then PCW should provide information supporting why such take is unavoidable.

The kernel density approach forms the basis for the avoidance areas (pp. 90-91); however, from a statistical standpoint, the underlying data used to develop the kernel analysis are insufficient. In particular, the point count locations and subsequent eagle flight path data do not provide adequate spatial coverage of the Project area. Because large portions of the Project area were not surveyed, it is possible there are additional areas of high eagle use not currently included in the avoidance areas identified in the ECP. Assuming the kernel analysis has merit, a visual comparison does not appear to show a clear relationship between the kernel analysis and all areas of high density eagle use. For example, the kernel analysis identified an area of high eagle use around Miller Hill (p. 74), but this area was not included in the avoidance map and did not result in modifications to turbine layout. Because avoidance and minimization must reduce the take of eagles to a level that is "unavoidable" (50 CFR 22.26), the ECP should identify and include all areas of high eagle use in avoidance areas or explain why such areas cannot be avoided. If PCW believes that avoidance and minimization is not possible and that associated take is unavoidable, then a clear explanation should be provided.

The ECP makes conclusions regarding eagle foraging locations, foraging behavior, and value of foraging areas, however there is little actual data or supporting documentation regarding prey items being used, foraging locations, and foraging behavior. However, there are conservation measures described in the draft ECP which propose to protect the prey base and are tied to specific locations. This lack of supporting information makes it is unclear if the conservation measures proposed will be effective.

In our letter of August 10, 2012, we expressed concerns about the state of knowledge regarding eagle foraging areas and concentrated prey base and how these may influence avoidance areas. Based on new information from ongoing prey base surveys (p. 41), the avoidance areas in the ECP may need further consideration, including the realignment or removal of turbines. Because of ongoing efforts to collect data on the prey base, the Service cannot adequately fully analyze PCW's efforts to avoid important foraging areas for eagles.

The ECP does not identify whether efforts were made to detect winter roost sites. If PCW has collected these data, it should be included in the ECP. If PCW has not made this effort, they should consider implementing a protocol to collect information on roost sites. Based on the information from these efforts, avoidance and minimization measures should be developed accordingly and included in the ECP.

The ECP provides avoidance and minimization measures that are unproven (e.g., adjusting turbine cut-in speeds) and others that have the potential to harm eagles (e.g., installing sound devices to disorient eagles). Avoidance and minimization measures included in the ECP should be limited to those for which a benefit to eagles has been demonstrated.

The Service does not support moving eagle nests that are near areas of desired turbine placement. In addition, removing the nest does not address the underlying issue that the habitat is desirable to eagles, and would likely continue to attract eagles and receive continued use in the future.

The ECP does not specifically address eagle disturbance issues, as "disturb" is a form of take under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). One particular example is the golden eagle nest in the Southwest corner of Sierra Madre, in which turbines are proposed to be built in close proximity to the nest. Based on the location of these turbines, nest abandonment is possible. Also, while the ECP discusses the juxtaposition of nests with likely/proposed turbine locations, it does not with respect to other project developments such as roads, staging areas, and power lines.

Data Collection

The ECP describes the collection of radar data and cites how these data helped provide up to 100 percent coverage of the project area as well as a "detailed assessment of patterns of spatial and seasonal use across the entire Project Site" (p. 65). However, the Project proponent stated in a meeting at the FWS Regional Office in Lakewood, CO that results from the radar work have limited utility and should not be used. The ECP should be very clear about the limitations of the radar data. If the radar data are used to support conclusions in the ECP, the use of the radar data, including limitations, should be described in the ECP.

The ECP concludes that it is appropriate to use observations of eagles out to 4,000 meters from the observer to identify areas of high eagle use, even though the highest detection probabilities occurred within 1,000 meters of the observer (p. 35). Observations out to 4,000 meters are used to assert that the long-watch data (with radar data) provide 100 percent coverage of the Project area. Additionally, these data were used to "complete a kernel density analysis to identify areas with the highest probability for eagle and other raptor use" (p. 65). The underlying assumption in using these data to identify areas of the highest eagle use is that any difference in the observed eagle activity is due to actual eagle use and not the detectability of the eagle. However, it is just as likely that a significant portion of the difference in eagle activity, and hence the identification of high eagle use areas, is actually due to the observer's ability (or inability) to detect eagles at distances up to 4,000 meters.

Recommendations in the draft ECPG and in other literature (e.g., Strickland 2011) establish that point count surveys for eagles and other large raptors should not exceed 800 meters (0.5 mile). While observations can be recorded at distances greater than 800 meters, they should be analyzed separately to avoid concerns about observer bias (Service 2011; Strickland 2011). Because the ECP uses data collected out to 4,000 meters to inform the kernel density analysis, it is possible the ECP has not identified all areas of high eagle use.

In addition, there are portions of the vast Project area where there are no recorded observations of eagle activity. While this lack of observation could be due to the lack of eagle activity, it is equally plausible the void is due to lack of survey effort in these locations. If the latter is true, this means portions of the Project footprint may have areas of high eagle use that are not identified in the kernel density analysis. Overlooking one or more areas of high eagle use due to inadequate survey effort will lead to a flawed assessment of avoidance areas and could lead to higher than predicted eagle fatalities.

Based on the Service's evaluation, only 3.5 percent of the Project's 215,233 acres (871 square kilometers) (p. ii) were covered by the fifteen 800-meter point counts during Year 2 surveys. This is substantially less than the minimum spatial coverage of at least 30 percent of the project footprint recommended in the ECPG (Service 2012) and is far from the 100 percent coverage described in the ECP. Additional data collection is ongoing, including an effort to survey at least 30 percent of the Project footprint with 800-meter point counts using a spatially-balanced design. Increasing spatial coverage of the Project area will reduce uncertainties about eagle use across the landscape and will better inform the models used to predict eagle fatalities.

Predicted Eagle Fatalities

The ECP predicts that the Project will result in eight to twelve eagle fatalities per year. This estimate is considerably lower than both the range of predicted fatalities provided in the BLM's FEIS of 46 to 64 eagles annually (BLM 2012) and the mean number of annual fatalities predicted by the Service using a Bayesian method described in the appendices to the draft ECPG (Service 2012).

The ECP acknowledges that the parties continue to work on the fatality estimates, including additional data collection, validation of the fatality models, and refinement of the fatality estimates based on avoidance and minimization. Because these efforts are ongoing, the Service understands that this project-landscape level ECP cannot provide the final eagle fatality predictions or the related detail on the compensatory mitigation required to offset the predicted take. However, in order for the Service to process an eagle permit application, all future site-specific ECP's must include a final eagle fatality prediction, with separate eagle fatality predictions for both golden and bald eagles.

The fatality estimate provided in the ECP raises several concerns. First, the ECP criticizes the WEST regression analysis that was used to calculate the fatality estimates in the BLM FEIS (pp. 76-79), concluding that it "does not represent the best available science for purposes of eagle fatality estimation" (p. 78). However, the ECP goes on to use the WEST regression model to develop the estimate of eight to twelve eagle fatalities per year using "Year 2" data rather than the "Year 1" data that were presented in the FEIS. The Service is concerned about this apparent discrepancy in the use of the WEST data and the issue should be resolved before any subsequent analysis.

At this point, we will not comment on whether the WEST regression does or does not represent the best available science; however, the Service has developed a model to predict eagle fatalities

at wind projects in conjunction with numerous experts and with peer review. The Service will continue to make science based and data dependent refinements to its model as more information becomes available, including post-construction monitoring data for operational wind facilities. A review of all available fatality models to date suggests that the Service's model best addresses numerous uncertainties and that it can be used to meet the regulatory permitting requirements.

Lastly, there are concerns about the adequacy of the data used to run the models. For example, only one year (i.e., labeled as "Year 2") of data were included in the model of projected eagle fatalities; "Year 3" surveys are underway but the ECP does not include this information (p. 34). Although the ECP references "Year 1," Year 2, and Year 3 surveys, only one full year of surveys (i.e., Year 2) is actually completed and available for use in the fatality prediction. The ECP describes Year 1 surveys as pilot surveys to help design latter surveys, and the ECP acknowledges that the information gathered in "Year 1" is not compatible with data from later years. Year 3 surveys began in late spring 2012 and are designed to extend to spring 2013. Consequently, information in the ECP from Year 3 represents only a few months; these surveys are substantially incomplete. Because data are still being collected that will inform the models and ultimately the amount of compensatory mitigation, it is premature to finalize a fatality estimate for this project-landscape level ECP using the existing data.

Compensatory Mitigation

When the Service considers an application to take eagles the Service evaluates avoidance and minimization measures in an ECP as well as a detailed analysis and description of the compensatory mitigation necessary to completely offset golden eagle fatalities[2] resulting from the Project. We recognize PCW and the Service have not agreed to fatality estimates for the project and therefore that identifying the amount or type of compensatory mitigation is not possible at this time. Hence, the Service recognizes why this project-landscape level s ECP does not include a commitment to implement specific measures of compensatory mitigation and does not describe the amount, type, methods and monitoring of the compensatory mitigation. We understand that subsequent ECP's will be submitted by PCW on a site specific basis in association with eagle take permit applications for future development. Consequently, we stress the importance that a complete analysis and description of compensatory mitigation be included in any future site-specific ECP's. Additionally, these site-specific ECPs should include provisions for how PCW will address the possibility that actual eagle fatalities from the Project exceed the predicted number of eagle fatalities in the ECP.

The current ECP does not anticipate the need for or propose compensatory mitigation (e.g., power pole retrofits) until after eagles have been killed and not until "anticipated impact levels [e.g., fatalities] are exceeded" (p. 100). This approach is contrary to guidance in the draft Eagle Conservation Plan Guidance (ECPG), which states that compensatory mitigation must occur prior to a wind project becoming operational (Service 2011, p. 30). It is very important to note, for golden eagles, the maximum cumulative take is zero (Service 2009); therefore, compensatory mitigation is required up front because wind projects must meet the statutory and regulatory

[2] At this point, we do not anticipate the need to provide compensatory mitigation for bald eagle fatalities that might result from the Project; however, this does not eliminate the need for PCW to avoid and minimize bald eagle fatalities to the maximum extent practicable (50 CFR 22.26).

eagle preservation standard of stable or increasing breeding populations (Service 2011, p. 30). While the ECP can include provisions for additional compensation to address unforeseen or extremely unlikely events, for the Service to issue an eagle take permit the ECP must include compensatory mitigation that will completely offset predicted eagle fatalities prior to the project becoming operational.

For any future site-specific ECP's developed as part of an eagle take permit application the Service recommends that all proposed compensatory mitigation measures, such as power pole retrofits, should be supported by a resource equivalency analysis (REA) or other quantitative methods. The Service recognizes the REA as a reliable, transparent, reproducible, and cost-effective tool to expedite wind power permits, while ensuring sufficient compensatory mitigation; however, project developers may use different compensatory mitigation modeling methods (Service 2012, p. 65). Regardless of the methods used, future site-specific ECP's will need to provide sufficient evidence and tools (if necessary) to ensure that the Service can provide appropriate review of the results to ensure the proposed compensatory mitigation for the Project meets the regulatory permitting requirements.

If power pole retrofits, or other mitigation actions deemed appropriate by the Service, are used for all or part of compensatory mitigation included in future site-specific ECP's then these documents also should demonstrate a commitment to implement those actions. Knowing what compensatory mitigation opportunities are available for implementation and having the ability to complete the compensatory mitigation are two separate issues. In future site-specific ECPs, PCW will need to clearly identify how much of any given type of compensatory mitigation is needed, and should demonstrate the ability to implement these mitigation actions.

Bald Eagles

The ECP does not adequately address bald eagles; of particular concern because it appears bald eagle activity within and near the Project area has increased in recent years (pp. 49-51). If bald eagle numbers and use of the site continue to increase, it will be important to identify high use and avoidance areas specifically for the bald eagle (other than Rasmussen Lake). For example, greater sage-grouse were found in bald eagle nests (p. 95), presumably as prey items; therefore, it would be important to understand where bald eagles are foraging for the grouse and whether proposed turbines would be located in flight paths between bald eagle nests and/or roosts and foraging areas (e.g., fish, grouse, waterfowl, carrion). Information about bald eagle use of the Project area, such as foraging areas and travel corridors, will help inform avoidance areas and other avoidance and minimization measures for bald eagles.

As currently presented, it is unclear whether the kernel density approach lumped golden eagle and bald eagle data together. If species observations are lumped, the areas currently identified as high eagle use areas might not fully address bald eagle use of the Project site. This is especially true if golden eagle observations overwhelmed bald eagle sightings in the kernel estimator (see additional concerns above about the kernel density analysis). The ECP should ensure that avoidance and minimization measures and avoidance areas are valid for bald eagles. Additionally, subsequent site-specific ECPs, associated with future project-related development, will need to provide a bald eagle fatality prediction.

Interpretation of Service Policy Documents

The ECP states that this Project is a Category 2 project (p. vii). The document further states the Service agrees with this by citing the Service's April 2011 letter to BLM stating we agreed development of an APP would be an appropriate action to take. We do not believe PCW has correctly interpreted our letter of April 2011. The letter stated that preparing an APP would be an appropriate mechanism to address impacts to migratory birds and eagles, provided that we had three years of data collection and that the Project included sufficient avoidance and minimization (e.g., 4-mile buffer around eagle nests); it did not suggest that the Project was a Category 2 project. As we clearly stated in these comments, the ECP does not yet include sufficient avoidance and minimization as described in the letter of August 10, 2012.

Many of the advanced conservation practices (ACPs) in the ECP are simply best management practices. The ECPG acknowledges the difficulty of developing scientifically based ACPs, and states that they will be developed with input from the Service (Service 2011). The Service stands ready to assist PCW in this effort.

We are concerned that the ECP repeatedly makes statements or generalizations about eagles but does not provide data or literature for support.

The ECP states, "The ACPs outlined in this section meet the Stage 4 objectives in the Draft ECP Guidance" (p. 87). The Service respectfully disagrees with that assertion at this time.

The ECP calculates a Project-area population of 18 to 28 eagles (p. 82), which is comprised of adults and young from active nests during 2011 and 2012, as well as a few floater eagles. Based on the low number of sub-adult eagles in the Project area and data suggesting little migratory behavior, the ECP suggests that only 18 to 28 eagles are at risk (p. 82). The ECP assumes these birds are year-round residents; however, the ECP presents little evidence to support this assumption, and it does not account for the possibility that neighboring eagles could venture within the Project area. The Service is unaware of any population study designed to estimate the number of eagles (resident or migrant) in the Project area.

Post-Construction Monitoring and Adaptive Management

The ECP presents methods for post-construction monitoring but does not provide the length of time they intend to do this. This is an important consideration in evaluating the adequacy of the ECP. Also, the post-construction monitoring plan should be developed in coordination with the Service.

The ECP has not fully developed the adaptive management process (for risk reduction), and the tiered approach to reduce risk to eagles is inadequate and even runs counter to regulations and the draft Eagle Conservation Plan Guidance (January 2011):

- For example, Tier 2 measures will be implemented if anticipated impacts (i.e., eagle fatalities) are exceeded. Tier 2 measures include utility power pole retrofits and carcass

removal on surrounding highways; however, these are examples of compensatory mitigation that must be implemented prior to eagle fatalities rather than after the fact;

- In addition, placement of these measures in Tier 2 (i.e., after eagles have been killed), is another example of how the ECP does not anticipate the need for compensatory mitigation in an application for an eagle take permit; and

- The removal and relocation of eagle nests is included as a Tier 3 measure to reduce risk; however, as stated earlier, this is not appropriate as it is another form of take and removing the nest does not address the underlying issue that the habitat is desirable to eagles.

Additional Data Gaps

The ECP states that the Project avoids the North Platte River area because that area provides important foraging and wintering habitat (p. 57). Documentation or data should be provided in the ECP to support these statements.

The ECP's reference to concentrated eagle use of the central basin (p.65) is not documented in the ECP.

The ECP asserts that key foraging areas are located outside of the wind development areas (p. 68); however, information to support this conclusion is not provided. Statements concerning activity and movements within the wind development areas are characteristic of movement between nests and roosting and foraging locations isn't supported with information (e.g., roosts and foraging locations are not identified).

The ECP reports some discrepancies exist in reported survey results for fossorial prey (pp. 68-69); this issue needs a definitive resolution.

The statement that sage grouse "core areas represent the most important foraging locations" within the vicinity of the Project is not supported by information presented in the ECP (p. 71).

The ECP states winter eagle use is closely tied to the availability of winterkill carcasses along area highways (p.74). This seems like an intuitive assumption, but no information is given to support this conclusion.

The ECP states foraging locations fall outside of the wind development areas (p. 74); however, no quantified or objective information on foraging locations is given. The ECP also states very little foraging behavior occurs within the wind development areas, but is unclear how this type of information was collected and no documentation is provided.

The Service recognizes development of an ECP is a rigorous, yet necessary endeavor given the high standards required for our consideration of any subsequent Eagle Take permit application. Therefore, we stand ready to discuss these issues with you and Regional leadership at our regional office in Lakewood, Colorado at your convenience. If you would accept this invitation,

please contact our office in Cheyenne to secure a meeting date and time. If you have specific questions regarding this letter, please contact Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 231.

Sincerely,

R. Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc: SWCA, Jon Kehmeier (via e-mail)
BLM, Pam Murdock (via e-mail)
BLM, Mike Valle (via e-mail)
FWS, Pam Repp (via e-mail)
FWS, Casey Stemler (via e-mail)

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VIA EMAIL: Tyler_Abbott@fws.gov

September 26, 2012

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Tyler:

Attached is a Supplement to Eagle Conservation Plan Addressing Estimated Eagle Fatalities for the Chokecherry and Sierra Madre Wind Energy Project. This Supplement to the Eagle Conservation Plan addresses: (a) eagle use data for the Project; (b) the eagle fatality estimates for the Project derived by the Service using its Eagle Fatality Model (Service's Model); (c) the eagle fatality estimates for the Project as re-designed with turbine no-build areas using the Service's Model; and (d) the assumptions used in the Service's Model, including eagle flight heights.

The Supplement describes the process utilized to analyze data and estimate eagle fatalities based upon PCW's re-designed project and the company's commitment not to place turbines in designated turbine no-build areas as set forth in the Eagle Conservation Plan submitted to the Service on August 14, 2012 and the attached ECP Supplement. The Supplement also incorporates the September 7, 2012 and September 12, 2012 expert reports of Dr. Joshua J. Millspaugh, which have been previously provided to the Service.

If you should have any questions, please let me know. Thank you.

Sincerely,

/s/ Garry L. Miller

Garry L. Miller
Vice President, Land and Environmental Affairs

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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Cheyenne, Wyoming 82009

In Reply Refer To:
06E13000/WY12CPA0215

SEP 28 2012

Mr. Garry L. Miller
Vice President, Land and Environmental Affairs
Power Company of Wyoming LLC
555 Seventeenth Street, Suite 2400
Denver, Colorado 80202

RE: Eagle Use Sampling Considerations and Recommendations for the proposed Chokecherry-Sierra Madre Wind Energy Development Project

Dear Mr. Miller:

On July 24, 2012, the U.S. Fish & Wildlife Service's (Service) Wyoming Field Office met with the Power Company of Wyoming (PCW) to discuss the Chokecherry Sierra Madre Proposed Wind Energy Facility. During that meeting—and in a subsequent letter of August 10, 2012—the Wyoming Field Office expressed concern about the spatial coverage provided by the small number of survey data points during previous sampling efforts that were used to characterize eagle use across the entire project landscape. Of particular concern was the utility of these data to inform modifications in project design and turbine siting for avoidance and minimization of project-related impacts to eagles and their habitat.

This letter transmits the Service's survey recommendations that we committed to provide in our letter of August 10, 2012. Additionally, we include comments on the proposed 2012-2013 800-meter Raptor Survey Protocols provided by PCW on August 31, 2012. In order to clarify differences between our survey recommendations and the protocol proposed by PCW, we include a comparison between these two: while some of our recommendations included in this letter are already found in the protocol provided by PCW, we provide recommendations to address any differences that still remain.

The overall purpose of these recommendations is to facilitate collection of additional avian survey data that will: (a) confirm or refine eagle and raptor avoidance areas by increasing our understanding of eagle and raptor use across the project area, and (b) increase spatial coverage of data collection within the proposed project area in order to better characterize eagle use within the project site. These data, in conjunction with previously collected data, will be useful to inform conservation measures developed to avoid and minimize impacts to eagles within the proposed project area, and will be incorporated into the Service's eagle fatality model. To this end, we provide the following recommendations:

(1) We recommend focusing sampling efforts within the most recently proposed project footprint in order to quantify eagle use in areas where turbines are planned for location. By collecting eagle and raptor use data in areas of likely development, we believe it will be easier to obtain a more reliable estimate of risk to eagles in these areas, from which more informed, site-specific, predictions can be made.

(2) Although we recommend concentrating sampling effort within the project footprint as stated above, we believe it also would be prudent to establish additional sample points outside of the currently proposed footprint in areas of potential development. Adding points in areas of possible alternative turbine layouts will provide data to assess the impact of those alternatives, which may be necessary if survey results identify areas of high eagle use within areas currently proposed for development. Without eagle use data outside of the proposed footprint, it would be difficult to show that the relocation of turbines outside of the currently proposed project footprint would avoid and minimize impacts to eagles. Without these data, the only likely alternatives would be a reduction in the total number of turbines, or a reduction in the spacing between turbines in areas where avian and raptors surveys were conducted.

(3) We recommend resampling at least fifty percent of the raptor point counts from previous years: this will help distinguish between apparent changes in documented eagle use caused by different point locations and associated differences in detectability, versus actual changes in habitat use. This is an important consideration, because the number of eagles and their location on the landscape is likely to vary across years (e.g., not every nest is active every year), making it difficult to account for inter-annual variability, which might lead to inaccurate conclusions about the risk of eagle fatalities. For example, observing fewer eagles at a second set of survey points could be misinterpreted as an area of lower eagle use, when in fact the number of eagles and eagle use across the landscape decreased due to other factors. In this example, the use (and hence risk) might have been the same for all survey points, but sampling different points across years would lead to the erroneous conclusion. Resampling some points across years can reduce this uncertainty by creating an index or allow for scaling of observations across years.

(4) Previous long-watch raptor surveys were based on an unlimited radius, and analysis of data from these surveys suggests that the detectability of eagles dropped off after 600 to 800 meters. We recommend using a distance of no more than 800 meters for point counts intended to collect data on eagles and other large raptors. This recommendation is found in our draft Eagle Conservation Plan Guidance (Service 2012, Appendix C, p. 18) and in other literature (e.g., Strickland et al. 2011). While it is acceptable to collect data on eagles and other raptors beyond 800 meters (e.g., location, flight height, flight path)—since they may be useful to identify travel corridors and areas of eagle use—the collection of this information should not distract surveyors from collecting data within the 800-meter point count. In addition, because only those data collected within 800 meters will be used in the models to predict eagle fatalities, data collected at distances more than 800 meters should be separated from data collected within 800 meters.

(5) Based on recommendations in the draft Eagle Conservation Plan Guidance, the sampling goal should provide a "minimal spatial coverage of at least 30% of the project footprint" (i.e., the total area sampled in any given year should be thirty percent of the total project footprint) (Service 2012, Appendix C, p. 18). We recognize that even this level of effort will not provide specific information for seventy percent of the project area; however, it may be assumed that the information is representative of the remaining project area, provided the sample points are appropriately located (e.g., stratified and spatially-balanced). To achieve the desired goal of at least 30 percent coverage of the Chokecherry Sierra Madre Proposed Project footprint, we calculate up to 70 survey points are needed, depending on how the project footprint is portrayed.

(6) We recommend sample locations be stratified by features of the landscape that may influence eagle and raptor activity, such as distinct geographic/topographic elements (e.g., escarpments), vegetation (if appropriate), and concentrated prey base. Doing so will allocate sampling points across the project in proportion to their occurrence on the landscape. A common sampling design in use today is the generalized random tessellation stratified sampling design (GRTS). We remain concerned that there is insufficient information about eagle habitat use associated with important eagle use areas including: active nests; concentrated prey base including grouse leks, prairie dog colonies, and reservoirs; as well as topographic features such as Miller Hill. Therefore, we recommend that some sample points be located near these important eagle use areas. Doing so would help with identifying additional avoidance areas or alleviating concerns for increased risk associated with these areas.

(7) Based on recommendations in the Service's Eagle Conservation Plan Guidance, count periods should be one to two hours long (Service 2012, Appendix C, p. 18). If longer survey periods are used (e.g., four to six hours), the surveys should be divided into smaller units such as one or two hour blocks (or the actual time of eagle observations recorded), so that the influence of time of day can be evaluated (e.g., in relation to when turbines are inactive).

(8) We recommend the protocol include a representative distribution of sampling events across all daylight hours across all point locations and seasons. Collecting data "evenly" across time and space should reduce any potential bias associated with locations, seasons, and time of day. This may also make it possible to evaluate how time of day influences eagle use of the site or when eagles are more likely to use specific topographic features. In addition, surveys should include multiple sampling events in each season per point.

(9) We recommend locating survey sampling points at least 800 meters (0.5 mile) from active eagle and ferruginous hawk nests to limit disturbance. It may be possible to reduce this distance if topographic features create a visual barrier between observers and the nest.

(10) We recommend data collection include identification of eagle species and their flight minutes within the 800-meter point count. Additional data collection could include, but should not necessarily be limited to (in relative order of importance): age and sex (if

possible), flight path, flight behavior (e.g., soaring, kiting), activity (e.g., territory defense, foraging), interactions with other birds, flight height, obvious prey items, time observed outside of the 800-meter point count, and time perched. It is acceptable to record detections beyond 800-meter as these can provide additional information about eagle and raptor use of the project area. However, collecting data beyond 800-meters should not detract from observations made within the 800-meter point count.

(11) We recommend collecting data on all raptors to the extent feasible; however, collecting data on other raptors should not preclude the collection of data on eagles.

(12) Based on eagle use data collected between April of 2011 and April of 2012, eagle activity relative to sampling effort appears to be higher in the winter and summer periods (Table 1). Higher eagle activity in the summer likely corresponds to the time during which adults are actively feeding young and when young are learning to fly. Higher eagle activity in the winter may be related to the presence of migrant eagles, or could be due to the location of survey points. Because data were not collected following the above recommendations during the summer of 2012, we recommend the collection of eagle and raptor use data continue through the 2013 nesting season (at least through August of 2013) to evaluate this potential season of higher use.

Table 1. Seasonal point count data for April 2011 through April 2012.

	Minutes of	Eagle Minutes		Eagle Minutes/Unit Effort	
Season	Observation	800 m	6400 m	800 m	6400 m
Spring	50,166	290	245	0.0058	0.0049
Summer	10,653	71	43	0.0067	0.0040
Fall	51,426	227	409	0.0044	0.0080
Winter	17,505	141	316	0.0081	0.0181
Total	129,750	729	1,013		

Comparison with Service Recommendations

The methods described in the "2012-2013 800-meter Raptor Survey Protocols" provided by PCW already include many of the recommendations provided above, such as the use of 800-meter point counts, survey duration of two hours, and survey coverage across all daylight hours. There are, however, a few differences between our recommendations and the protocols submitted by PCW that should be addressed as follows:

(1) Consistent with the draft Eagle Conservation Plan Guidance, we recommend a minimum of 30 percent coverage of the project footprint. This could include up to 70 points depending on how much area is included in the project footprint. Using information from the document (i.e., 65 points = 34.7 percent of the area), we calculate that 54 survey points would be needed to reach 30 percent coverage rather than the 40 points described in the document. Increasing the number of survey points will provide fine-scale data to better understand habitat use of the site by eagles, which is important in developing

avoidance areas and in siting turbines. It is also important to consider, in advance, how the data from the sampling scheme will be extrapolated to the Project site; therefore, we recommend providing a description of this in the protocol.

(2) Similar to the protocol submitted by PCW, we recommend focusing sampling efforts on the proposed project footprint; however, we also recommend including some survey points in areas outside of the current footprint to identify alternative locations if turbines need to be relocated away from areas currently proposed for development. These would be additional points, however, and should not replace survey data points needed to obtain the 30 percent coverage of the project footprint.

(3) We also recommend resampling at least fifty percent of the raptor point counts from previous years to allow comparison of eagle use across years. Based on Figure 1 of the protocol submitted by PCW, it may be possible to move some survey points a short distance so that they overlap with previous counts, but it may be necessary to incorporate some of the previously sampled points into the design.

(4) We recommend a spatially balanced design, such as stratification by landscape features, particularly the landscape features that influence eagle and raptor behavior. See recommendation number 6 above for details. This approach may already be included in the protocol provided by PCW, but it should be described explicitly.

(5) At present, surveys are tentatively planned to occur once per month between December 2012 and March 2013. We do not believe that this level of effort is sufficient to document winter eagle use, especially if there are short windows of higher use. We understand the need for safety and recognize that some locations may be inaccessible. However, results from the previous year suggest winter is also the season with the highest eagle use (Table 1), so it is important to collect data across the Project site to assess this use, otherwise predictions of use and fatalities may be inaccurate. To address concerns with limited survey data during winter months, we recommend all locations be sampled multiple times and that at least half of the locations be sampled at least twice per month. In addition, we encourage surveyors to record eagle observations while moving between survey points to help identify specific areas that receive eagle use during the winter months.

(6) The document anticipates survey efforts through March 2013 with the possibility of surveys beyond this month. Because of higher use during the summer months (i.e., during the breeding season), and because of the extremely low amount of temporal coverage during these months in 2012, we recommend sampling efforts continue through at least August 2013 to cover the breeding season. Without data from 2013, it would be necessary to use the limited data collected in 2012 to calculate eagle use during the late spring and summer months (i.e., April through August).

Comments on the "2012-2013 800-meter Raptor Survey Protocols" from PCW, dated August 31, 2012

(1) In several locations, the document states that it was "fully compliant" with recommendations by the U.S. Fish and Wildlife Service (Service). First, it is important to understand that the draft Eagle Conservation Plan Guidance is voluntary; consequently we prefer to use the term "consistent with" rather than "compliant with" when describing recommendations found within the Eagle Conservation Plan Guidance. Second, we do not believe that the protocol provided by PCW is, in fact, consistent with the Eagle Conservation Plan Guidance for numerous reasons, one key reason being that the limited number of 800-meter survey points do not provide the recommended minimum 30 percent coverage of the project footprint. Additionally, we do not believe it is scientifically justifiable to combine survey points from multiple years in order to meet the minimum recommended standard of 30 percent coverage: the minimum 30 percent coverage should occur within each individual year.

(2) The document makes a definitive statement about "unrealistic projections" concerning eagle risk. This statement is based on several assumptions, including that previous survey efforts correctly identified areas of high eagle use. One of the reasons for increasing the spatial coverage in 2012-2013 is to increase our confidence in understanding eagle and raptor use across the Project area. Because substantial uncertainty exists as a result of the limited amount of spatial and temporal survey coverage used to document impacts and relative risk to eagles, the Service believes our projections concerning risk to eagles are realistic and clearly demonstrate the need for increased coverage. In addition, our letter of August 10, 2012, identified numerous areas of potential high eagle use that are not currently included in the avoidance areas, such as the golden eagle nest in the southwest corner of Sierra Madre. Our letter also identified the presence of high density prey base, proximity of sage grouse leks and other habitat features that are used by eagles. Because these habitat features (and others) are not included in the proposed avoidance areas, the projections of risk and high eagle fatalities identified by the Service are possible.

(3) The document states that 34.7 percent coverage of the project site and that this is greater than the 30 percent recommended by the Service. As stated above, we do not believe that it is scientifically justifiable to combine survey points from multiple years in order to meet the recommended minimum standard of 30 percent coverage; the minimum 30 percent coverage should occur within each individual year.

(4) The data sheet attached to the protocol provided by PCW does not appear to have a means of recording flight path in data. It should be clear how flight path data will be collected on the existing data sheet, or additional datasheets should be included if there is more than one.

If you have specific questions regarding this letter, please contact Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 231.

Sincerely,

for R. Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc: SWCA, Jon Kehmeier (via e-mail)
BLM, Pam Murdock (via e-mail)
BLM, Mike Valle (via e-mail)
FWS, Pam Repp (via e-mail)
FWS, Casey Stemler (via e-mail)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
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Mr. Garry L. Miller
Vice President, Land and Environmental Affairs
Power Company of Wyoming LLC
555 Seventeenth Street, Suite 2400
Denver, Colorado 80202

Dear Mr. Miller:

This letter provides the U.S. Fish and Wildlife Service's (Service) recommendations to avoid and minimize impacts to golden eagles at the proposed Chokecherry Sierra Madre Wind Energy Facility (CCSM). Our goal in providing these recommendations to the Power Company of Wyoming (PCW) is to contribute to maintaining stable or increasing breeding populations of golden eagles by implementing conservation measures that will maintain golden eagle breeding territories and by minimizing impacts to important eagle use areas (e.g., eagle nests, foraging areas, and communal roosts; 50 CFR, Part 22). These recommendations also should benefit numerous other raptor species, because many raptor species use the same habitats and features as golden eagles. While we outline our overall avoidance and minimization framework for golden eagles, we also provide examples of how these recommendations should be applied to the CCSM. We encourage PCW to follow these recommendations and take all steps necessary to avoid and minimize take of eagles to the maximum degree practicable such that any remaining take is unavoidable despite application of advanced conservation practices developed in coordination with the Service.

The recommendations in this letter are similar to those we provided in our letter of August 10, 2012. We acknowledge your response letter of December 11, 2012, and we appreciate your comments and explanations therein. Our August 10th letter did not specify the size of buffers or identify specific areas to avoid, though we suggested using an estimate of the average golden eagle territory size as a starting point for buffering active nests. In an attempt to be more explicit in our approach and recommendations, we reiterate many of our previous overarching recommendations below in greater detail and clarity.

Because CCSM has important eagle-use areas within its project footprint, the CCSM project falls into a category of projects considered high risk to eagles, or a Category 1 project (Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy Version 2, April 2013 [ECPG 2013], p. 25). In addition, the Final Environmental Impact Statement for CCSM predicts an annual fatality estimate of 46 to 64 eagles per year (BLM 2012)[1]. While the number of predicted eagle fatalities may be lower due to PCW's proposed avoidance areas (i.e., turbine no-build areas), the proposed avoidance areas still allow the placement of turbines near numerous golden eagle nests (i.e., Category 1). "Construction of projects at sites in category 1 is not recommended" and "projects or alternatives in category 1 should be substantially redesigned if they are to at least meet the category 2 criteria" (ECPG 2013, p. 25). The Service offers a process for wind power developers to receive authorization to take eagles under the Bald and Golden Eagle Protection Act. This process requires developers to avoid and minimize the take of eagles to the maximum degree practicable and that any remaining take be unavoidable. This includes, among other things, the proper siting of turbines. Implementing the following recommendations should allow CCSM to move forward toward being eligible for a programmatic eagle take permit as a Category 2 project (ECPG 2013, p. 25).

RECOMMENDATIONS FOR AVOIDANCE AND MINIMIZATION

OCCUPIED NESTS

For occupied golden eagle nests, we recommend a turbine no-build buffer within the project-specific ½-mean inter-nest distance (½-MIND). The ½-MIND buffer approximates the average territory size and is based on an average distance among all occupied nests within a given year. Eagle pairs that nest within one-half the mean project-area inter-nest distance are potentially susceptible to disturbance take and blade strike mortality, as these pairs and offspring may use the project footprint (ECPG 2013, p. 14). The ½-MIND can be adjusted at individual nests if site-specific data (e.g., telemetry data, prey analysis, other data) are adequate to show eagle activity around the nest is non-circular or that the territory is larger or smaller than the ½-MIND.

For CCSM, the project-specific ½-MIND is 3,500 meters (about 2.2 miles), which is based on data from 2011, the year with the highest number of occupied nests. Absent sufficient data, turbines should not be built within 3,500 meters of occupied nests.

In applying this recommendation, we define occupied golden eagle nests as nest sites that were occupied at least once during the last five years or last five years of field surveys. An occupied nest is a nest structure at which any of the following is observed: (1) an adult eagle in an incubating position, (2) eggs, (3) nestlings or fledglings, (4) occurrence of a pair of adult eagles (or sometimes subadults) at or near a nest through at least the time incubation normally occurs, (5) a newly constructed or refurbished stick nest in the area where territorial behavior of an eagle had been observed early in the breeding season, or (6) a recently repaired nest with fresh sticks, fresh boughs on top, and/or droppings and/or molted feathers (ECPG 2013, p. 64). In years when food resources are scarce, it is not uncommon for a pair of eagles to occupy a nest yet never lay eggs; such nests are considered occupied (ECPG 2013, p. 64). Because golden eagles

[1]Bureau of Land Management [BLM]. 2012. Chokecherry and Sierra Madre Wind Energy Project Final Environmental Impact Statement (Volume II). Rawlins Field Office, Rawlins, Wyoming.

often will use the same nest in multiple years there is a high likelihood these nests could be occupied again during the life of a project. Nests form the center of activity during the breeding season and are often centers of activity during the non-breeding season as well. Buffering or otherwise protecting eagle nests should substantially decrease the probability of lethal take, as well as disturbance take, of eagles. Other raptors using the same nesting habitats as golden eagles (e.g., prairie falcon) also will benefit from protection of golden eagle nest sites.

Based on information in your letter of December 11, 2012, adjustments to the ½-MIND buffer may be appropriate at some occupied nests. For example, point count data, observational data in conjunction with radar data, and an evaluation of foraging locations (based on prey availability) all suggest eagle activity at occupied nests along the Bolton Rim occurs primarily south of the Bolton Rim, away from proposed turbine development. If the additional data being collected through 2013 confirm these findings, the ½-MIND buffer could be reduced on the northern side of the three occupied golden eagle nests along the Bolton Rim to accommodate the currently proposed turbines. Any reduction in the buffer, however, should not result in disturbance or territory abandonment; therefore, we anticipate the buffer would still be no less than the PCW-proposed avoidance area, which places turbines more than 1,600 meters (1.0 mile) from the nests.

Another example of possible site-specific adjustments is nest #199. This is an individual nest south of the project area that blew off the cliff in 2012. The area where the nest was located will be monitored in 2013 and will continue to be monitored in future years for evidence of nest reconstruction (PCW, December 11, 2012, p. 11). If the nest becomes active in 2013, we recommend applying the project-specific ½-MIND buffer of 3,500 meters; however, this buffer could be adjusted if adequate data are available to determine that the territory, including foraging locations and travel corridors, does not overlap proposed turbines, the closest turbines being about 2,400 meters (1.5 miles) away from the nest.

For some occupied nests, adequate data are not yet available and making downward adjustments to the ½-MIND buffer is not recommended. For example, observational data show eagle activity occurs east and southeast of nest #162 in southwest Sierra Madre, but eagle activity was not observed west and northwest of the nest. While it is possible that eagles only fly in those directions, it is likely that the lack of eagle observations west and northwest of the nest is related to the location of the observation point rather than eagle activity; therefore, adjusting the ½-MIND around nest #162 is not recommended without additional specific data supporting an adjustment.

Eagle activity south of nest #145 in NW Chokecherry was low during 2012, and possible foraging locations for eagles at this nest may be north and northwest of the nest, outside of the project area (PCW, December 11, 2012, p. 5). Because the nest was not occupied in 2012, we do not know how eagles from this nest will use the landscape, which may include use of the project area west, south and east of the nest. Therefore, we recommend the 3,500-meter buffer. It may be appropriate to reduce the size of the buffer to the south and southwest if data from 2013 confirm eagle use does not occur south of the nest; however, we anticipate a minimum buffer

will be needed around the nest to avoid disturbance and to reduce the likelihood of fatalities associated with eagle movement between the nest area and the interior rim of Chokecherry.

Unoccupied Nests

We recommend that turbines not be constructed within 800 meters (0.5 mile) of any unoccupied (historic) golden eagle nest, and that all turbines between 800 meters and 1,600 meters (1.0 mile) of any unoccupied nest are curtailed during each year starting 15 January until 1 May, or until adequate nest surveys demonstrate that the nests are unoccupied. Further, if the nest becomes occupied, turbines within the ½-MIND of the nest should be curtailed during the breeding season until the young fledge and are no longer dependent on the nest or until the nest becomes unoccupied.

In applying this recommendation, we define unoccupied golden eagle nests as historic nest sites that were not occupied during the last five years or last five years of field surveys. It should be noted that occupied nests can be incorrectly assigned as unoccupied if the nests are not repeatedly surveyed during the same nesting season. Even if a nest was unoccupied in one or more years, it is possible that eagles will reuse that nest in future years, especially since the intervals between nest use can be lengthy. Given that the anticipated life of a wind project is 30 years (though repowering could extend that indefinitely) it is likely that some unoccupied nests will become occupied during the life of the project. In addition, nests usually occur in areas of historical eagle use (due to topographic features and prey resources) and represent areas where eagles are expected to return in the future.

Areas of Concentrated Prey Resources

We recommend that turbines not be constructed in areas of concentrated prey resources unless it is demonstrated that the areas of concentrated prey resources do not overlap or are not immediately adjacent to other important eagle use areas (i.e., eagle nests, foraging areas, and communal roosts; 50 CFR 22.3), and where sufficient data are available to confirm that the concentrated prey resources are not in areas of project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity). Areas of concentrated prey resources may be used by golden eagles during the entire year, including the nesting season, spring and fall migrations, and during the wintering period.

For CCSM, the areas of concentrated prey resources include white-tailed prairie dog towns. Because white-tailed prairie dogs hibernate during the winter months, the concentrated prey resources are not available year round; however, white-tailed prairie dogs are still available during the nesting season and during part of the fall migration period. Therefore, turbines should not be placed in white-tailed prairie dog towns unless the towns do not overlap or are not immediately adjacent to eagle nests, other foraging areas, communal roosts, or project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity).

OTHER PROJECT-SPECIFIC EAGLE ACTIVITY AREAS

We recommend applying buffers for other project-specific eagle activity areas identified by survey data (e.g., 800-meter point counts). These are different than "important eagle use areas" (as defined in regulations and the ECPG 2013, p. 35) which are limited to nests, foraging areas, and communal roost sites. Other project-specific eagle activity areas include migration corridors, migration concentration sites, stopover sites, perches, specific areas where eagles gain uplift for foraging and other movements, movement corridors, etc. They include all types of eagle use areas except the "important eagle use areas." Although project-specific, these other project-specific eagle activity areas are typically used by eagles; therefore, it is appropriate to identify these areas and provide buffer recommendations for them. In applying this recommendation, we will focus on areas where there is an intersection of geographic relief (e.g., cliff features used for nesting, ridge features used for migration, rims used for orthographic lift) and documented project-specific eagle activity areas. Furthermore, the recommended buffers for geographic features would vary based on the value and use of those features by eagles, with those having greater value and use by eagles receiving larger buffers.

In many respects, this recommendation follows the approach used by PCW to identify areas such as the Interior Rim in Chokecherry as proposed avoidance areas (i.e., turbine no-build areas). However, we have identified additional areas for avoidance. For example, based on the high level of eagle activity remaining outside of the proposed avoidance area along the Interior Rim, we recommend extending the buffer eastward along this geologic feature (Interior Rim). Other examples include the rim in Sage Creek Basin and portions of Miller Hill.

We look forward to discussing these recommendations with you, and addressing any questions or comments that you may have, during our meeting scheduled for May 15, 2013. If you have specific questions regarding this letter in the interim, please contact Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 231.

Sincerely,

For R.Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc SWCA, Principal Ecologist, Broomfield, CO (J. Kehmeier) (jkehmeier@swca.com)
BLM, Supervisory RECO Coordinator, Cheyenne, WY (M. Valle) (mvalle@blm.gov)
BLM, RECO Project Manager, Rawlins, WY (H. Schultz) (hschultz@blm.gov)
FWS, Chief, Lakewood, CO (P. Repp) (pam_repp@fws.gov)
FWS, Chief – Bird Habitat Conservation, Lakewood, CO (C. Stemler) (casey_stemler@fws.gov)

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MEMORANDUM

BY ELECTRONIC MAIL

TO: U.S. Fish and Wildlife Service

FROM: Power Company of Wyoming LLC

DATE: August 30, 2013

RE: PCW's Development Plan

This memo addresses the question posed by the U.S. Fish and Wildlife Service (the Service) about how PCW's planned submission of site-specific development plans and its phased construction approach comports with the Bureau of Land Management's Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project).

Background

The CCSM Project analyzed by the BLM in the FEIS and the subject of the ROD was summarized in the Executive Summary of the FEIS as follows:

- A 2,000- to 3,000-megawatt (MW) wind farm consisting of approximately 1,000 wind turbine generators (WTGs) with a nameplate capacity ranging from 1.5- to 3-MW;
- Development of step-up transformers, underground and overhead electric collection and communication lines, electric substations, rail distribution facility (RDF), operations and maintenance facilities, and laydown areas;
- Haul road and transmission connection between the two sites;
- Construct new roads and upgrade existing roads; and
- Power from the wind farms would be transmitted via overhead electric transmission lines that would connect to a new substation in the Application Area.

FEIS at ES-1. This summary of the CCSM Project remains accurate. In addition to the CCSM Project facilities described above, PCW will reopen an onsite quarry that will supply base aggregate for construction of the CCSM Project. The BLM will include the quarry in its environmental analysis of the rail facility and haul road.

BLM prepared a project-wide EIS based on a Plan of Development prepared by PCW (Appendix B of the ROD). The Plan of Development included a **conceptual** project with specific turbine and facility site locations and a conceptual construction sequence that implemented the Plan of Development. The conceptual project provided BLM with the information it needed to prepare its overall impacts analysis which assumed the "greatest potential for disturbance" (ROD at p. 3-1). The BLM's project-wide EIS did not authorize site-specific construction associated with the siting/location of individual project components. Instead, a detailed procedure is outlined in the ROD under which PCW will submit site-specific plans of development to the BLM for subsequent NEPA analysis tiered "to the analysis and site-specific terms and conditions described in the ROD associated with the project-wide EIS" (ROD at p. C-1). The ROD provides that "BLM will closely evaluate the site-specific plans of development (SPODs) to determine whether the impacts exceed the disturbance estimates from the conceptual layouts that served as the basis for determining significance of impacts in the project-wide level EIS." (ROD at p. 3-1).

As outlined in the ROD, BLM determined two areas on the Overland Trail Ranch were suitable for wind energy development: the Chokecherry wind development area, and the Sierra Madre wind development area. The Sierra Madre development area consists of two distinct areas divided by Hwy 71 - with the majority of the wind development acreage located west of Hwy 71. (ROD, App. B at 4-26, Figure 4-10 *also inserted below*). The portion of Sierra Madre located west of Hwy 71 is referred to as Miller Hill and the portion of Sierra Madre located east of Hwy 71 is referred to as Sage Creek Basin. (ROD, App. B at 4-25 and 4-26, Figure 4-10 *also inserted below*). The Chokecherry wind development area is located entirely east of Hwy 71, but is divided into Western and Eastern Chokecherry based on topography. (ROD, App. B at 4-26, Figure 4-10 *also inserted below*).

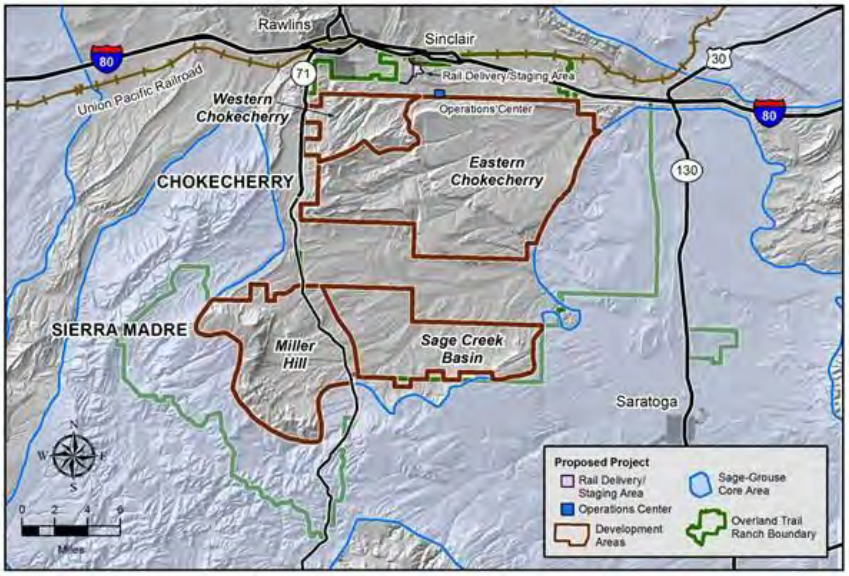

Figure 4-10

PCW's conceptual construction sequence provided for the construction of turbines to occur first in the Miller Hill area in line with PCW's goal of developing the highest-quality wind resources first (ROD, App. B at 1-8). Turbine construction then occurred in both the Sage Creek Basin and Western Chokecherry areas simultaneously (ROD, App. B at 4-25, Table 4-1). Finally, under the conceptual construction sequence, Eastern Chokecherry would be developed last. (ROD, App. B at 4-25, Table 4-1). Thus, the conceptual sequence of construction was: (1) Miller Hill; (2) Sage Creek Basin and Western Chokecherry simultaneously; and (3) Eastern Chokecherry.

PCW's Plan of Development also clearly states that "construction approaches will not be finalized until the detailed design of the Project is complete. Additional details will be provided in site-specific PODs" (ROD, App. B at p. 4-1). The Plan of Development further provides that the "Project design will continue to be updated and refined to utilize the best data and information available" (ROD, App. B at P. 4-1).

PCW's Plan of Development noted that PCW originally planned to build the CCSM Project over three years; however, to mitigate potential socioeconomic effects caused by a large labor force, PCW agreed to a four-year schedule. In the EIS, BLM evaluated a five-year construction period for the CCSM Project which was incorporated as a mitigation measure. This five-year construction period was to construct the entire CCSM Project – all 1,000 turbines in both Sierra Madre and Chokecherry.

In sum, the project-wide EIS and ROD contemplated that "conceptual" construction plans would be refined and become "final" plans or site-specific plans of development, and those final SPODs would once again be evaluated by the BLM prior to it granting PCW any ROWs. This process provides the ability for PCW to work with the Service in submitting refined turbine layouts in the SPODs that implement further eagle avoidance and minimization measures.

PCW's Current Development Plan

The CCSM Project consisting of approximately 1,000 wind turbine generators and 2,000 to 3,000 MW, as analyzed by the BLM and summarized in the FEIS remains the same. As outlined above, both the BLM and PCW contemplated and understood that there would be updates, adjustments, and refinements to the conceptual project included in the Plan of Development that was considered in the FEIS and ROD; this is reflected in the FEIS and ROD as well as the Plan of Development. As envisioned, PCW is making some adjustments with respect to when and where construction in the wind development areas will occur.

- First, instead of submitting the site-specific development plans for all 1000 turbines in both wind development areas simultaneously, PCW will submit a site-specific development plan for 500 turbines or 1500 MW (Phase I), to be followed at a later date by a second submission of a site-specific development plan for the remaining 500 turbines or 1500 MW (Phase II). Construction of Phase I will take place over a 36 to 39 month period.

- Second, instead of the construction sequence of: (1) Miller Hill; (2) Sage Creek Basin and West Chokecherry simultaneously; and (3) Eastern Chokecherry, Phase I will include only Miller Hill and West Chokecherry. (ROD, App. B, 4-26, Figure 4-10 *also included above*). Phase II will include Sage Creek Basin and Eastern Chokecherry. This construction sequence comports with PCW's goal of developing the highest-quality wind resources first and the only change in sequence is the decision not to develop West Chokecherry and Sage Creek Basin simultaneously.

Neither of these adjustments - the phasing of construction or the areas initially constructed - affect the analysis of CCSM Project impacts set out in the FEIS that was based on a **conceptual** project included in the Plan of Development (ROD at Appendix B) and the "greatest potential for disturbance" (ROD at p. 3-1). Phasing of construction was also recommended by the Service to allow PCW time to incorporate adaptive management techniques into Phase II. PCW will seek separate Eagle Take Permits for Phase I and for Phase II.

In sum, the overall CCSM Project scope, major elements and areas of wind development remain the same. PCW's current approach to submitting its site-specific plans of development and its phased construction of the wind development areas comports with the overall EIS and ROD analyses and conditions.

From:	Abbott, Tyler
To:	Garry Miller; Roxane Perruso; Jon Kehmeier
Cc:	Mark Sattelberg; Casey Stemler; Kevin Kritz; Nathan Darnall; Patricia Sweanor; Clint Riley
Subject:	Final FWS Recommendations for Areas of Concentrated Prey Resources at CCSM
Date:	Friday, September 27, 2013 4:30:29 PM
Attachments:	20130927_CCSM_PreyBaseRecommendationsNorthernLowerMillerHill.jpg 20130927_CCSM_PreyBaseRecommendationsSouthernLowerMillerHill.jpg 20130924_WTPD_MiddleLowerMillerHill_ConvexHullBuffer.zip 20130924_WTPD_120mBuffer3Towns.zip 20130924_WTPD_LowerMillerHill_NorthernArea120mBuffer.zip Recommendations Areas of Concentrated Prey Resources.docx

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Gary,

Thank you for fulfilling PCW's commitment to provide the most current concentrated prey resource data and report to the Service by the mutually agreed-upon time frame. In accordance with our agreement, with this transmittal the Service is fulfilling our commitment for a 2-week turnaround time: attached please find the Service's final recommendations regarding areas of concentrated prey resources for the proposed Chokecherry Sierra Madre Wind Facility. These recommendations represent both the Service's Regional Migratory Bird Management Office and the Wyoming Ecological Services Field Office.

As Nathan has indicated below, attached are two maps and a narrative that illustrate and describe three areas identified in the recommendations. Also, Nathan has attached zip files of the GIS layers.

If you have any questions, please feel free to contact myself or Nathan.

Thank you, Tyler

--
Tyler Abbott, Deputy Field Supervisor
U.S. Fish and Wildlife Service
Wyoming Ecological Services Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, WY 82009
Office: (307) 772-2374 x 231
Cell: (307) 286-7242
tyler_abbott@fws.gov

---------- Forwarded message ----------
From: **Nathan Darnall** <nathan_darnall@fws.gov>
Date: Fri, Sep 27, 2013 at 4:01 PM
Subject: Recommendations for Areas of Concentrated Prey Resources
To: Tyler Abbott <tyler_abbott@fws.gov>

Tyler,

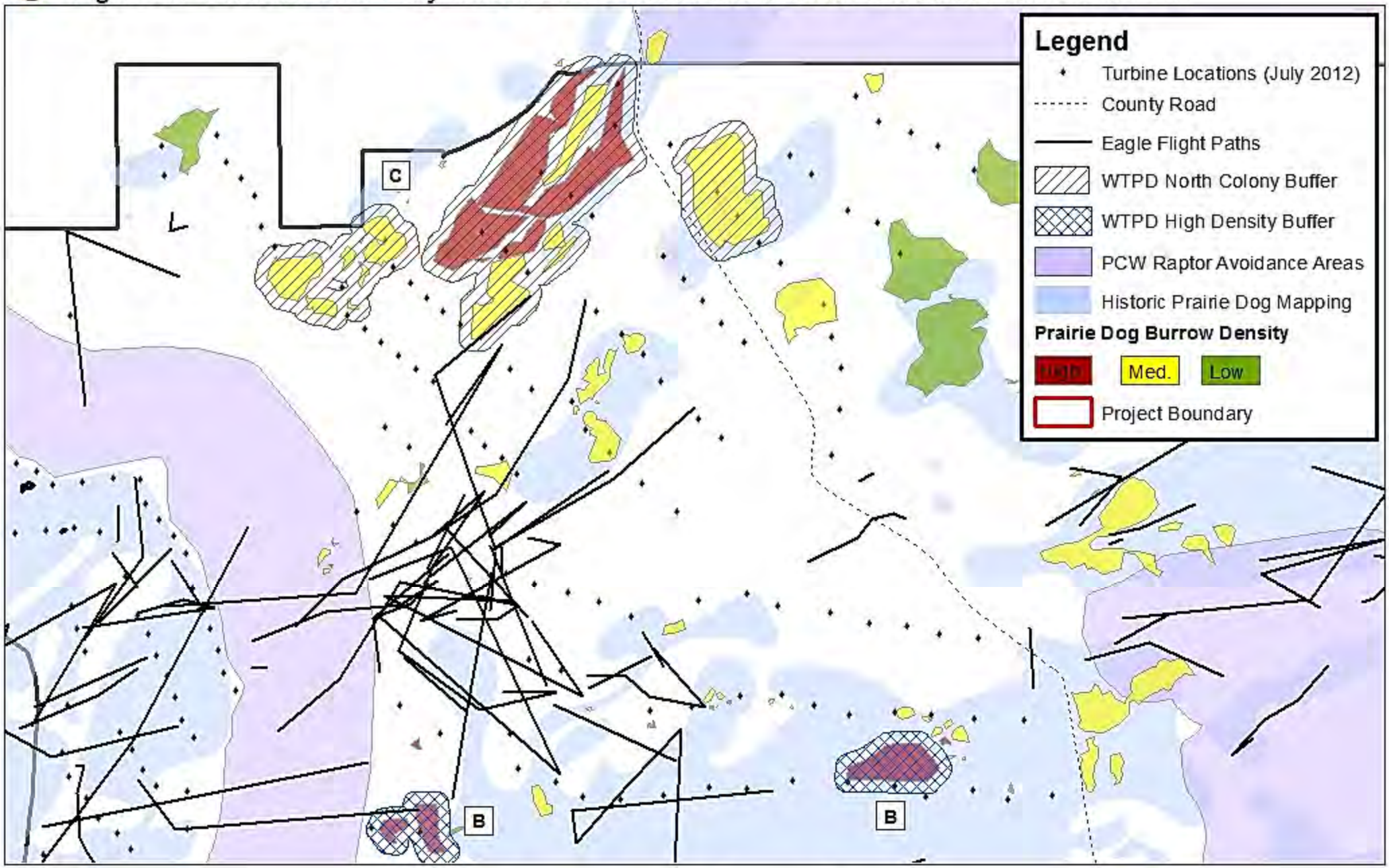
Here are the joint Ecological Services-Migratory Bird recommendations for

avoidance and minimization concerning areas of concentrated prey resources. I've attached two maps and a write-up that show/describe the three areas in the recommendations. I've also attached zip files of the GIS layers for them.

Nathan

Nathan Darnall
Section 7 and Conservation Planning Assistance Coordinator
U.S. Fish and Wildlife Service
Wyoming Ecological Services Office
Office: (307) 772-2374 x 246
Work Cell: (307) 286-1334
Fax: (307)772-2358
nathan_darnall@fws.gov
http://www.fws.gov/wyominges/Index.html
http://www.fws.gov/mountain-prairie/es/

Figure 3. Concentrated Prey Resource Recommendations for Northern Lower Miller Hill

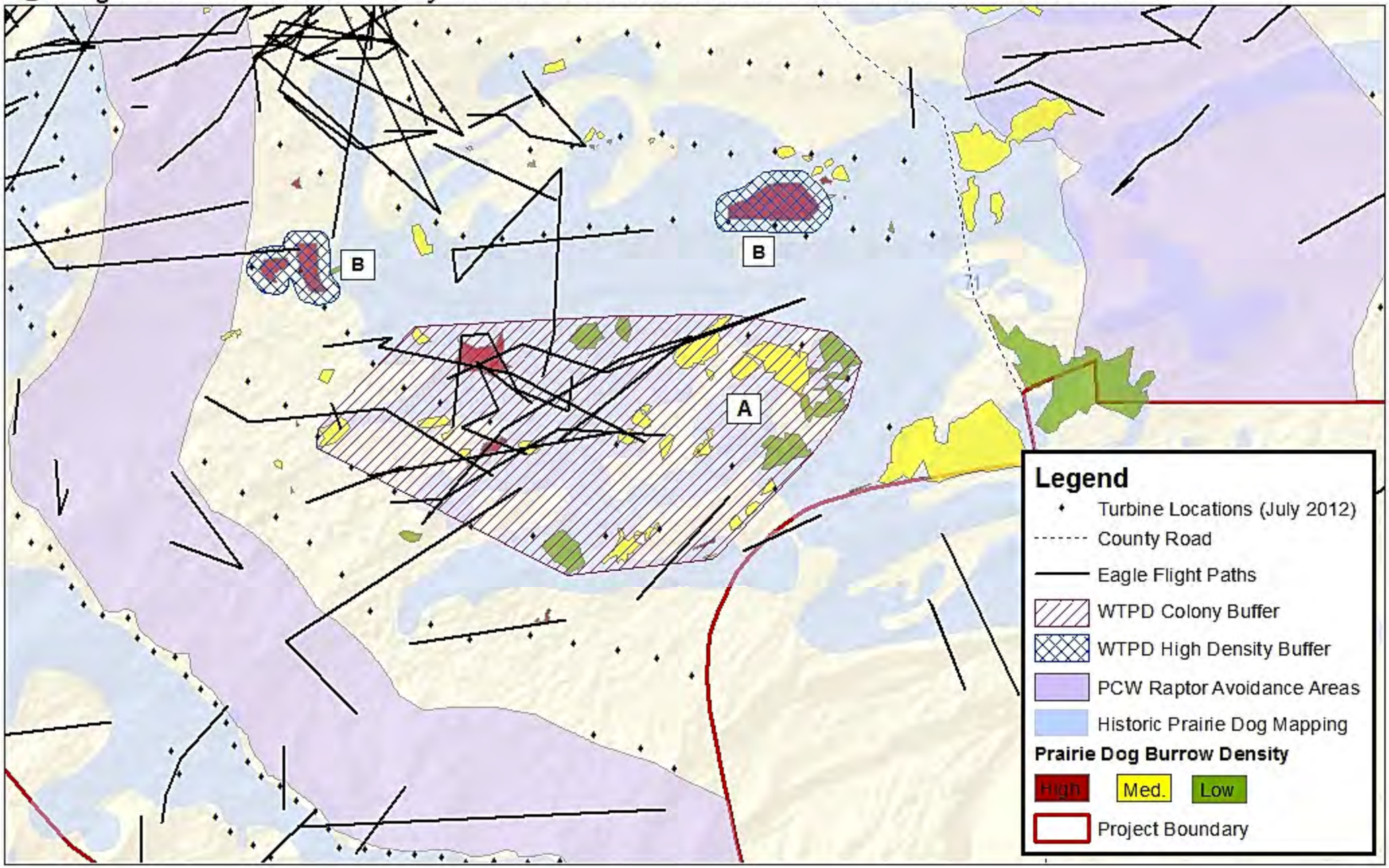


Created By: USFWS, Wyoming ES
Map Date: 09/27/2013
Source: ESRI | SWCA | FWS | BLM

0 0.65 1.3 1.95 2.6 Miles

N

Figure 2. Concentrated Prey Resource Recommendations for Southern Lower Miller Hill



Created By: USFWS, Wyoming ES
Map Date: 09/27/2013
Source: ESRI | SWCA | FWS | BLM

0 0.65 1.3 1.95 2.6 Miles

N

Recommendations for Avoidance and Minimization for the Chokecherry Sierra Madre Wind Energy Facility

C. Areas of Concentrated Prey Resources

Turbines should not be constructed in areas of concentrated prey resources unless it can be demonstrated that the areas of concentrated prey resources do not overlap or are not immediately adjacent to other important eagle use areas (i.e., eagle nests, foraging areas, and communal roosts; 50 CFR 22.3), and where sufficient data are available to confirm that the concentrated prey resources are not in areas of project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity).

Data used in Analysis

White-tailed Prairie Dog Data:
- Mapping provided by SWCA from 2013
- WGFD layer of non-block cleared area

Eagle Flight Path Data:
- April – June 2011
- July – August 2011
- September – October 2011
- May – July 2012
- September – October 2012
- April – June 2013
- June – August 2013

Recommendations for the Eagle Conservation Plan

Recommendations for Lower Miller Hill

(A) South – West of Rasmussen Lake is a relatively dense cluster of white-tailed prairie dog towns that collectively intersect at least eight eagle flight paths and that lie within a white-tailed prairie dog colony mapped by the Wyoming Game and Fish Department (WGFD). While the towns are not large individually (largest is 44.5 acres), due to their close proximity to each other they may collectively (317 acres) create a geographic unit with overall higher density of prey resources than adjoining areas, and therefore attract eagles and other raptors.

Towns Excluded from the Analysis

Other relatively large towns north of the cluster (487, 488 and 49) are separated from the group by more than two and a half times the average distance between the towns within the cluster (average = 353 meters). These three towns were not included in the cluster but will be treated separately due to their size and density of burrows. However, if the area between the cluster and the three towns was not surveyed in 2013 and if more towns are present, the cluster should be enlarged to include these towns.

One large town east of the cluster (2942) was not included, because it was inactive in 2013 and is about 0.5 kilometer from the group; however, including this town may be recommended as it could become reoccupied in the future and doing so would only impact one additional turbine.

Finally, several small towns west of the cluster (485, 84, 3797, 3796, 3744, and 1728) were not included in the cluster, because of their small size and location outside of the WGFD polygon, and also due to inactivity at some towns and the lack of observed eagle flight paths.

Analysis

Once the towns to include in (or exclude from) the cluster were identified using the criteria presented above (Table 1), the Minimum Bounding Geometry tool in ArcMap (Geometry type: convex hull; Group option: all) was used to define the spatial extent of the avoidance area. Depending on how the buffer is applied (or expanded), 15 to 20 turbines are impacted.

Table 1. Object ID (from GIS), burrow density (high, medium, low) and size (acres) of white-tailed prairie dog towns included in the cluster analysis. All of the towns were active in 2013 except 886 and 3354(*).

ID	Density	Acres		ID	Density	Acres		ID	Density	Acres
86	High	1.2		1720	Medium	3.0		3792	Medium	4.8
897	High	6.6		886*	Medium	5.4		3794	Medium	3.8
3793	High	30.5		891	Medium	1.2		3804	Medium	11.8
	Subtotal	**38.3**		893	Medium	10.0			Subtotal	**162.1**
83	Medium	5.2		1721	Medium	2.6		60	Low	26.0
85	Medium	0.9		1725	Medium	2.9		74	Low	14.6
87	Medium	14.0		3354*	Medium	1.1		75	Low	6.5
88	Medium	2.7		3351	Medium	5.3		80	Low	25.3
90	Medium	1.4		3358	Medium	31.7		126	Low	44.5
91	Medium	6.5		3355	Medium	42.2			Subtotal	**116.9**
				3360	Medium	5.6			Total	**317.3**

Recommendations for Chokecherry

There are no white-tailed prairie dog towns inside the project boundary for Phase 1 of Chokecherry (Nevins Ridge); therefore, we developed no recommendations for this area of the project. Prairie dog towns occur north of the Chokecherry boundary near the Interior Rim, an area identified by PCW as a no-build location. Recommended no-build areas are also located west southwest of the towns due to occupied and unoccupied nests.

Recommendations for Upper Miller Hill

There are a few small prairie dog towns on the top of Miller Hill at the west side of the project. We developed no recommendations for this area due to the small size of the towns and the general lack of eagle activity near the towns.

(B) South – West of Rasmussen Lake are three relatively large white-tailed prairie dog towns with high density of burrows/animals (487, 488 and 49). As discussed previously, these three towns are separated from the cluster in **A** by more than two and a half times the average distance between the towns in the cluster. Other data, such as observed eagle flight paths, do not strongly suggest these towns are heavily used by eagles as foraging locations. However, compared to other towns, these are relatively large with a high burrow density, suggesting that white-tailed prairie dogs might be locally abundant and may attract eagles and other raptors.

The recommendation is to buffer these three towns by 120 meters (396 feet), the approximate height of the "typical" wind turbine. This recommendation impacts 4 turbines from the July 18, 2012 layout.

(C) North – The north side of lower Miller Hill contains some of the largest and most dense white-tailed prairie dog towns mapped in 2013, with a total area of about 1 square mile (Table 2). While no demonstrated important eagle use areas or multiple eagle flight paths overlap these towns, we recommend this area be included in avoidance and minimization under the Bird and Bat Conservation Strategy (BBCS) to protect other raptors. In addition, ACPs could be developed for eagles. Measures might include: (1) turbine removal, (2) seasonal curtailment, and (3) additional study to determine how the area is used by raptors and eagles. The 120-meter buffer is based on the height of a "typical" wind turbine. This recommendation impacts approximately 17 turbines from the July 18, 2012 layout.

Table 2. Object ID (from GIS), burrow density (high, medium, low) and size (acres) of white-tailed prairie dog towns included in BBCS avoidance area in the northern Lower Miller Hill.

ID	Density	Acres	ID	Density	Acres
908	High	209.2	3753	Medium	0.3
906	High	75.1	3773	Medium	33.2
904	High	19.2	3752	Medium	4.9
902	High	6.0	3751	Medium	42.2
	Sub Total	309.5	3771	Medium	**9.4**
909	Medium	1.0	3772	Medium	**2.4**
907	Medium	37.7	3770	Medium	1.2
903	Medium	8.0	3757	Medium	141.9
3750	Medium	59.7		Sub Total	341.9
				Grand Total	651.4

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MEMORANDUM

BY ELECTRONIC MAIL

TO: U.S. Fish and Wildlife Service

DATE: November 26, 2013

RE: PCW's compliance with the Service's comprehensive eagle avoidance and minimization recommendations

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As recommended in the Eagle Conservation Plan Guidance (ECP Guidance) and Land-based Wind Energy Guidelines (Wind Energy Guidelines), Power Company of Wyoming LLC (PCW) has worked closely with the U.S Fish and Wildlife Service (Service) to identify eagle avoidance and minimization measures for Phase I of the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project). This memorandum documents PCW's compliance with the eagle avoidance and minimization measures recommended by the Service.

PCW has completed a preliminary site evaluation, site characterization, and site-specific surveys and assessments (field studies) for the CCSM Project. PCW and the Service used these field studies to conduct a risk assessment for the CCSM Project and to identify conservation measures to avoid and minimize the take of eagles. Specifically, the Service provided recommendations to PCW in letters dated August 10, 2012, May 3, 2013, and October 1, 2013; the Service offered additional recommendations, modifications, and detail on the implementation of its recommendations at meetings held on May 15, 2013 and July 24, 2013.

As requested by the Service and as contemplated under the ECP Guidance and Wind Energy Guidelines, PCW has used the site-specific data for the CCSM Project and the recommendations from the Service, in conjunction with the initial results of the Service's eagle fatality model, to substantially re-design the CCSM Project and develop the Phase I wind turbine layout, (Figure 1 and Figure 2). The Phase I wind turbine layout avoids and minimizes risks to eagles such that additional take is unavoidable, consistent with the ECP Guidance and the provisions of the Bald and Golden Eagle Protection Act.

Phase I Wind Turbine Layout

PCW has worked cooperatively with the Service to incorporate its avoidance and minimization recommendations resulting in substantially revising the CCSM Project, specifically, the Phase I wind turbine layout. PCW has adopted the Service's recommendations set out in the August 10, 2012, May 3, 2013, and October 1, 2013, letters, as modified and clarified at the May 15, 2013 and July 24, 2013 meetings and has implemented them as provided by the Service, with the

exception of Prey Recommendation 3, BBCS Recommendations 1 and 2, and Use Recommendation 3. As to these limited exceptions, PCW, relying on site-specific data, has identified alternate approaches to implementing the Service's recommendations that provide equivalent or even greater protection to bald and golden eagles. These alternate implementation strategies are addressed in detail in this Memorandum.

A fundamental element of the Phase I wind turbine layout is the designated Turbine No-Build Areas (Figure 3). These areas are designed to reduce impacts to eagles and other raptors by avoiding placement of turbines in and adjacent to documented important eagle use areas, movement corridors, and nest locations and nesting substrate. Eagle use within the designated Turbine No-Build Areas represents approximately 80% of all use observed during the 2011 and 2012 long-watch raptor surveys. As such, designation of these areas substantially reduces the risk to eagles.

The Phase I wind turbine layout incorporates the designated Turbine No-Build Areas and the avoidance and minimization measures (Figures 4 and 5), as described below. The layout is in full compliance with the ECP and WEG Guidance and represents the culmination of an iterative approach to siting and site characterization consistent with Stages 1 and 2 of the ECP Guidance and Tiers 1 through 3 of the WEG Guidance. The layout, when combined with approved or experimental Advanced Conservation Practices, conservation and mitigation measures, and monitoring and adaptive management, avoids and minimizes impacts to bald and golden eagles such that additional take is unavoidable.

Avoidance and Minimization Recommendations

The avoidance and minimization recommendations developed by the Service focus on identifying and avoiding areas such as occupied and unoccupied nests, areas of concentrated prey base, and movement corridors. From the initial letter in August 2012 through the information provided in October 2013, the Service continued to refine its recommendations to add specificity and to reflect the additional site-specific data and information that was collected for the CCSM Project.

The recommendations provided by the Service in its May 3, 2013 letter have become known as Recommendations A through D. Recommendations A through D refer to the following:

- Recommendation A – Occupied Nests
- Recommendation B – Unoccupied Nests
- Recommendation C – Areas of Concentrated Prey Resources
- Recommendation D – Other Project-specific Eagle Activity Areas

The recommendations made by the Service for the CCSM Project and information regarding how each recommendation is incorporated into the Phase I wind turbine layout is organized by subject matter in the following sections: (1) Nests (Recommendations A and B); (2) Areas of Concentrated Prey Resources (Recommendation C); (3) Other Project-specific Eagle Activity Areas (Recommendation D); (4) Miller Hill; and (5) Non-eagle Raptors.

Nests (Recommendations A & B)

"Important eagle-use areas" as defined in 50 CFR 22.3 include eagle nests and important landscape features in close proximity to eagle nests. As such, significant effort was expended by

PCW and the Service to identify eagle nests in the vicinity of the CCSM Project Site and to create recommendations to protect the nests and important landscape features. The majority of the eagle nests identified by PCW are far removed from the Phase I development or lie within designated Turbine No-Build Areas designed to protect them; however, for the two occupied golden eagle nests, the occupied bald eagle nest, and the inactive nests within five miles of the Phase I wind turbine layout, PCW and the Service worked cooperatively to develop recommendations and protective measures.

On August 10, 2012, the Service provided PCW with its initial recommendations for the protection of nests and nesting territories. [1] On May 3, 2013, following a review of the 2011-2012 survey data and discussion regarding the initial recommendations, the Service clarified its initial recommendations. The Service defined occupied nests as any nest that has been used for nesting within the previous five calendar years or five years of survey. Unoccupied nests were defined as those nests that have not been used for nesting in the previous five calendar years or years of survey.

Subsequently, on May 15, 2013, PCW and the Service met to discuss how the recommendations provided in the May 3, 2013, letter could be implemented at the CCSM Project. At the May 15, 2013 meeting, the Service provided maps that illustrated the implementation of the Service's recommendations in relation to nest #162, nest #145, and the unoccupied nests in the Chokecherry wind development area. The Service subsequently refined its recommendations based on additional data PCW submitted to the Service on May 30, 2013. The Service presented its refined recommendations for the protection of nests and nesting territories at a meeting on July 24, 2013. These included verbal recommendations related to curtailment, as well as maps illustrating recommendations for nest #162 and nest #145 that superseded those previously discussed on May 15, 2013.

The following list of recommendations relating to nests and nesting territories have been compiled from the letters, maps and guidance provided by the Service, as referenced above. Each recommendation is followed by a discussion of how PCW has incorporated the recommendation in the Phase I wind turbine layout.

Nest Recommendation 1. *For occupied golden eagle nests, we recommend a turbine no-build buffer within the project specific ½-mean inter-nest distance (½-MIND). The ½-MIND buffer approximates the average territory size and is based on an average distance among all occupied nests within a given year. Eagle pairs that nest within one-half the mean project-area inter-nest distance are potentially susceptible to disturbance take and blade strike mortality, as these pairs and offspring may use the project footprint (ECPG 2013, p. 14). The ½-MIND can be adjusted at individual nests if site-specific data (e.g., telemetry data, prey*

[1] Only those recommendations that apply to the Phase I wind development are addressed in this memorandum.

analysis, other data) are adequate to show eagle activity around the nest is non-circular or that the territory is larger or smaller than the ½-MIND. [2]

For CCSM, the project-specific ½-MIND is 3,500 meters (about 2.2 miles), which is based on data from 2011, the year with the highest number of occupied nests. Absent sufficient data, turbines should not be built within 3,500 meters of occupied nests. [recommended 05/03/13, superseded by Nest Recommendations 3 and 4]

Only two occupied golden eagle nests were identified within the Phase I development area, nest #162 and nest #145. All other occupied golden eagle nests in the vicinity of the CCSM Project Site are 5 miles or more from the Phase I development area and the ½-MIND for these nests does not intersect with the Phase I development area. Consistent with the ECP Guidance, site-specific recommendations were developed for both of the occupied nests within the Phase I development area. Therefore, because there was sufficient site-specific information, this more general recommendation was used along with the site-specific data to develop Nest Recommendations 3 and 4 which supersede this recommendation. See PCW's response to Nest Recommendations 3 and 4 for the measures used to protect eagles that may use nest #162 or nest #145.

Nest Recommendation 2. *We recommend that turbines not be constructed within 800 meters (0.5 mile) of any unoccupied (historic) golden eagle nest, and that all turbines between 800 meters and 1,600 meters (1.0 mile) of any unoccupied nest are curtailed during each year starting 15 January until 1 May, or until adequate nest surveys demonstrate that the nests are unoccupied. Further, if the nest becomes occupied, turbines within the ½-MIND of the nest should be curtailed during the breeding season until the young fledge and are no longer dependent on the nest or until the nest becomes unoccupied.*[3] [recommended 05/03/13, detailed 05/15/13 (map 5)]

In compliance with Nest Recommendation 2, there are no turbines within 800 meters of any golden eagle nest (occupied or unoccupied) in the Phase I wind turbine layout (Figure 1 and Figure 2). In addition, PCW has removed many turbines from locations within 1,600m of golden eagle nests, e.g. 19 turbines located within 1,600 meters of the two unoccupied nests located immediately east of nest #145 were removed from the preliminary Phase I wind turbine layout (Figure 5) .

Where turbines are still located within 1,600m of a golden eagle nest, turbines will be curtailed between February 1 and April 30 or until nest activity is determined. While the Service recommended seasonal curtailment from January 15 through May 1, PCW is proposing to curtail turbines seasonally between February 1 and April 30 based on site-specific data. The attached histogram generated from 800-meter point count data

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[2] This recommendation continues to specifically define occupied golden eagle nests. The recommendation also notes that based on information already submitted by PCW, adjustments to the ½-MIND buffer may be appropriate at some occupied nests based on site-specific data collection.
[3] This recommendation continues to specifically define unoccupied golden eagle nests.

collected in 2012 and 2013 demonstrates that eagle use of the Phase I development area is very low during January and increases in mid-February (Figure 6). Because of the extremely low documented use in January, PCW proposes to begin seasonal curtailment on February 1 of each year and continue seasonal curtailment until the activity of each nest is determined.

Attached Figures 4 and 5 show the measures applied to unoccupied golden eagle nests within the Phase I development area; these nests are located along Sheep Mountain, Bolten Rim and in the northern portion of the Chokecherry wind development area.

Nest Recommendation 3. *Add avoidance area around GOEA nest #162 at SW corner of Sierra Madre.* [recommended 08/10/12, updated 05/15/13 (map 1) and 07/24/13 (map 3)]

Nest #162 is located in the southwest corner of the Sierra Madre Phase I development area. The nest is located on a ledge along the southwest face of a small, pyramid-shaped mesa. Areas within the ½-MIND surrounding Nest #162 were surveyed in 2011 through 2013. Nest #162 was only active in 2011. During the period in which the nest was active, approximately 100 hours of survey data were collected to document flight paths and use surrounding the nest. An additional 163 hours of survey data were collected within the ½-MIND surrounding this nest in 2011 following the fledging of the juvenile golden eagle. Collectively, these data were used to identify site-specific avoidance and minimization measures for Nest #162.

Eagle flight path data collected during the period in which the nest was active in 2011 indicates that the majority of the observed eagle activity occurs south and west of the nest location in an area with documented greater sage-grouse use and pronghorn fawning activities. Two of the greater sage-grouse that were fitted with GPS transmitters by PCW were preyed upon by the eagles occupying this nest location as evidenced by the transmitters being relocated inside and at the base of the nest. Inspection of the nest after fledging indicated that the majority of prey remains in the nest were greater sage-grouse and pronghorn. Areas to the north and east of the nest within the Phase I development area do not provide suitable habitat for consistent use by pronghorn or sage-grouse; this information and the lack of observed eagle flight paths in this area during the nesting period indicate that use from this nest occurs mainly outside of the Phase I development area to the south and west.

While nest #162 has only been active for one year during monitoring, large amounts of data have been collected and used by PCW and the Service to develop site-specific measures for the protection of eagles that may use nest #162. As shown on attached Figure 4, no turbines will be built within 800m of the nest. In addition, as described in Nest Recommendation 2, turbines will be curtailed seasonally within 1,600m of the nest between February 1 and April 30 or until nest activity is determined. If nest #162 is active, turbines within the ½-MIND north and east of the nest location will be operated normally with no curtailment while the remaining turbines within the ½-MIND will be curtailed during the breeding season until the young fledge and are no longer dependent on the nest or until the nest fails and becomes inactive (Figure 4). Due to the majority of the use associated with nest #162 occurring to the south and west, this curtailment

strategy is protective of eagles that may use nest #162 and is consistent with the ECP Guidance which provides for use of site-specific data to identify appropriate, practicable avoidance and minimization measures. The avoidance and curtailment measures applied to nest #162 are shown in attached Figure 4 – Sierra Madre Avoidance and Minimization Measures. Nest Recommendation 2 would be applied to nest #162 in the event that it becomes unoccupied after 5 calendar years or 5 survey years.

Nest Recommendation 4. *Collect additional data on eagle use at the GOEA nest in Chokecherry West* [refers to GOEA nest #145], *including foraging areas. If inactive, describe likely foraging areas and potential use within Chokecherry West. Expand avoidance area in NW to protect eagle use near the nest.* [recommended 08/10/12, updated 05/15/13 (map 2) and 07/24/13 (map 2)]

Nest #145 is located on a northwest facing cliff band along the north central edge of the Chokecherry Phase I development area. Nest #145 was surveyed in 2008 and 2011 through 2013. Nest #145 was only active in 2008. Site-specific recommendations have been developed for nest #145 based on topographic features, potential prey-base locations, and eagles use observed in the vicinity of the nest.

In compliance with the Service's site-specific recommendations, PCW has not located turbines within 800m of nest #145 in the Phase I wind turbine layout. In addition, PCW agrees with the Service that seasonal curtailment is appropriate within 1,600m of nest #145 and is protective of eagles. However, rather than curtailment, PCW has complied with the Service's recommendation by removing 13 turbines within 1,600m of nest #145 from the preliminary Phase I wind turbine layout (Figure 5).

The site-specific measures developed for nest #145 protect the nest and provide a flight corridor connecting nest #145 with the Turbine No-Build Areas in the Chokecherry Phase I development area. These measures avoid topographic features potentially used by eagles and provide connectivity to the Interior Chokecherry Rim Turbine No-Build area and potential prey resources located northeast of the nest. The measures are consistent with the ECP Guidance which provides for use of site-specific data to identify appropriate, practicable avoidance and minimization measures. The measures applied to protect eagles that may use nest #145 are shown in attached Figure 5 – Chokecherry Avoidance and Minimization Measures. Nest Recommendation 2 would be applied to nest #145 in the event that it becomes unoccupied after 5 calendar years or 5 survey years.

Nest Recommendation 5. *Confirm BAEA use around Rasmussen Lake and adjust avoidance area if necessary to protect eagles from nest #171 as well as fall and winter eagle use* [recommended 08/10/12]

In its August 10, 2012, letter, the Service identified that the ½-MIND for bald eagle nests in the CCSM Project Site is 3,686 meters. The Phase I wind turbine layout does not contain any turbine locations within the ½-MIND surrounding bald eagle nest #171 (Figure 1). Additionally, between 2011 and 2012 more than 325 hours of survey data were collected across all seasons at three sites surrounding Rasmussen Reservoir as part

of long-watch surveys. These data show that use of the Phase I Development area by bald eagles occurs primarily between the nest and Rasmusssen Reservoir. Based on these data, the Rasmussen Reservoir Turbine No-Build Area (Figure 3) was designated to create a use area around the reservoir as well as a flight corridor between nest #171 and the reservoir where foraging behavior by bald eagles has been observed.

Nest Recommendation 6. *Evaluate and/or model the geologic features and potential flight paths and foraging areas to estimate the areas of high eagle use in the event these inactive nests (territories) are reoccupied. Based on results of the modeling or site-specific evaluation, adjust the proposed avoidance area to protect areas of highest eagle use.* [recommended 08/10/12, superseded by Nest Recommendation 2 and Use Recommendations 1 through 6]

Nest Recommendation 6 while specific to inactive nests and nesting territories has largely been superseded by the more specific Nest Recommendation 2 and the "other project-specific eagle activity areas" recommendations (Use Recommendations 1 through 6). PCW has evaluated the CCSM Project Site and Phase I development area for geologic features and potential flight paths and foraging areas that may be associated with high eagle use if unoccupied nests and nesting territories become active and has applied the measures described in Nest Recommendations 1 through 8 and Use Recommendations 1 through 6, along with the designated Turbine No-Build Areas to protect potential high eagle use areas associated with unoccupied nests and nesting territories.

Nest Recommendation 7. *The Service clarified that curtailment, as contemplated in Nest Recommendations 1 through 5, only applies during daylight hours when eagles are active. The Service further indicated that it defines daylight hours as ½ hour before sunrise to ½ hour after sunset in the absence of site-specific data.* [recommended 07/24/13 (meeting notes)]

When turbines are curtailed, as contemplated in Nest Recommendations 1through 5, turbines will be curtailed during daylight hours (sunrise to sunset). The Service has recommended curtailment for ½ hour before sunrise to ½ hour after sunset; however, site-specific long-watch survey data collected in 2011 and 2012[4] demonstrates that eagle activity is very low in the CCSM Project Site during early morning and late evening hours. In 42 hours of survey data collected prior to 8:00 AM in 2011 and 2012, only one eagle observation was recorded. This observation was recorded at 7:55 AM on August 18, 2011, substantially later than sunrise in any season. Similarly, very few eagle observations occurred during the hours surrounding sunset. During April to June 2011 and January to June 2012 (selected to represent periods representative of use during nesting activities) , only 11 minutes of eagle use were recorded in nearly 55 hours of survey time after 5:00 PM. These minutes represent only 0.78% of all observed eagle activity in the CCSM project site during spring 2011 and spring 2012. Additionally, all

[4] The 2012-2013 800m point-count data is not applicable to this analysis.

observed eagle activity occurred prior to 5:20 PM and before sunset. Because site-specific data shows low use before sunrise and after sunset, PCW believes there is scientific support for modifying the Service's recommended curtailment hours to begin at sunrise and end at sunset.

Nest Recommendation 8. *The Service recommends that PCW develop a specific monitoring program to determine and confirm nest activity to comply with Nest Recommendations 1 through 7.* [recommended 07/24/13 (meeting notes)]

PCW will adhere to the Services Nest Recommendation 8. PCW's Phase I ECP will describe a robust monitoring program to document nest activity each spring. If a nest is active, PCW will follow the Service's recommendations concerning seasonal curtailment, as set forth in this memorandum.

Areas of Concentrated Prey Resources (Recommendation C)

While areas of concentrated prey resources are not "important eagle-use areas" as defined in 50 CFR 22.3, the Service recommends that areas of concentrated prey resources should be avoided if they overlap or are adjacent to important eagle-use areas or areas the Service has identified as "project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity)." PCW has conducted surveys of prey resources on the CCSM Project Site to identify prey resources of sufficient size and density that are also associated with eagle-use to identify those that may meet the Service's criteria for avoidance. Based on the results of these surveys, the Service has developed site-specific recommendations for avoidance of prey resources in the Phase I development area.

On August 10, 2012, the Service provided PCW with its initial recommendations regarding areas of concentrated prey resources.[5] As part of its recommendations, the Service requested additional surveys to assist in the identification of prey resources on the CCSM Project Site. PCW provided the Service with the requested information on November 20, 2012. On May 3, 2013, after review of the prey resource data, the Service identified white-tailed prairie dogs (WTPD) as the most widespread prey resource on the CCSM Project Site and refined its recommendations to specifically focus on WTPD. On May 15, 2013, PCW and the Service met to discuss the implementation of the prey resource recommendations. The Service provided PCW with maps demonstrating how its recommendations could be implemented in the CCSM Project.

Concurrently with the development of the Service's recommendations, PCW conducted detailed wildlife surveys for the CCSM Project. The survey protocol included the identification and delineation of WTPD burrows and towns. PCW provided the site-specific data from the 2013 field surveys to the Service on September 6, 2013. Based on the 2013 survey data, the Service refined its recommendations and submitted new recommendations and implementation maps to PCW on October 1, 2013.

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[5] Only those recommendations that are applicable to the Phase I development are discussed in this memorandum.

The following list of prey resource recommendations has been compiled from the letters and maps provided by the Service, as described above. Each recommendation is followed by a discussion of how PCW has incorporated the recommendation in the Phase I wind turbine layout.

Prey Recommendation 1. *Previous studies came to different conclusions on prairie dog burrow densities in the project area. Determine current prairie dog activity, including burrow densities, following approved protocols, survey designs, and surveyor training. Ensure sampling effort provides adequate spatial coverage.*[recommended 08/10/12]

PCW has completed a full evaluation of potential prey resources as part of Stages 1 and 2 of the ECP Guidance process. In 2013, PCW completed pedestrian surveys of the Phase I development area to identify WTPD colonies. The boundaries of all WTPD colonies were delineated, activity was determined, and a relative burrow density was assigned to each colony. Using the WTPD data combined with eagle use data collected between 2011 and 2013, PCW identified those colonies that have the greatest potential for use by eagles. These areas were documented in PCW's 2012 Prey Base Assessment and the White-tailed Prairie Dog Survey Report and Eagle Use Assessment for Phase I of the Chokecherry and Sierra Madre Wind Energy Project submitted to the Service on September 6, 2013.

Prey Recommendation 2. *We recommend that turbines not be constructed in areas of concentrated prey resources unless it is demonstrated that the areas of concentrated prey resources do not overlap or are not immediately adjacent to other important eagle use areas (i.e., eagle nests, foraging areas, and communal roosts; 50 CFR 22.3), and where sufficient data are available to confirm that the concentrated prey resources are not in areas of project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity).*

For CCSM, the areas of concentrated prey resources include white-tailed prairie dog towns. Turbines should not be placed in white-tailed prairie dog towns unless the towns do not overlap or are not immediately adjacent to eagle nests, other foraging areas, communal roosts, or project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity). [recommended 05/03/13, detailed 5/15/13 (map 6), superseded by Prey Recommendation 3]

This recommendation has been superseded by the more site-specific recommendations on avoidance of concentrated prey resources included in Prey Recommendation 3. PCW has avoided turbine construction in areas of concentrated prey resources, as described in PCW's response to Prey Recommendation 3.

Prey Recommendation 3. *West of Rasmussen Lake is a relatively dense cluster of white-tailed prairie dog towns that collectively intersect at least eight eagle flight paths and that lie within a white-tailed prairie dog colony mapped by the Wyoming Game and Fish Department (WGFD). While the towns are not large individually (largest is 44.5 acres), due to their close proximity to each other they may collectively (317 acres) create a geographic*

unit with overall higher density of prey resources than adjoining areas, and therefore attract eagles and other raptors.

Other relatively large towns north of the cluster (487, 488 and 49) are separated from the group by more than two and a half times the average distance between the towns within the cluster (average = 353 meters). These three towns were not included in the cluster but will be treated separately due to their size and density of burrows. However, if the area between the cluster and the three towns was not surveyed in 2013 and if more towns are present, the cluster should be enlarged to include these towns.

One large town east of the cluster (2942) was not included, because it was inactive in 2013 and is about 0.5 kilometer from the group; however, including this town may be recommended as it could become reoccupied in the future. Finally, several small towns west of the cluster (485, 84, 3797, 3796, 3744, and 1728) were not included in the cluster, because of their small size and location outside of the WGFD polygon, and also due to inactivity at some towns and the lack of observed eagle flight paths. [recommended 10/01/13]

PCW has evaluated this recommendation and has made modifications to the preliminary Phase I wind turbine layout to accommodate the prey resources in the identified areas. While PCW s White-tailed Prairie Dog Survey Report and Eagle Use Assessment for Phase I of the CCSM Project did not identify any concentrated prey resources within the Phase I development area with demonstrated foraging activity by eagles that could be considered important eagle use areas, PCW developed measures to provide protection to eagles that may use these prey resources that are equivalent to those recommended by the Service.

The area included in Prey Recommendation 3 contains small, dispersed colonies of white-tailed prairie dogs. The Service's recommendation cites that eight eagle flight paths intersect in this area of white-tailed prairie dog activity. However, the Service did not consider the amount of survey time associated with those observations. Observations of eagle use in the area of white-tailed prairie dog activity were recorded from three monitoring locations (RM13, RM20, and RM17). Between 2011 and 2012, more than 160 hours of survey were completed at these three locations during the period in which white-tailed prairie dogs are available as potential prey (April through October). Eight flight paths recorded in 160 hours of survey time does not represent consistent use that would indicate an important foraging area. No observed eagle foraging behavior has been documented in this area. The majority of documented eagle use in this area occurs in the northern half of the Service's recommended avoidance area and consists of direct and powered flight with some soaring behavior.

Based on this site-specific information, PCW has removed the northern turbine row and the easternmost turbines from the central row, a total of 16 turbines, from the preliminary Phase I wind turbine layout (Figure 4). This results in removal of turbines from an area of approximately 3,500 acres. The exclusion of these turbines avoids the largest concentration of the densest WTPD colonies and eagle use areas and provides a 0.5 to 1.5 mile wide corridor between the Miller Hill Turbine No-Build Area and the Rasmussen Reservoir Turbine No-Build Area and Sage-Grouse Core Areas. When combined with

the measures PCW has implemented to respond to BBCS Recommendation 1, this measure provides equal or greater protection for eagles than Prey Recommendation 3. *See attached Figure 4 – Sierra Madre Avoidance and Minimization Measures*

Other Project-specific Eagle Activity Areas (Recommendation D)

In addition to important eagle-use areas, the Service provided recommended avoidance areas referred to as "other project-specific eagle activity areas." The Service states that "although project-specific, these other project-specific eagle activity areas are typically used by eagles; therefore, it is appropriate to identify these areas and provide buffer recommendations for them."

The concept of other project-specific eagle activity areas was first introduced in the recommendation letter provided by the Service on May 3, 2013. At the May 15, 2013, meeting, the Service provided maps to PCW demonstrating how their recommendations might be implemented in the CCSM Project. Following discussion of the May 3, 2013, recommendations and the collection of additional eagle use data, on July 24, 2013, the Service presented an updated map demonstrating the implementation of the project-specific eagle activity areas recommendations, along with a verbal explanation of the areas identified on the map.

The following list of other project-specific eagle activity area recommendations has been compiled from the letters, maps and guidance provided by the Service, as described above. Each recommendation is followed by a discussion of how PCW has incorporated the recommendation in the Phase I wind turbine layout.

Use Recommendation 1. *We recommend applying buffers for other project-specific eagle activity areas identified by survey data (e.g., 800-meter point counts). These are different than "important eagle use areas" (as defined in regulations and the ECPG 2013, p. 35) which are limited to nests, foraging areas, and communal roost sites. Other project-specific eagle activity areas include migration corridors, migration concentration sites, stopover sites, perches, specific areas where eagles gain uplift for foraging and other movements, movement corridors, etc. They include all types of eagle use areas except the "important eagle use areas." Although project-specific, these other project-specific eagle activity areas are typically used by eagles; therefore, it is appropriate to identify these areas and provide buffer recommendations for them. In applying this recommendation, we will focus on areas where there is an intersection of geographic relief (e.g., cliff features used for nesting, ridge features used for migration, rims used for orthographic lift) and documented project-specific eagle activity areas. Furthermore, the recommended buffers for geographic features would vary based on the value and use of those features by eagles, with those having greater value and use by eagles receiving larger buffers.* [recommended 05/03/13, detailed 5/15/13 (map 7), revised 7/24/13 (map 3), superseded by Use Recommendations 2 through 6]

Use Recommendation 1 was largely superseded by the Service's July 24, 2013, site-specific recommendations for avoidance of "other project-specific eagle activity areas", Use Recommendations 2 through 6. Please refer to PCW's response to Use Recommendations 2 through 6 for information on how Use Recommendation 1 was implemented.

Use Recommendation 2. *The Service recommends a 100 m setback from the rim of Miller Hill.* [recommended 07/24/13 (map 3)]

PCW's understands that this recommendation is intended to minimize risks to eagles that could use the Miller Hill Rim for soaring and kiting behaviors. PCW has collected extensive data on the wind resource on the CCSM Project Site. Winds in the CCSM Project Site are from the west and southwest for as much as 75% of the time, as demonstrated on the attached wind rose from meteorological tower Sierra Madre 13 located on Miller Hill (Figure 7).[6] Since Miller Hill faces to the east and northeast, downdraft conditions are commonly created along the Miller Hill Rim. Because of the strong directionality of the winds in the CCSM Project Site and the predominantly downdraft conditions, Miller Hill Rim does not provide regular soaring and kiting opportunities for eagles and other raptors. However, a 100m setback does provide protection for birds that might use the Miller Hill Rim during low wind conditions or infrequently when winds are from the east and northeast.

Use Recommendation 2 has been applied to the Phase I wind turbine layout as shown in Figure 4. Implementing this recommendation resulted in the removal of 9 turbines from the preliminary wind turbine layout. In addition, while removing and rearranging the Phase I wind turbine layout to accommodate this recommendation, the bases of the wind turbines were generally moved farther than 100m from Miller Hill Rim; therefore this measure is consistent with Use Recommendation 2. *See attached Figure 4 – Sierra Madre Avoidance and Minimization Measures*

Use Recommendation 3. *The Service recommends a 300m setback from the rim of Miller Hill to coincide with an eagle use area and to buffer a topographic feature.* [recommended 07/24/13 (map 3)]

The Service recommended a 300 meter setback from the Miller Hill Rim for turbines located within approximately 1,000 meters north and 1,300 meters south of County Road 505W (Miller Hill Road) in the Upper Miller Hill turbine development area. PCW's understanding is that this recommendation is intended to minimize risks to eagles that could use this portion of the Miller Hill Rim for soaring and kiting behaviors. As described in Use Recommendation 2, Miller Hill Rim does not provide regular soaring and kiting opportunities. Additionally, analysis of flight paths collected between 2011 and 2013 indicate that eagles generally fly perpendicular with the Miller Hill Rim in this area. This indicates that a 300-meter setback will likely provide no additional protection for eagles above and beyond the 100m setback adopted in Use Recommendation 2.

PCW has developed an alternate strategy to avoid and minimize risks to eagles in the area identified in Use Recommendation 3. Based on the eagle use data in this area, PCW has removed 4 turbines that were in the preliminary Phase I wind turbine layout (3

[6] See Figure 1 for the location of the Sierra Madre 13 meteorological tower.

immediately north of County Road 505W and 1 approximately 1200m south of County Road 505W) and has set one turbine back approximately 270m from Miller Hill Rim (Figure 4). The removal and setback of these turbines avoids impacts to eagles in an area with documented use and provides the protection intended by the Service with the 300 meter setback because it removes turbines and expands the flight corridor in this area when combined with the measures adopted for Use Recommendation 4. This measure provides equal or greater protection to eagles and non-eagle raptors as it removes many of the highest risk turbines and expands the avoidance areas described in Use Recommendation 4. *See attached Figure 4 – Sierra Madre Avoidance and Minimization Measures*

Use Recommendation 4. *The Service recommends placing a 300-meter buffer around west and southwest facing slopes in the McKinney Creek headwaters roughly adjacent to County Road 505W (Miller Hill Road) in the Upper Miller Hill Phase I development area.* [recommended 07/24/13 (map 3)]

Eagle flight paths in the area are roughly perpendicular with Miller Hill Rim and consist of direct powered flight indicating that eagles are using the predominant westerly and southwesterly wind directions to move through the area. Eagle use data does not indicate that eagles are using this area for soaring and kiting behaviors; however, after review of the eagle use data, PCW has removed 6 turbines from the preliminary Phase I turbine layout in this area to maintain a movement corridor for eagles (Figure 4). When combined with the measures described in PCW's response to Use Recommendation 3, the removal of these turbines creates a 0.75 to 1 mile wide movement corridor that provides a connection to undeveloped portions of Miller Hill, the Miller Hill Turbine No-Build Area, and the other avoidance areas PCW designated in response to Use Recommendations 2 through 6. *See attached Figure 4 – Sierra Madre Avoidance and Minimization Measures*

Use Recommendation 5. *The Service recommends placing a 300-meter buffer around west and southwest facing slopes immediately adjacent the RM14 raptor monitoring location in the Lower Miller Hill Phase I development area.* [recommended 07/24/13 (map 3)]

Between 2011 and 2013, PCW completed raptor monitoring at multiple locations throughout the CCSM Project Site. Raptor Monitoring site 14 (RM14) was monitored for the majority of the survey period and was documented as having consistent use by eagles and non-eagle raptors. Eagle use in this area indicates that the slopes surrounding the monitoring site could be used by eagles and non-eagle raptors for soaring and kiting activities. PCW has incorporated this recommendation into the Phase I wind turbine layout (Figure 4).

Use Recommendation 6. *The Service recommends placing a 300-meter buffer around slopes immediately adjacent to the RM13 raptor monitoring location in the Lower Miller Hill Phase I development area.* [recommended 07/24/13 (map 3)]

Between 2011 and 2013, PCW completed raptor monitoring at multiple locations throughout the CCSM Project site. Raptor Monitoring site 13 (RM13) was monitored in

2011 and areas adjacent to RM13 were monitored during 2012 and 2013. Eagle use in this area indicates that the slopes surrounding the monitoring site could be used by eagles and non-eagle raptors for soaring and kiting activities. PCW has incorporated this recommendation into the Phase I wind turbine layout (Figure 4).

Miller Hill

On August 10, 2012, the Service provided its initial recommendations regarding the Miller Hill area of the CCSM Project. These recommendations have largely been superseded or incorporated into the Service's subsequent recommendations as described below; however, PCW has described each recommendation and how it has been applied to the Phase I wind turbine layout for reference.

Miller Hill Recommendation 1. *Based on eagle exposure rates, RM14 had the third highest eagle use (similar to that of the Interior Rim) of all 15 eagle/raptor point count locations, and RM13 had the fourth highest use. Both of these points occur on the eastern side of the proposed avoidance area, suggesting additional survey data are needed in this location. We will provide survey recommendations in the near future.* [recommended 08/10/12, superseded by Use Recommendations 5 and 6]

Refer to PCW's response to Use Recommendations 5 and 6.

Miller Hill Recommendation 2. *At least one study reported high density prairie dog colonies and towns occur on the western side of Miller Hill. Eagle flight path data on this side suggest lower eagle use than on the eastern side; however, additional survey data are also needed for this area due to potential high density prey base, and the presence of sage-grouse that are also prey items for golden eagles. We will provide survey recommendations in the near future.* [recommended 08/10/12, superseded by Prey Recommendation 3]

Refer to PCW's response to Prey Recommendation 3 and BBCS Recommendations 1 and 2.

Miller Hill Recommendation 3. *Monitor GOEA nest #162 at SW corner of Sierra Madre. If active in 2013, determine activity patterns of the eagles including flight paths, foraging locations, and roosts, and continue monitoring activity of the adults and fledglings.* [recommended 08/10/12]

Nest 162 was not active in 2012 or 2013. Refer to PCW's response to Nest Recommendations 1 through 8.

Miller Hill Recommendation 4. *In evaluating eagle use on the western side of Miller Hill (and at nest #162), monitor eagle use patterns at and near the greater sage-grouse leks, particularly while grouse are on leks.* [recommended 08/10/12]

PCW has collected more than four years of data related to greater sage-grouse use in the CCSM Project Site. Eagle use patterns at or near greater sage-grouse leks do not indicate that these locations are important for eagle foraging; therefore, these locations do not

represent important eagle use areas. PCW's 2012 Prey Base Assessment Report describes in detail observed eagle use associated with lek locations.

Miller Hill Recommendation 5. *Determine if golden eagles are moving between Miller Hill and Rasmussen Reservoir in search of prey, particularly during the fall when prairie dog numbers decline and waterfowl and coot numbers increase.* [recommended 08/10/12]

Some possibility exists for movement between Miller Hill and Rasmussen Reservoir. To address Miller Hill Recommendation 5, PCW has removed two full rows of turbines and has partially removed a third row of turbines from the preliminary Phase I turbine layout (refer to PCW's responses to Prey Recommendations 1 through 3, BBCS Recommendation 1 and Figure 4) and has established 300 meter buffers surrounding slopes adjacent to monitoring locations RM13 and RM14 (refer to PCW's response to Use Recommendations 5 and 6).

Non-eagle Raptors

On October 1, 2013, the Service recommended two areas to avoid for the benefit of non-eagle raptors based on the prey resource survey data for the CCSM Project. While the Service acknowledges that these areas are not associated with eagle use areas or flight paths, it states that the areas "may attract eagles and other raptors" and that PCW should consider incorporating these avoidance areas into the Bird and Bat Conservation Strategy (BBCS) for the CCSM Project. PCW has reviewed the site-specific data and the Service's recommendations for non-eagle raptors. PCW has identified alternate approaches to implement the Service's recommendations in the Phase I wind turbine layout. PCW believes that these alternate implementation strategies provide the protection the Service seeks in its recommendations.

BBCS Recommendation 1. *South – West of Rasmussen Lake are three relatively large white-tailed prairie dog towns with high density of burrows/animals (487, 488 and 49). As discussed previously, these three towns are separated from the cluster in A* [refers to the area identified in Prey Recommendation 3] *by more than two and a half times the average distance between the towns in the cluster. Other data, such as observed eagle flight paths, do not strongly suggest these towns are heavily used by eagles as foraging locations. However, compared to other towns, these are relatively large with a high burrow density, suggesting that white-tailed prairie dogs might be locally abundant and may attract eagles and other raptors. The recommendation is to buffer these three towns by 120 meters (396 feet), the approximate height of the "typical" wind turbine.* [recommended 10/01/13]

The Service developed BBCS Recommendation 1 to protect a prey resource area that "may attract eagles and other raptors." PCW has evaluated this recommendation and has proposed alternate measures to the preliminary Phase I wind turbine layout to protect eagles and other raptors that may be attracted to the identified prey resource.

PCW's White-tailed Prairie Dog Survey Report and Eagle Use Assessment for Phase I of the Chokecherry and Sierra Madre Wind Energy Project did not identify any concentrated prey resources within the Phase I development area that are also important eagle use areas; however, based on the concern expressed by the Service, PCW evaluated the site-specific information and removed the row of turbines immediately north of the colony

located approximately 0.9 miles west of County Road 401 from the preliminary Phase I wind turbine layout (Figure 4). Removal of this row of turbines provides a 1 to 1.25 mile wide corridor connecting the Miller Hill Turbine No-Build Area and the Rasmussen Reservoir Turbine No-Build Area. Removal of these turbines preserves the existing prey resource and provides additional connectivity between the Turbine No-Build Areas. In combination with PCW's response to the Prey Recommendations, these measures provide the protections for eagles and non-raptors the Service requested in BBCS Recommendation 1.

BBCS Recommendation 2. *North – The north side of lower Miller Hill contains some of the largest and most dense white-tailed prairie dog towns mapped in 2013, with a total area of about 1 square mile (Table 2). While no demonstrated important eagle use areas or multiple eagle flight paths overlap these towns, we recommend this area be included in avoidance and minimization under the Bird and Bat Conservation Strategy (BBCS) to protect other raptors. In addition, ACPs could be developed for eagles. Measures might include: (1) turbine removal, (2) seasonal curtailment, and (3) additional study to determine how the area is used by raptors and eagles. The 120-meter buffer is based on the height of a "typical" wind turbine.* [recommended 10/01/13]

The Service's recommendation is designed to "protect other raptors." Avian surveys were conducted in this area from 2011 to 2013. Nearly 138 hours of observation occurred in this area during 2011 through 2012 long-watch surveys. An additional 19 hours of survey occurred in this area as part of the 2012 through 2013 800-meter point count surveys. During 157 hours of survey, only five raptors (two northern harriers, one merlin, one ferruginous hawk, and one Swainson's hawk) were documented in the vicinity of these prairie dog colonies. No eagle observations occurred in this area. Of these observations, only the Swainson's hawk and ferruginous hawk are likely to regularly prey on white-tailed prairie dogs. Due to the very low use of the area by "other raptors," this recommendation will provide little benefit to raptor species compared with other recommendations made by the Service and the conservation measures identified in PCW's response to BBCS Recommendation 1; therefore, the Phase I wind turbine layout does not avoid the area identified in BBCS Recommendation 2. *See attached Figure 4 – Sierra Madre Avoidance and Minimization Measures*

Conclusion

PCW has worked closely with the Service to develop measures to avoid and minimize impacts to bald and golden eagles. PCW's designated Turbine No-Build Areas avoid placement of turbines in identified important eagle use areas and provide flight corridors between those areas. Additionally, the comprehensive measures described in this memorandum avoid or minimize risks in important eagle use areas as well as other areas commonly used by eagles and other raptors including topographic features, prey resources, and movement corridors.

All the avoidance and minimization measures PCW is implementing are based on site-specific data collected over a four year period using protocols developed in coordination with the Service and in compliance with the ECP Guidance and WEG Guidance. In developing the Phase I wind turbine layout, PCW has incorporated and applied the Service's recommended avoidance and minimization measures as discussed in detail above. As a result, the Phase I wind turbine layout

complies with the ECP and WEG Guidance and represents the culmination of an iterative approach to siting and site characterization consistent with Stages 1 and 2 of the ECP Guidance and Tiers 1 through 3 of the WEG Guidance. The resulting Phase I wind turbine layout, when combined with approved or experimental Advanced Conservation Practices avoids and minimizes impacts to bald and golden eagles such that additional take is unavoidable.

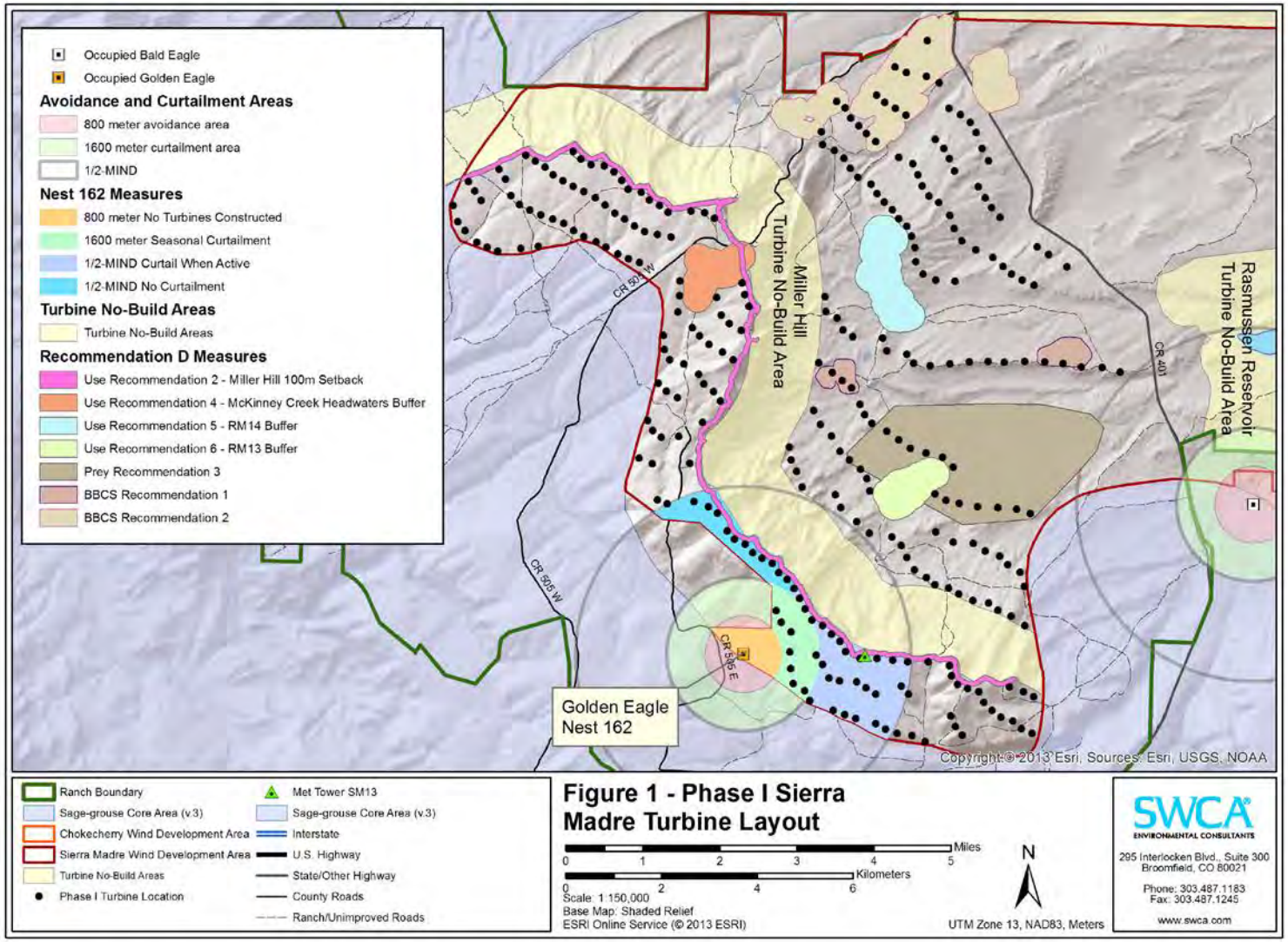

Figure 1 - Phase I Sierra Madre Turbine Layout

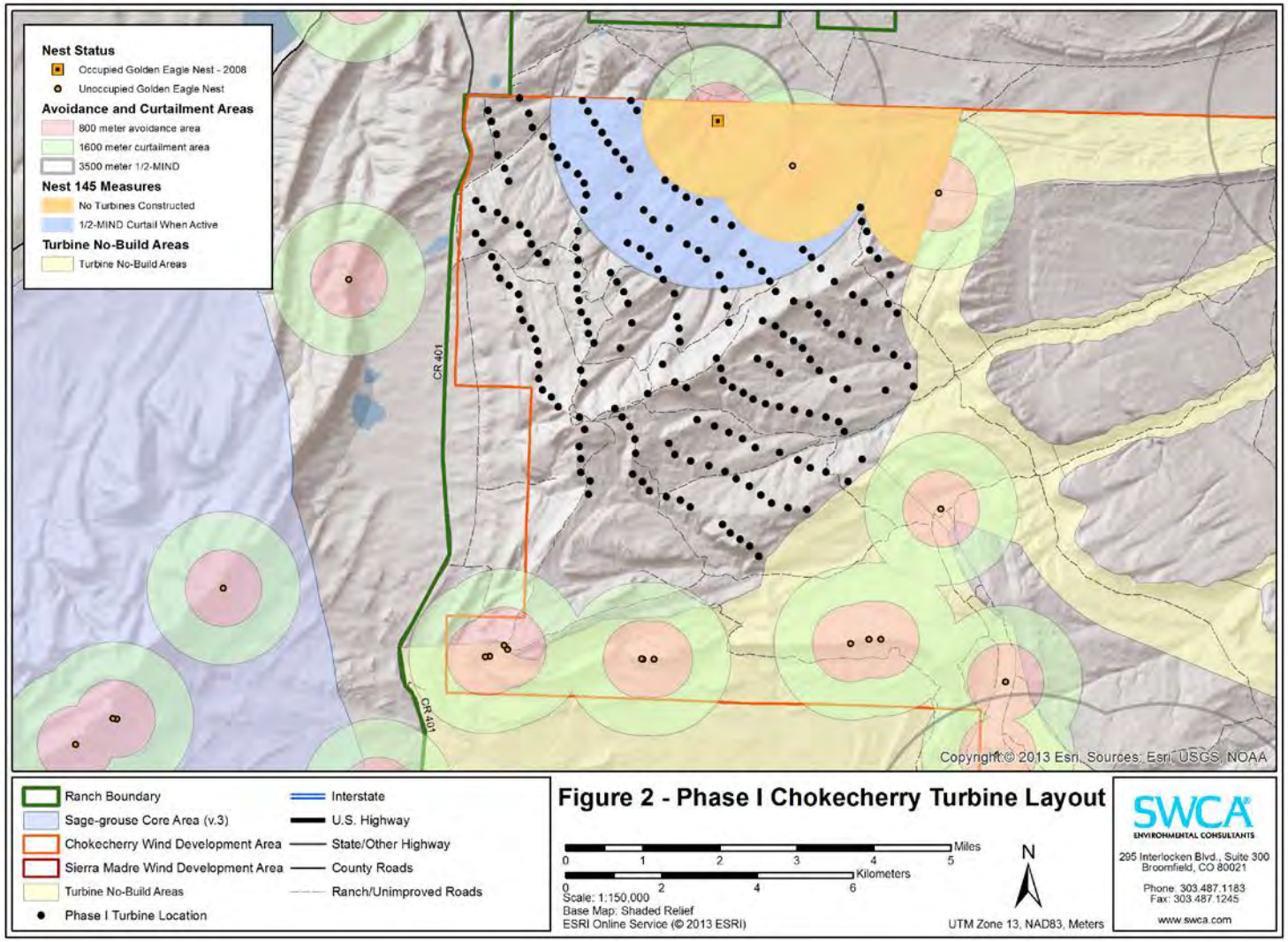

Figure 2 - Phase I Chokecherry Turbine Layout

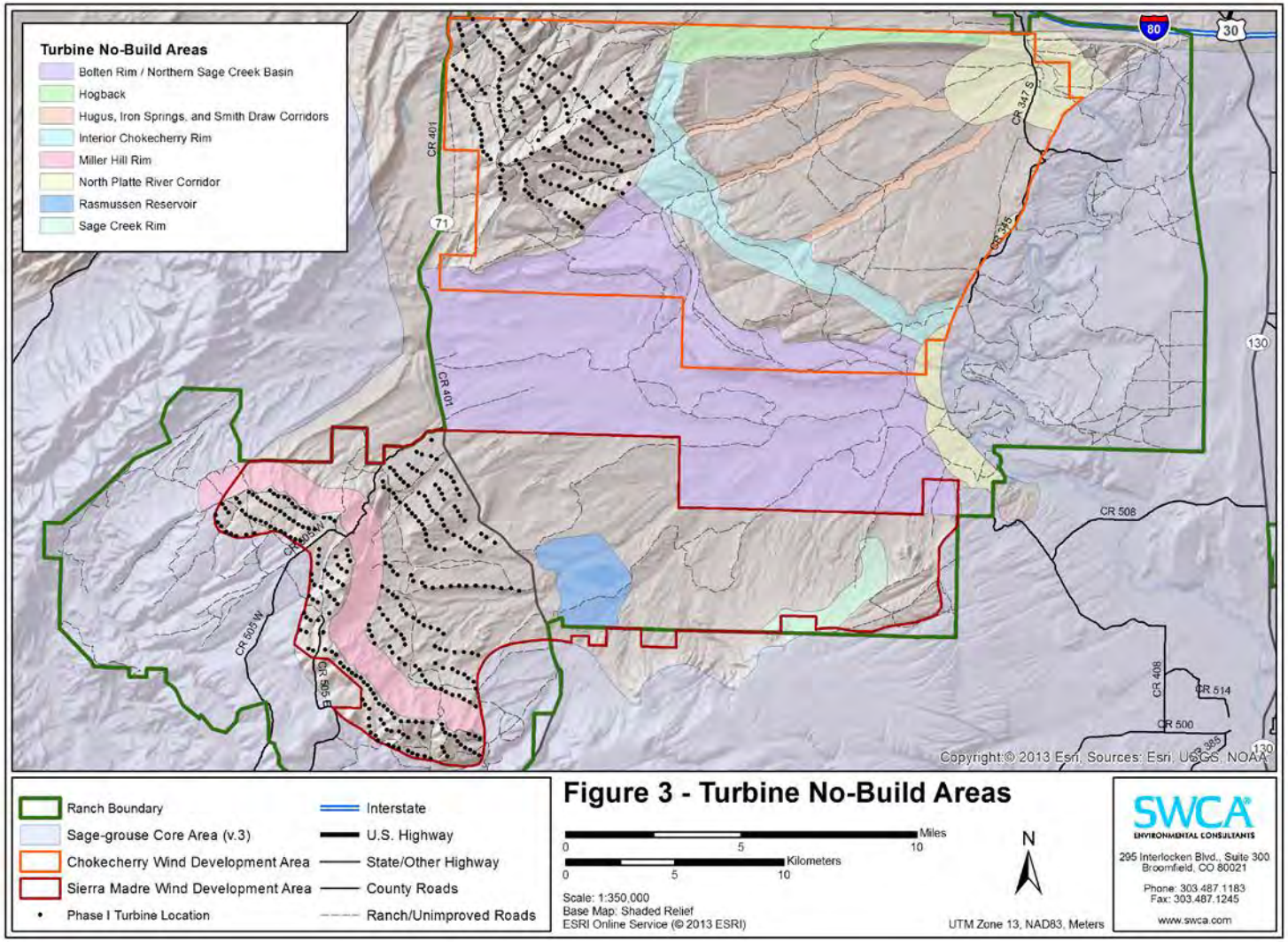

Figure 3 - Turbine No-Build Areas

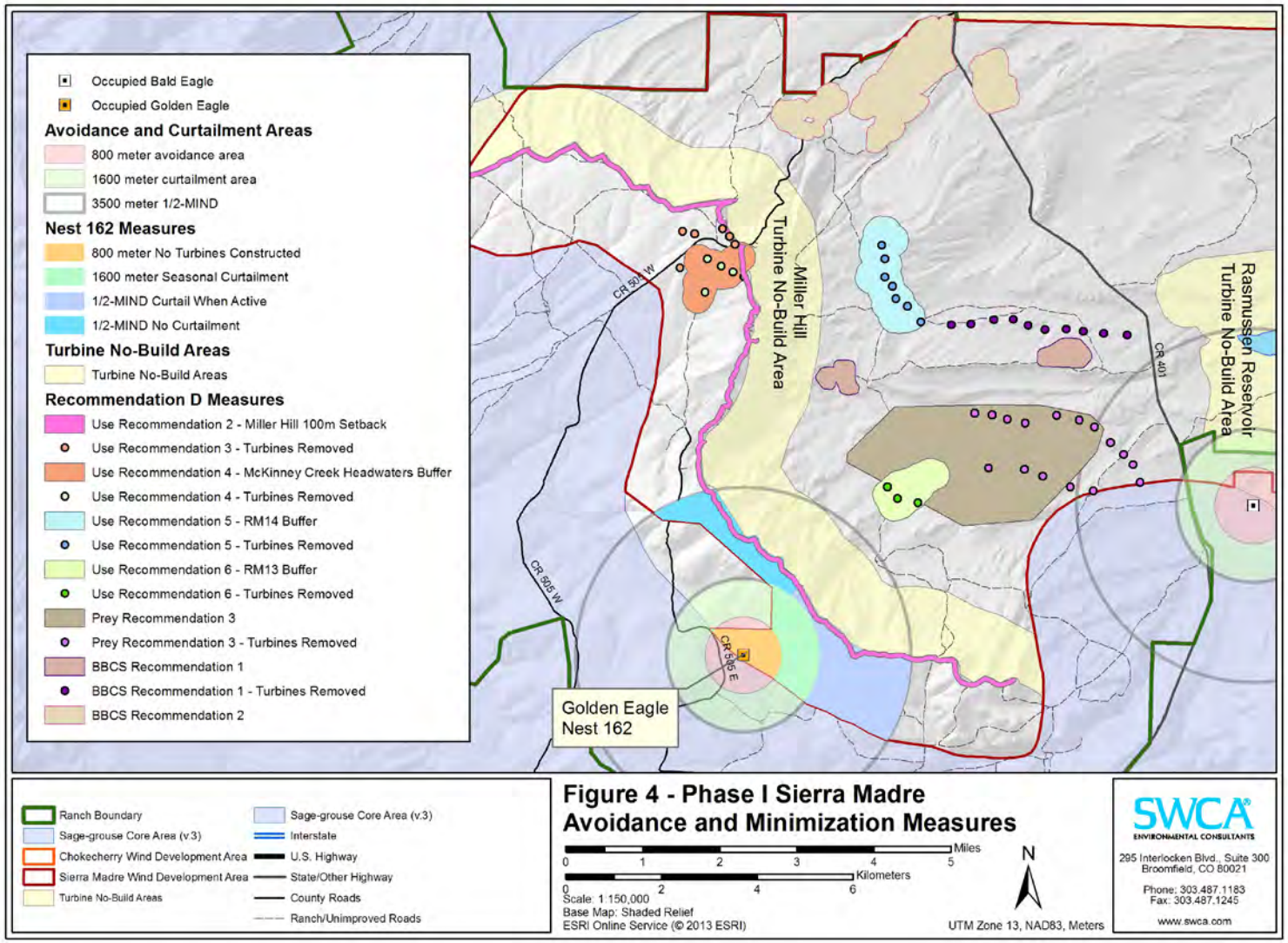

Figure 4 - Phase I Sierra Madre Avoidance and Minimization Measures

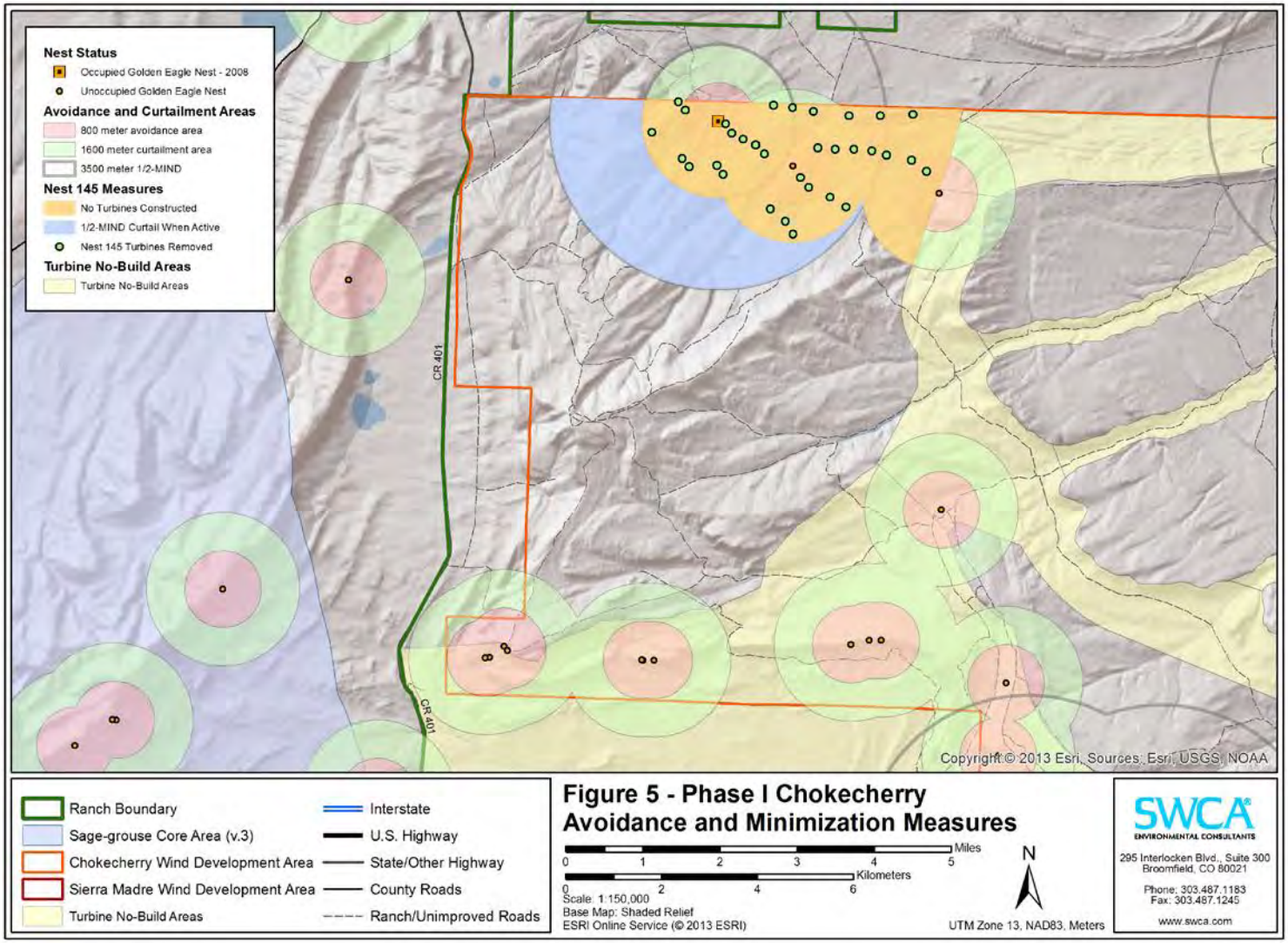

Figure 5 - Phase I Chokecherry Avoidance and Minimization Measures

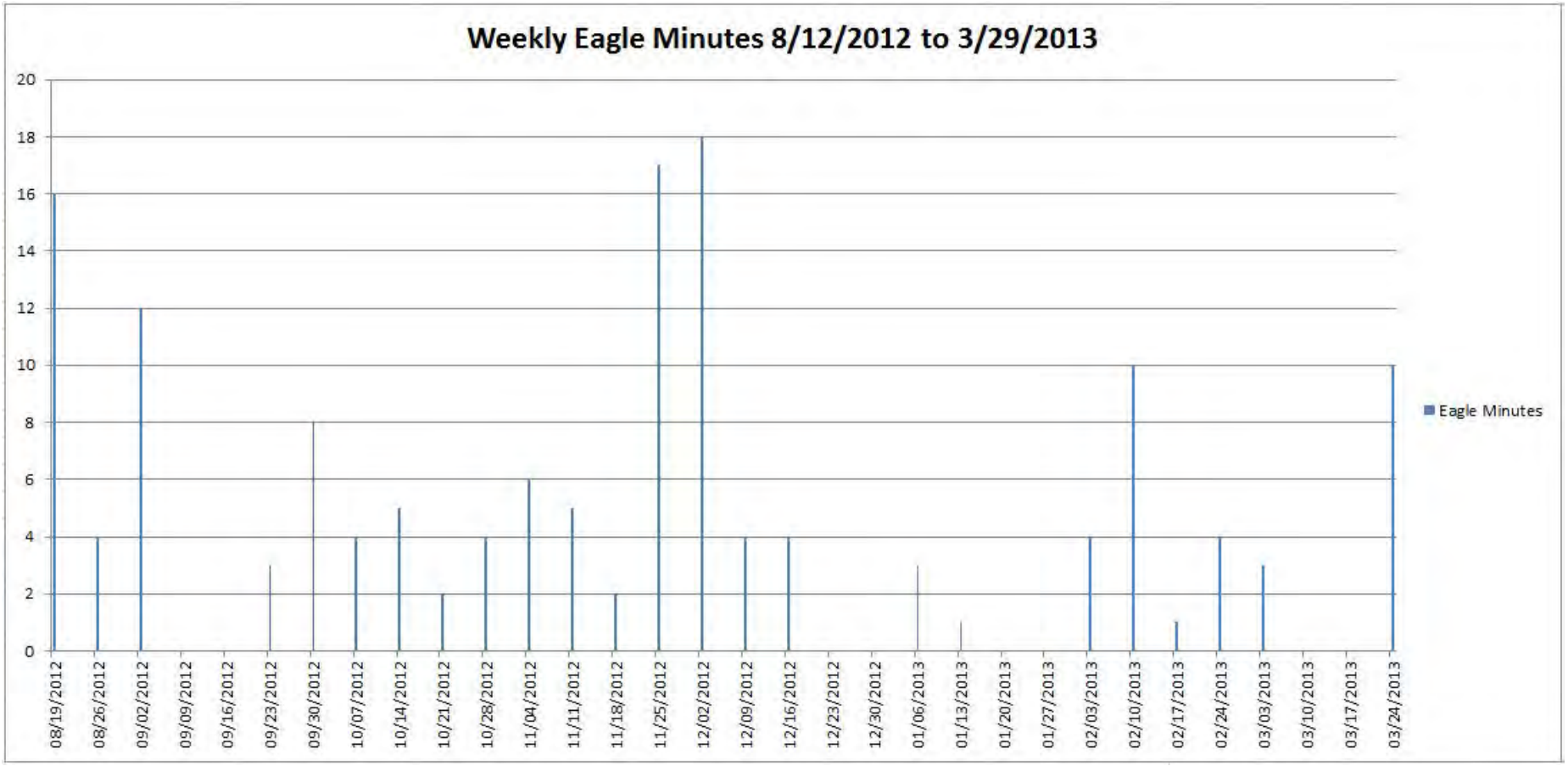

Figure 6. Summary of eagle flight minutes between August 2012 and March 2013. The Y-axis represents the number of minutes of observed eagle use recorded during each week's survey efforts. Approximately 30 hours of survey occurred each week during this period.

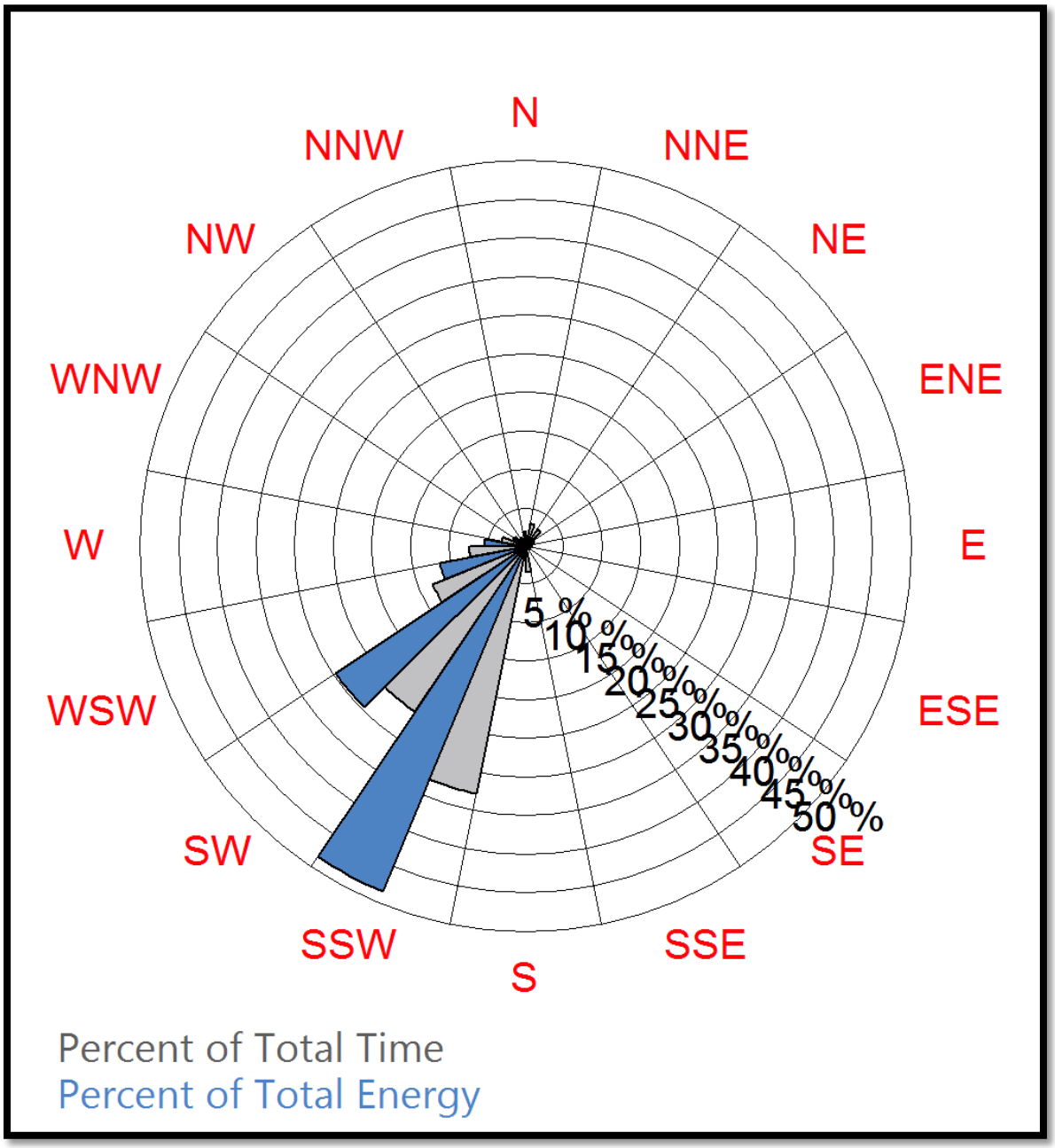

Figure 7. Annual Wind Rose for Meteorological Tower "Sierra Madre 13"

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Fax 303.299.1356
www.powercompanyofwyoming.com

MEMORANDUM

BY ELECTRONIC MAIL

TO: U.S. Fish and Wildlife Service

DATE: January 22, 2014

RE: Revisions to CCSM Project Phase I Wind Turbine layout in response to the Service's eagle avoidance and minimization recommendations made on December 5, 2013

Power Company of Wyoming LLC (PCW) and the U.S Fish and Wildlife Service (Service) continue to work cooperatively to identify eagle avoidance and minimization measures for Phase I of the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project). PCW and the Service met on December 5, 2013, to discuss the CCSM Project Phase I wind turbine layout submitted by PCW on November 26, 2013. This memorandum outlines the recommendations made by the Service on December 5, 2013, and provides a revised Phase I wind turbine layout that complies with these recommendations (Figures 1 and 2).

Previously, on November 26, 2013, PCW provided the Service with the Phase I wind turbine layout and a memorandum discussing the layout's compliance with the Service's recommended eagle avoidance and minimization measures. In the memorandum, PCW compiled the various eagle avoidance and minimization measures recommended by the Service over the course of the CCSM Project review and gave each recommendation a specific designation. For ease of reference, this memorandum relies upon the designations used in the November 26, 2013, memorandum.

At the meeting on December 5, 2013, PCW and the Service discussed the Service's review of the November 26, 2013, memorandum and Phase I wind turbine layout and PCW's implementation of the recommended eagle avoidance and minimization measures. The Service agreed that PCW's compilation of the Service's recommendations was accurate. Therefore, the discussion focused on areas outlined in the November 26, 2013, memorandum where PCW identified an alternate approach to implementing the Service's recommendations. This memorandum addresses the recommendations discussed at the December 5, 2013, meeting and any subsequent modifications the Service and PCW agreed to with respect to either the implementation strategies or the Phase I wind turbine layout.

RECOMMENDATIONS

Nest Recommendation 2

Recommendation: We recommend that turbines not be constructed within 800 meters (0.5 mile) of any unoccupied (historic) golden eagle nest, and that all turbines between 800 meters and 1,600 meters (1.0 mile) of any unoccupied nest are curtailed during each year starting 15 January until 1 May, or until adequate nest surveys demonstrate that the nests are unoccupied. Further, if the nest becomes occupied, turbines within the ½-MIND of the nest should be curtailed during the breeding season until the young fledge and are no longer dependent on the nest or until the nest becomes unoccupied. [recommended 05/03/13, detailed 05/15/13 (map 5)]

Update: Nest Recommendation 2 will be implemented as described by PCW in the November 26, 2013 memorandum. The site-specific data and analysis for the CCSM Project demonstrate that eagle use is very low during January and early February; therefore, PCW will curtail turbines located within 1,600 meters of an unoccupied golden eagle nest between February 1 and April 30 or until nest activity is determined. (This modification to the recommended seasonal curtailment period also applies to Nest Recommendations 3 and 4)

Nest Recommendation 3

Recommendation: Add avoidance area around GOEA nest #162 at SW corner of Sierra Madre. [recommended 08/10/12, updated 05/15/13 (map 1), 07/24/13 (map 3), and 12/05/13]

Update: In addition to the eagle avoidance and minimization measures for nest #162 described in the November 26, 2013 memorandum, the Service recommended that PCW seasonally curtail nine turbines along Miller Hill rim outside of the 1600 meter curtailment area while the nest is occupied. If the nest becomes unoccupied, as defined in the May 3, 2013 letter from the Service, the nine additional turbines along Miller Hill rim would no longer be curtailed and the nest would be treated like other unoccupied nests under Nest Recommendation 2 above. PCW agrees to comply with this updated recommendation and will apply the measures shown on Figure 3 to nest #162.

Nest Recommendation 7

Recommendation: The Service clarified that curtailment, as contemplated in Nest Recommendations 1 through 5, only applies during daylight hours when eagles are active. The Service further indicated that it defines daylight hours as ½ hour before sunrise to ½ hour after sunset in the absence of site-specific data. [recommended 07/24/13 (meeting notes)]

Update: Nest Recommendation 7 will be implemented as described in the November 26, 2013 memorandum. The site-specific data and analysis for the CCSM Project demonstrate that eagle activity is very low during early morning and late evening hours; therefore, turbines subject to curtailment under Nest Recommendations 1 through 5 will be curtailed during daylight hours (sunrise to sunset).

Prey Recommendation 3

Recommendation: West of Rasmussen Lake is a relatively dense cluster of white-tailed prairie dog towns that collectively intersect at least eight eagle flight paths and that lie within a white-tailed prairie dog colony mapped by the Wyoming Game and Fish Department (WGFD). While the towns are not large individually (largest is 44.5 acres), due to their close proximity to each other they may collectively (317 acres) create a geographic unit with overall higher density of prey resources than adjoining areas, and therefore attract eagles and other raptors.

Other relatively large towns north of the cluster (487, 488 and 49) are separated from the group by more than two and a half times the average distance between the towns within the cluster (average = 353 meters). These three towns were not included in the cluster but will be treated separately due to their size and density of burrows. However, if the area between the cluster and the three towns was not surveyed in 2013 and if more towns are present, the cluster should be enlarged to include these towns.

One large town east of the cluster (2942) was not included, because it was inactive in 2013 and is about 0.5 kilometer from the group; however, including this town may be recommended as it could become reoccupied in the future. Finally, several small towns west of the cluster (485, 84, 3797, 3796, 3744, and 1728) were not included in the cluster, because of their small size and location outside of the WGFD polygon, and also due to inactivity at some towns and the lack of observed eagle flight paths. [recommended 10/01/13]

Update: Based on recommendations made by the Service in the December 5, 2013 meeting on the implementation of Prey Recommendation 3, PCW modified the November 26, 2013 Phase I wind turbine layout. As shown on Figures 4 and 5, ten turbines were relocated to other portions of the Phase I wind development area. Seven turbines along the southern boundary of the Prey Recommendation 3 area remain in the Phase I wind turbine layout based on the site-specific data that show a lack of observed eagle use surrounding those turbine locations. The lack of observed eagle use in the southern portion of the Prey Recommendation 3 area indicates that the area is not an “important eagle-use area” or a “project-specific eagle activity area” and therefore does not meet the Service’s criteria for avoidance. (This modification to the implementation of Prey Recommendation 3 does not affect compliance with Miller Hill Recommendations 2 and 5 as described in the November 26, 2013 letter.)

CONCLUSION

The Phase I wind turbine layout shown in Figures 1 and 2 complies with the eagle avoidance and minimization recommendations made by the Service, as set forth in the November 26, 2013, memorandum from PCW to the Service and as updated following the meeting on December 5, 2013. The layout reflects the measures recommended by the Service and implemented by PCW to avoid and minimize impacts to bald and golden eagles to the extent practicable such that that additional take is unavoidable, consistent with the ECP Guidance, Wind Energy Guidelines, and the provisions of the Bald and Golden Eagle Protection Act.

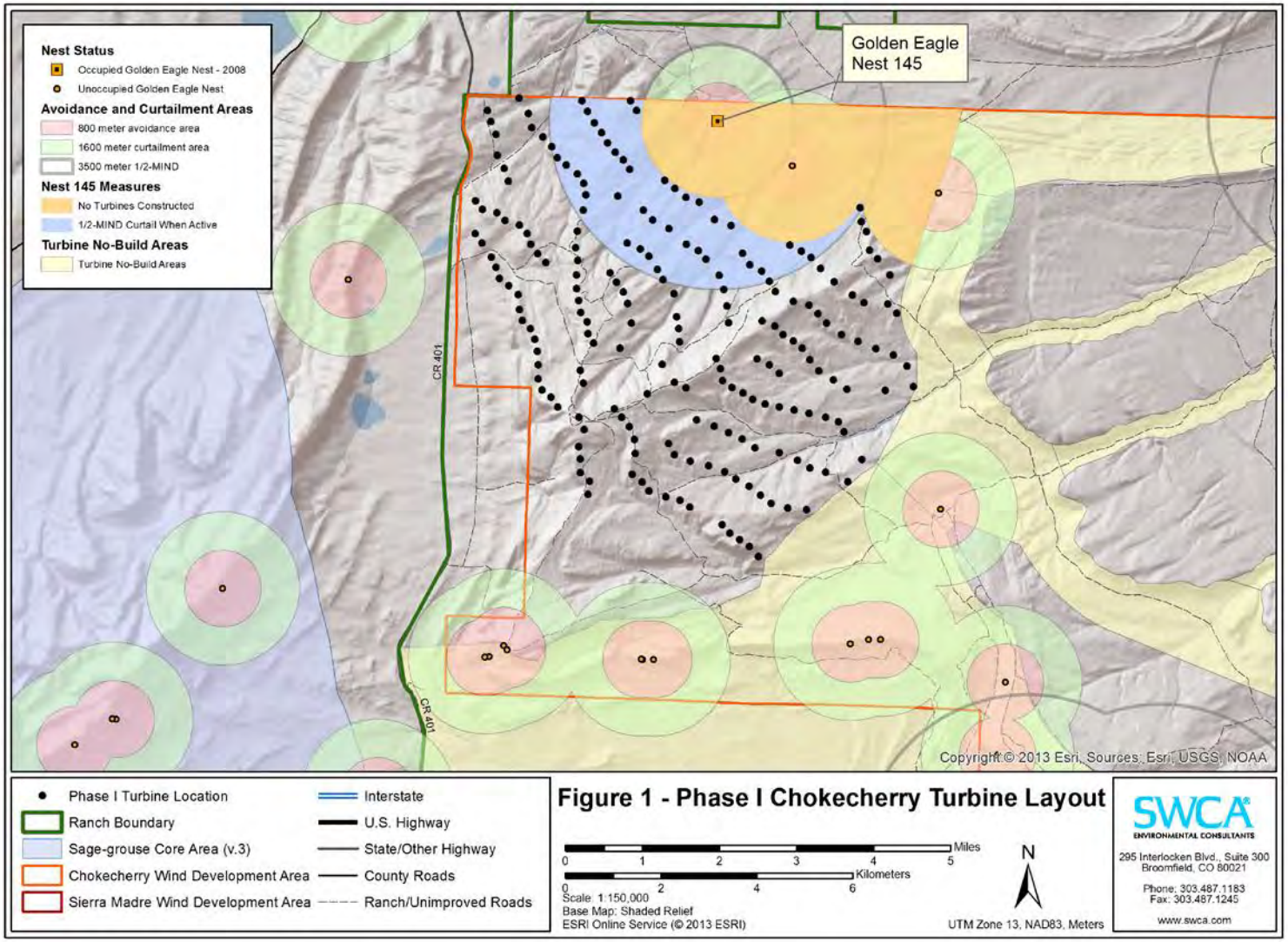

Figure 1 - Phase I Chokecherry Turbine Layout

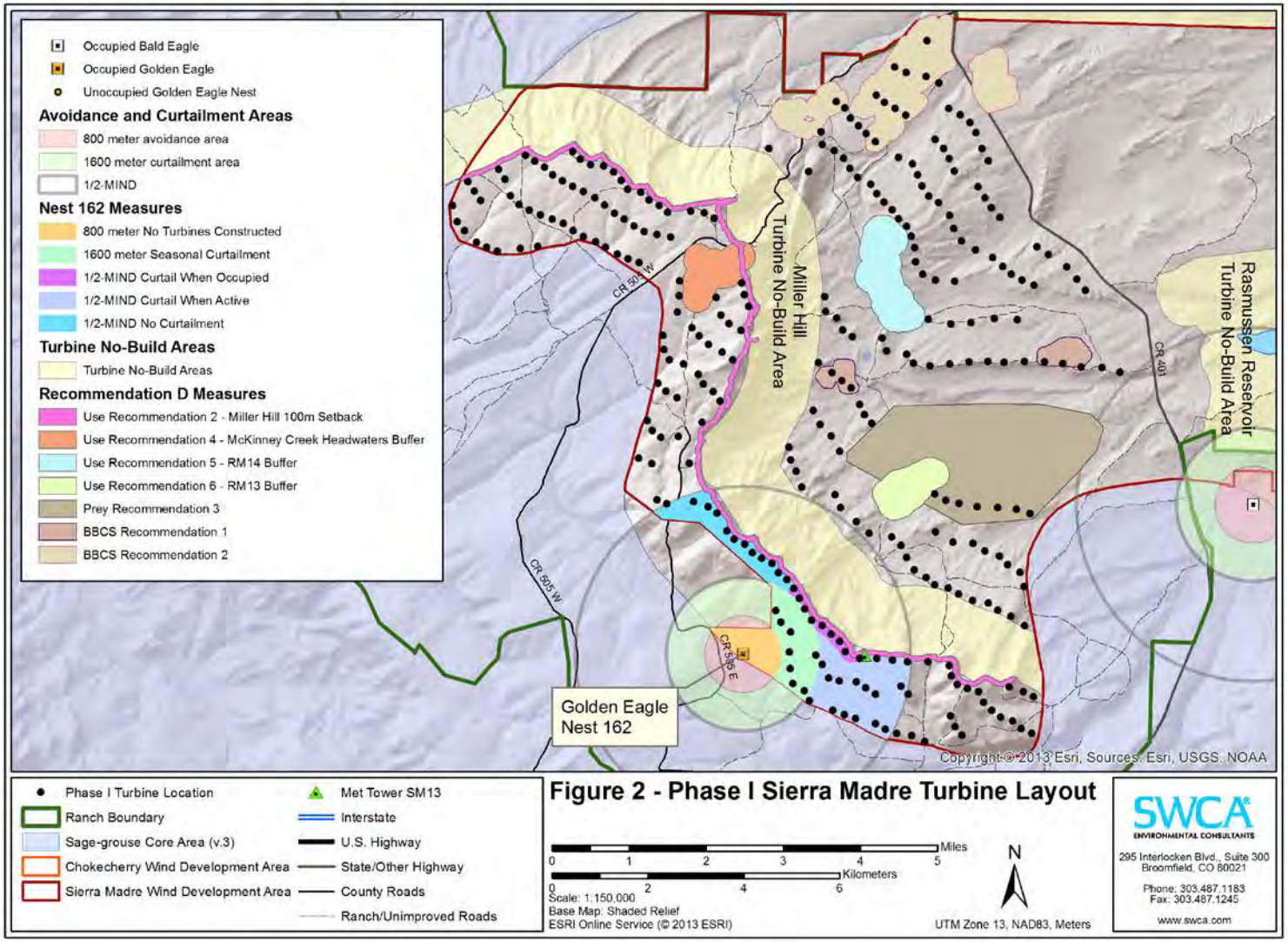

Figure 2 - Phase I Sierra Madre Turbine Layout

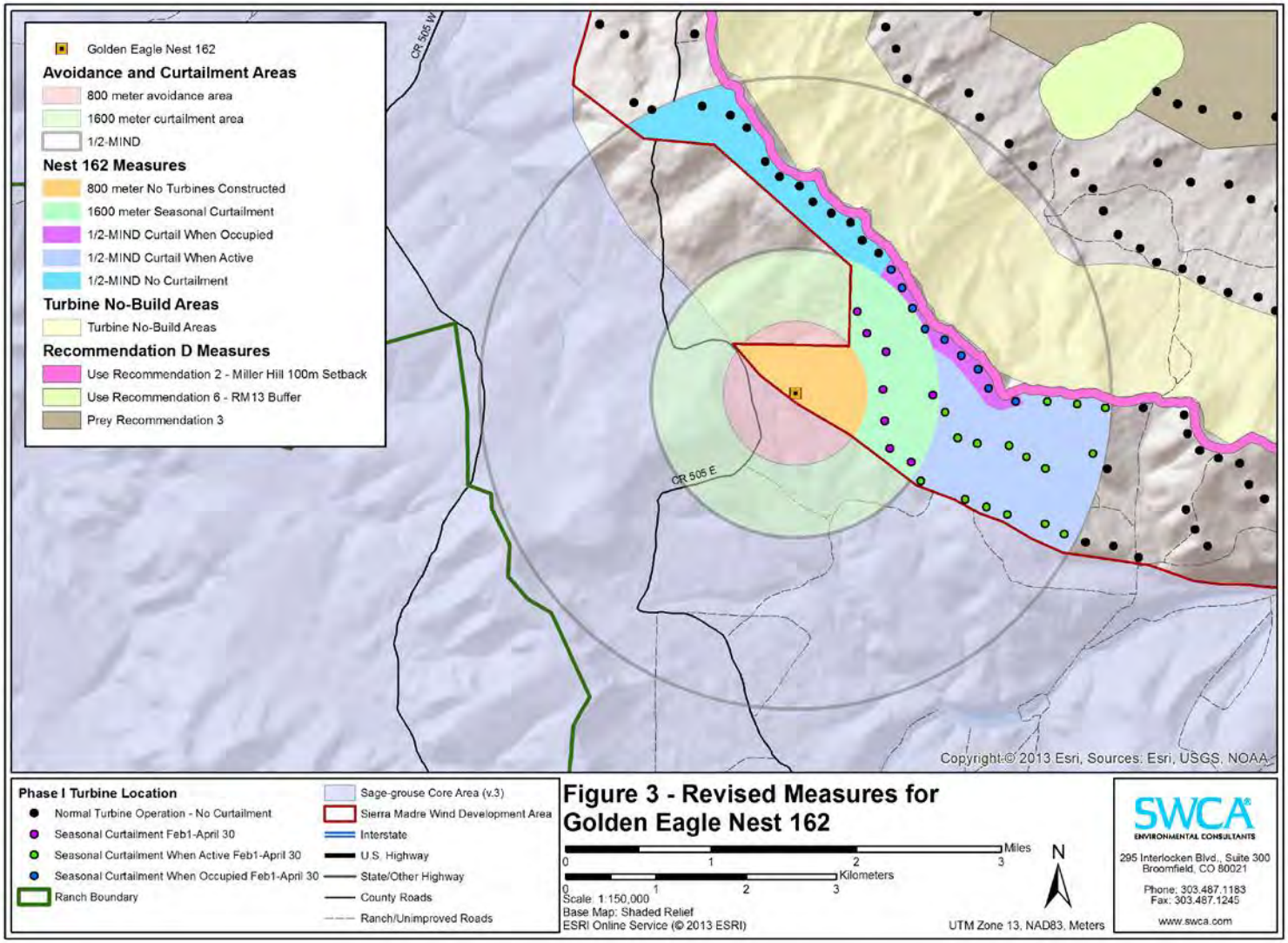

Figure 3 - Revised Measures for Golden Eagle Nest 162

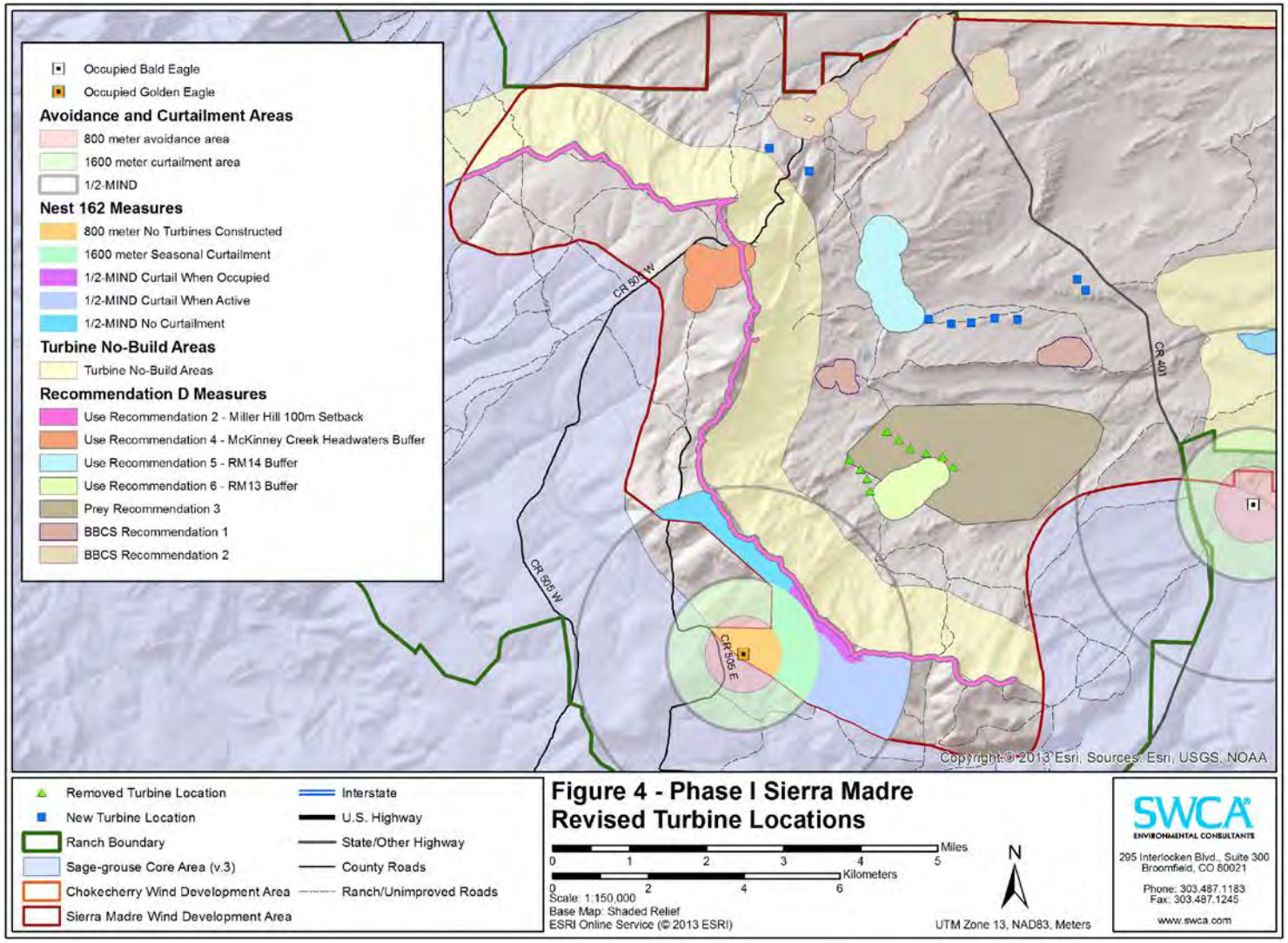

Figure 4 - Phase I Sierra Madre Revised Turbine Locations

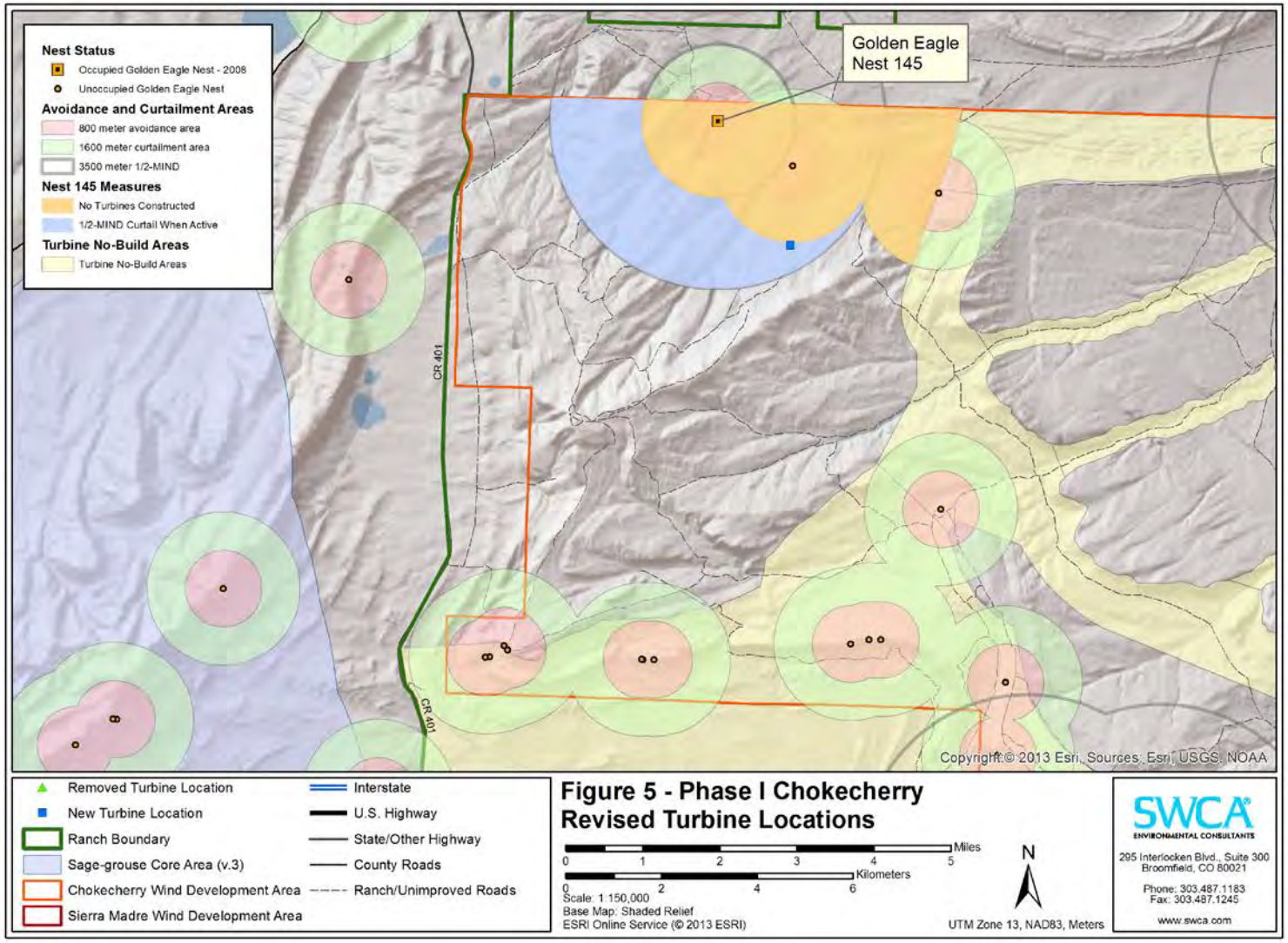

Figure 5 - Phase I Chokecherry Revised Turbine Locations

U.S. Fish and Wildlife Service Recommendations for Eagle Nests Referenced in EA1 and Site-Specific Plans of Development (SPODs 1, 2, 3, and 4) for the Chokecherry and Sierra Madre Wind Energy Project Phase 1

U.S. Fish and Wildlife Service, Region 6, Wyoming Ecological Services Field Office
and Region 6 Migratory Bird Management Office

August 14, 2014

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Recommendations for Eagle Nests Referenced in EA1 and SPODs 1, 2, 3, and 4

Quarry

Issue: The quarry is located within 540 feet of golden eagle (GOEA) nest #145 (GE20870401) that was active in 2008. Construction of the quarry is scheduled for September through October of 2014, outside of the eagle nesting season. Expected operation of the quarry during construction of the haul road and turbines and other structures is April through November.

Recommendations: We recommend PCW affirm its commitment to suspend operations at the quarry if the GOEA nest is occupied until after the young have fledged. If the nest is occupied, this means the quarry might not be usable until the young fledge, which may be in June or even July in some years, rather than starting operations in April.

Suspending operations at the quarry for two or more months could impact the construction schedule of other project features; therefore, we recommend PCW identify alternate sources of gravel and commit to using the source(s), if needed, for up to several months.

The nest is already included in annual monitoring as part of the turbine curtailment plan, but we recommend the nest also be monitored annually prior to construction and operation of the gravel pit to determine if the nest is occupied.

Haul Road

Issue: Two historical (unoccupied) GOEA nests occur within 340 feet (GE20873601) and 590 feet (GE19860702) of the haul road. The SPOD states that the location of the haul road cannot be moved due to design constraints. Construction of the haul road is expected September through November of 2014 and again from June to November in 2015, which is largely outside of the eagle nesting season. However, during turbine construction, the haul road could be in use as early as March and as late as December (SPOD 4, p. 5-2), which overlaps the eagle nesting season (generally February through July). The haul road will be decommissioned at completion of the project (p. 7-3), but use of the road (type, amount and timing) during project operations is not clearly described.

Recommendations: We recommend PCW affirm its commitment to suspend construction of the haul road near occupied nests until after the young have fledged (e.g., through July, if necessary).

We recommend the nests be monitored annually prior to operation of the haul road to determine if the nests are occupied.

Suspending use of the haul road for 2 to 5 months could substantially impact the construction schedule of the turbines. However, we recommend PCW suspend use of the haul road near any occupied eagle nest until after the young have fledged.

We recommend PCW describe plans for long-term use of the haul road after project construction (e.g., the types of vehicles, timing, and number of trips per day/week) as well as options for using other roads until surveys can determine nests are unoccupied or until young in occupied nests fledge.

If there are no alternatives and use of the haul road is necessary from February through April, then we recommend additional discussions about whether applying for a permit for disturbance take would be appropriate.

The haul road and quarry road will be designed to allow for two-way travel at 40 miles per hour. At this speed, vehicles may run over small mammals and hit large mammals, creating road-kill that may attract eagles and other birds; therefore, we recommend PCW develop a protocol to promptly remove road-kill from these roads.

North Platte River Water Facility

Issue: One bald eagle nest (HL20851101) is within 530 feet of the facility. Construction will occur June through August 2015 and will include a pump. Most activity (e.g., truck loading) will occur at the Smith Draw Water Station, many miles away, but periodic maintenance at the pump will be required.

Recommendations: If the bald eagle nest is occupied, we recommend PCW delay construction until after young have fledged.

We recommend PCW provide more details about the timing and level of activity at the facility during routine operations (maintenance) and whether there are visual barriers between the facility and the nest. Also, describe steps and measures anticipated if pump and facilities are damaged by high flows, and whether these actions can be delayed until young fledge.

We recommend PCW determine ambient noise and noise level of the pump and whether any minimization measures (e.g., sound barrier) are needed to reduce noise levels at the nest.

Transmission Pad

Issue: SPOD4 (Phase 1 Turbines) identifies one GOEA nest (GE20873601) within 475 feet of a transmission pad. This GOEA nest is the same as the one within 340 feet of the haul road.

Recommendations: The term “transmission pad” is only used in the table, but it might be the same as “substation pad” used elsewhere. We recommend PCW provide a description of a transmission pad and whether it is the foundation for an electrical substation and overhead lines.

It is difficult to provide recommendations without understanding what a transmission pad is. However, depending on the level of human activity at the pad after construction, we generally recommend avoiding disturbance within 0.5 mile from an eagle nest, though the distance could be reduced if there are visual barriers and/or human activity is of low intensity.

We recommend construction occur during the non-nesting season unless monitoring is able to determine the nest is unoccupied for that nesting season.

See recommendation under Haul Road for disturbance take.

Evaluate Additional Nests

The SPODs evaluated nests within 825 feet of infrastructure (1,200 for FEHA). However, we recommend PCW conduct an evaluation of all eagle nests within 0.5 mile (2,640 feet) of the haul road, quarry, water facilities, and all other structures and access points (roads, buildings, pads, transmission lines, etc.) regardless of land ownership. We recommend evaluating the total distance (horizontal and vertical), type and intensity and duration of disturbance, and whether there are physical barriers between the disturbance and the nest.

In general, we recommend avoid disturbance within 0.5 mile of eagle nests unless topographic features or other factors allow this distance to be reduced. If PCW cannot accommodate the 0.5-mile buffers, then we need additional discussion about disturbance and whether or not applying for an eagle take permit to cover disturbance take of eagles might be appropriate.

http://www.fws.gov/wyominges/Pages/Species/Species_SpeciesConcern/Raptors.html

Recommendation for EA1

We recommend EA1 include more information about timing of construction and operations and PCW's commitment to suspend activities if nests are occupied. These topics are discussed in the various SPODs, but it would be useful to incorporate this information in EA1 to demonstrate how disturbance to eagles is avoided and minimized. In addition, EA1 could benefit from a discussion about "disturbance" of eagle nests in the environmental consequences section.

From:	Jon Kehmeier
To:	Kelly Cummins
Subject:	FW: CCSM Update and Next Steps
Date:	Friday, October 10, 2014 4:15:49 PM
Attachments:	image001.jpg 2012-08-31 PCW Resp to T Abbott e-mail.pdf

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From: Garry Miller [mailto:Garry.Miller@tac-denver.com]
Sent: Friday, August 31, 2012 3:28 PM
To: Tyler_Abbott@fws.gov
Cc: Brian_A_Millsap@fws.gov; Casey_Stemler@fws.gov; Dave_E_Carlson@fws.gov; Emily_Bjerre@fws.gov; Kevin_Kritz@fws.gov; Mark_Sattelberg@fws.gov; Michael_Thabault@fws.gov; Nathan_Darnall@fws.gov; Pam_Repp@fws.gov; Patricia_Sweanor@fws.gov; Tim_Modde@fws.gov; Jon Kehmeier; Murdock, Pamela M; mvalle@blm.gov; David_Cottingham@fws.gov; Frankie_Green@fws.gov; noreen_walsh@fws.gov; Millspaugh, Joshua J.; Clint King; Roxane Perruso
Subject: RE: CCSM Update and Next Steps

Tyler,

Thank you for the below update concerning tasks the Service is working on for the Chokecherry and Sierra Madre Wind Energy Project. Please see attached letter updating you on PCW's activities. If you have any questions, please let me know.

Garry

GARRY L. MILLER
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From: Tyler_Abbott@fws.gov [mailto:Tyler_Abbott@fws.gov]
Sent: Wednesday, August 29, 2012 11:21 AM
To: Garry Miller
Cc: Brian_A_Millsap@fws.gov; Casey_Stemler@fws.gov; Dave_E_Carlson@fws.gov; Emily_Bjerre@fws.gov; Kevin_Kritz@fws.gov; Mark_Sattelberg@fws.gov; Michael_Thabault@fws.gov; Nathan_Darnall@fws.gov; Pam_Repp@fws.gov; Patricia_Sweanor@fws.gov; Tim_Modde@fws.gov; Jon Kehmeier; Murdock, Pamela M; mvalle@blm.gov; David_Cottingham@fws.gov; Frankie_Green@fws.gov
Subject: CCSM Update and Next Steps

Garry,

There has been a lot of activity regarding product development by PCW and SWCA, and the review of those products by FWS, over the past several weeks. This message is to provide you an update on tasks FWS is currently working on for Chokecherry Sierra Madre, and to lay out what the Wyoming Field Office-- as the FWS lead for this project--sees as next steps.

First, from a process standpoint, I want to emphasize that the Wyoming Ecological Services Field Office in Cheyenne is the lead for this project. Although we are coordinating closely with the Migratory Bird Management Office at both the Regional and National level, the Wyoming Field Office is responsible for facilitating development (by PCW) of an Avian and Bat Protection Plan and Eagle Conservation Plan. Consequently, it is essential that information sharing by PCW and SWCA with FWS include myself and Nathan Darnall (as the staff lead on this project). The Wyoming Field Office appreciates the opportunities we have had over the past two years to coordinate and collaborate with PCW and SWCA on all issues pertaining to this proposed project, and we look forward to continuing to do so.

I understand from Kevin Kritz that you have been working on a number of things recently, including:

- working through the FWS eagle fatality model and generating estimates with clipped avoidance areas;
- developing survey methods to supplement previous and/or ongoing methods;
- eagle population abundance estimates;
- obtaining and/or consolidating information on prey bases.

I appreciate the amount of time and effort that PCW and SWCA has been continuing to invest in these activities that keep the process moving forward-- and we look forward to continuing to work with you on these efforts. In order for this office to continue to support you in these efforts, and to provide ongoing recommendations, ***I would urge you to please share these findings and products with us as soon as you can.***

It would be particularly helpful, for example, for us to understand the nature of the fatality model runs you have conducted, including data used, assumptions, or anything that may be different from the way Patuxent has conducted preliminary runs. The purpose of working together on fatality model runs is to explore the range of alternative models using various assumptions, data and inputs to facilitate our understanding of the full range of risks to eagles. A key point here is that ***the goal is to develop the best predictive model possible***-- the goal is not simply about finding ways to bring down the estimates of eagle fatality by adjusting model assumptions and/or inputs. Those fatality estimates may be affected by future survey data and will come down through a combination of avoidance and minimization measures implemented on the ground, which will be ***reflected in*** the final estimates provided by the model runs. Also, please keep in mind that as you are conducting model runs with clipped avoidance areas, the identification/determination of some of these areas may be premature since future finer-scaled data collection might suggest modifications.

Kevin also stated that you would like to have a meeting some time this week. While I will have Nathan send out a Doodle Poll to set up a meeting some time within the next month, I believe the best course of action to keep this project moving forward is for the FWS to complete several tasks it is currently working on prior to setting-up additional meetings. Additionally, this office sent a letter to PCW on August 10, 2012, articulating several issues of concern and recommendations regarding development and implementation of avoidance and minimization measures in the ABPP and ECP. This letter was issued at the request of PCW as an outcome of our meeting on July 24, 2012. This office remains concerned that-- as of yet-- these issues and recommendations have not been addressed.

FWS is currently working on the following tasks for CCSM:

(1) Reviewing the ECP dated August 14, 2012;
(2) Responding to a FOIA request on CCSM from American Bird Conservancy;
(3) Developing survey recommendations/guidelines to be implemented by SWCA as soon as possible;
(4) Completing the Biological Opinion in accordance with Section 7 of the ESA;
(5) Working with Patuxent staff to continue preliminary fatality model runs;
(6) Review any additional products developed by SWCA including items listed above or anything else sent for review.

As I stated above, the Wyoming Field Office looks forward to continued cooperation and collaboration with PCW and SWCA on all issues pertaining to the proposed Chokecherry Sierra Madre project. Please feel free to call me with any questions,

Thank you, Tyler

Tyler Abbott
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VIA EMAIL: Tyler_Abbott@fws.gov

August 31, 2011

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Tyler:

Thank you for your e-mail of August 29, 2012. I appreciate the update concerning the U. S. Fish and Wildlife Service's (Service) activities in relation to the Chokecherry and Sierra Madre Wind Energy Project (Project). This letter is an update on matters currently being addressed by Power Company of Wyoming LLC (PCW).

First, in regard to the communication protocol, at the end of the meeting at Region 6 on July 13, 2012, Deputy Regional Director Noreen Walsh directed that: (1) the Wyoming Ecological Services Field Office in Cheyenne is the overall lead for reviewing matters related to the Project, especially the Bird and Bat Conservation Strategy and the Eagle Conservation Plan (ECP); and (2) that Kevin Kritz of the Regional Office would be the lead and coordinate discussions related to the Service's model, and that I should communicate with him regarding modeling. I called Kevin on August 21 to inquire as to the status of the model assumptions which the Service was to provide PCW (they have since been received) and to update him on PCW's activities related to the model. I submitted the ECP to you for review on August 14, 2012 and am willing to meet with you or have a conference call with you at any time to discuss the ECP and the significant commitments it contains as well as the redesign of the Project based on PCW's eagle data.

The Service and PCW share the same goal – to develop the best predictive model possible. Towards this end PCW retained the services of Dr. Joshua Millspaugh, a leading expert in the application of statistical techniques and tools to address conservation issues. As I shared with Kevin, Dr. Millspaugh has identified several unreasonable assumptions within the Service's model in light of site-specific information that have been collected for the Project. Three areas of concern which Dr. Millspaugh is examining in depth are the Service's assumptions that (1) there is an infinite population of eagles in the Project area, (2) turbines operate during all daylight hours, all year long, and (3) the hazard area is a cylinder with infinite height around the wind turbine and the eagle is at risk anywhere within the cylinder (i.e., the model does not consider that when eagle flight height is above or below the turbine rotor swept zone, eagles are

not at risk of collision). Dr. Millspaugh is considering scientifically supportable modifications (which are both biologically justifiable and mathematically rigorous) to the Service's model to address these short-comings. When he completes his work, I will share with you his expert report(s).

Another area which Dr. Millspaugh, working in concert with SWCA, is examining is the effect PCW's Project redesign has on predicted eagle fatalities. As you know, the Service's model run included the high eagle-use areas where PCW has agreed to no turbine development. Dr. Millspaugh has rerun the model, clipping out areas of no turbine development but otherwise using all of the Service's assumptions, to arrive at a revised fatality prediction. He is presently finishing up his expert report. The report will be provided to you as soon as it becomes available.

As previously stated, the goal is to develop the best predictive model possible, one that is based on realistic, scientifically supportable data and methods; this is critical if the Service is going to rely on the model to make decisions regarding the Project. If the result of using realistic, scientifically supportable data and methods is that the fatality estimates are lower, then the Service should consider this data, not arbitrarily rely upon its initial modeling for the Project. The Service's eagle guidance directs project developers to estimate eagle fatalities prior to implementing avoidance and minimization measures and advanced conservation practices (ACPs). At this stage, PCW is still working on a realistic fatality estimate from which ACPs may be applied. As you and I have discussed, and Dr. Millspaugh will opine, the Service's estimate of 63 or fewer eagles at the 80% quantile is an extreme case and does not accurately reflect Project risk. I understood from the telephone conference calls with Emily Bjerre, Mark Otto and Brian Millsap that they were open to discussing the model and making adjustments where necessary and appropriate to arrive at a more realistic predictive fatality estimate – an estimate based on science and appropriate to PCW's site-specific conditions.

I also understood that the model is dynamic and will be adjusted in the future as additional survey data becomes available and risks to eagles from wind development are better understood. In fact, I encourage the Service to make this a "living" statistical model that is periodically updated and peer reviewed by the scientific community – both inside and outside of the Service. PCW's efforts are compliant with the Service's eagle guidance which instructs project developers to redesign their wind project such that risk to eagles might be minimized to the maximum degree achievable. PCW fully intends to incorporate future survey data, when available, into the eagle model and update the risk assessment. As detailed in the ECP, this will be done during the site-specific permitting process.

PCW and the Service discussed at the meeting on July 24, 2012, and again during subsequent conference calls, that the Service would provide PCW guidance on implementing new survey protocols prior to August 15, the beginning of the fall migration period. The Service's August 10, 2012 letter also stated that specific recommendations for data collection needs and design would be provided in the near future. The new protocols are necessary as the existing protocols, which the Service instructed PCW to implement, are based upon long-watch 4,000-meter raptor counts and use of avian radar. These surveys were designed to identify high eagle-use areas.

While being beneficial for identifying the high-use areas, informing PCW's redesign of the Project, and the development of PCW's avoidance measures that are identified in the ECP, following this protocol has resulted in an upward bias of eagle-use that has resulted in unrealistically high estimates of fatality.

Rather than waiting for additional recommendations from the Service, I asked Jon Kehmeier and Clint King of SWCA, in consultation with Dr. Millspaugh, to devise new protocols in order to insure timely implementation. Jon, Clint and Dr. Millspaugh considered the Service's model inputs and assumptions and the draft eagle guidance, including the recently available technical appendices, and devised survey protocols more appropriate to the Service's model. They also considered observational dependencies, which the Service's model fails to take into account. The new protocols are based upon a simple random sampling (SRS) design modified to provide spatial balance and to account for logistics. As you know, the Service's model assumes a completely random distribution of eagle minutes throughout the site and is spatially blind, therefore the modified SRS design is a much more appropriate and representative sampling protocol than that previously recommended by the Service and implemented by PCW. I remain concerned based upon the August 10th letter that the Service is focused on continuing surveys of high eagle-use areas. Surveying only areas of expected high eagle-use results in an upward bias in the recording of eagle minute data, a bias which the Service's model is not equipped to handle. I believe that the survey methods employed to date have adequately identified the high eagle-use areas and future surveys should focus on gathering representative data across the Project site, which is in line with assumptions of the fatality model.

SWCA has formalized the protocols (making some adjustments based upon the first two week's field experience) and these will be submitted to the Service directly.

Another item PCW is working on for the Service is the prey-base report. I have asked SWCA to take a broader view than originally anticipated resulting in additional time required preparing the report. I anticipate sending you the report next week.

A response to the Service's August 10th letter is also in preparation. I prioritized finishing the eagle model analysis, survey protocols, and prey-base report first, so the response to the August 10th letter will follow the completion of these items. However, I think that many of the issues raised in the letter have either been addressed through the ECP, or will be addressed in the model comments, prey-base report, and new survey protocols.

One last issue I wish to address in this letter, there has been intense focus over the past several weeks on the absolute value of the number of predicted eagle fatalities for the Project. While the absolute number of individual eagles potentially impacted by the Project is important, the Service must also consider the broader view of the environmental benefits to be realized through development of the Project as well as placing the Project in proper perspective with other wind projects the Service is supporting. At 3,000 megawatts (MW) and 1,000 turbines, the Chokecherry and Sierra Madre Wind Energy Project will be the largest wind project in the world. The Project will reduce CO_2 emissions by 7 to 11 million tons per year – enough to offset the emissions of between 950 and 1,400 MW of baseload coal electricity generation. The

Service has recognized climate change as the greatest threat to all wildlife. Therefore, the Service should also recognize the substantial environmental benefits, particularly benefits to wildlife, to be gained by development of the Project. If these benefits could be included in the Service's model for the Project, I suspect that the model would demonstrate a net gain in eagle population within the western United States.

The scale of the Project in relation to other wind projects must also be considered. For instance, the Service is considering issuing an eagle take permit for the West Butte Wind Project in Oregon – a proposed 104 MW project. I understand that the Service is about to approve a permit for take of three eagles over a five year period based upon its evaluation that this de minimis level of take complies with its eagle permit regulations. Dividing three eagles by 104 MW results in a take of 0.0288 eagles/MW/5 years. Scaling to 3,000 MW results in 86.54 eagles over a five year period, equivalent to 17.31 eagles per year. Applying the same standard to the Chokecherry and Sierra Madre Wind Energy Project as to the West Butte Wind Project, the Service should find that take levels of 86 eagles over a five year period (approximately 17 per year) is de minimis and the Project may proceed without delay. Furthermore, this is consistent with the Service's eagle guidance which identifies a 1% take within the local area population as a relatively benign harvest rate. As detailed in PCW's ECP, 1% take within the local area population is equal to 27 eagles per year, or 135 eagles over a five year period.

Finally, as summer comes to an end I want to again invite you and your staff to visit the site before it gets weathered out. I do not believe that either you or Nathan have ever visited the property and Trish was only able to spend a few hours with the BLM's biologist earlier this year driving the public roads (I ran into her and Heath that day and the weather was terrible). I would be pleased to have Jon or Clint accompany you, Nathan and Trish on a tour of the Project to discuss their observations of eagle use across the site. You could also examine the radar as an on-site visit is the most practical way to understand its benefits and limitations. Former Service-employee Travis Sanderson spent quite a bit of time participating with SWCA's crews in radar validation surveys and raptor counts, and I think he found it very helpful in understanding and evaluating eagle-use throughout the Project site.

I share your excitement on continuing to work together and collaborate on the Chokecherry and Sierra Madre Wind Energy Project so that development of this world class. Project proceeds with minimal impact on eagles as well as all other environmental resources while meeting the nation's need for clean, renewable energy.

Sincerely,

/s/ Garry L. Miller

Garry L. Miller
Vice President, Land and Environmental Affairs

From:	Jon Kehmeier
To:	Kelly Cummins
Subject:	FW: Chokecherry & Sierra Madre Wind Energy Project - ECP Supplement
Date:	Friday, October 10, 2014 4:15:55 PM
Attachments:	ECP Supp - 9 26 2012 final.pdf 2012-09-26 PCW Submittal ECP Supplement.pdf

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From: Garry Miller [mailto:Garry.Miller@tac-denver.com]
Sent: Wednesday, September 26, 2012 12:55 PM
To: Tyler_Abbott@fws.gov
Cc: Brian_A_Millsap@fws.gov; Casey_Stemler@fws.gov; Dave_E_Carlson@fws.gov; Emily_Bjerre@fws.gov; Kevin_Kritz@fws.gov; Mark_Sattelberg@fws.gov; Michael_Thabault@fws.gov; Nathan_Darnall@fws.gov; Pam_Repp@fws.gov; Patricia_Sweanor@fws.gov; Tim_Modde@fws.gov; Jon Kehmeier; Murdock, Pamela M; mvalle@blm.gov; David_Cottingham@fws.gov; Frankie_Green@fws.gov; noreen_walsh@fws.gov; Millspaugh, Joshua J.; Clint King; Roxane Perruso
Subject: Chokecherry & Sierra Madre Wind Energy Project - ECP Supplement

Dear Tyler:

Attached is a Supplement to Eagle Conservation Plan Addressing Estimated Eagle Fatalities for the Chokecherry and Sierra Madre Wind Energy Project. The Supplement describes the process utilized to analyze data and estimate eagle fatalities based upon PCW's re-designed project and the company's commitment not to place turbines in designated turbine no-build areas as set forth in the Eagle Conservation Plan submitted to the Service on August 14, 2012 and the attached ECP Supplement. The Supplement also incorporates the September 7, 2012 and September 12, 2012 expert reports of Dr. Joshua J. Millspaugh, which have been previously provided to the Service.

If you should have any questions, please let me know. Thank you.

Garry

GARRY L. MILLER
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Appendix I

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U.S. Fish and Wildlife Service Summary Document for Review of Eagle Use Data and Eagle Fatality Prediction Analysis for the Chokecherry and Sierra Madre Wind Energy Project Phase 1

U.S. Fish and Wildlife Service, Region 6, Wyoming Ecological Services Field Office
and Region 6 Migratory Bird Management Office

May 27, 2014

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U.S. Fish and Wildlife Service Summary Document for Review of Eagle Use Data and Eagle Fatality Prediction Analysis for the Chokecherry and Sierra Madre (CCSM) Wind Energy Project Phase 1

EXECUTIVE SUMMARY

This document describes the data, decision criteria, and methods used by the U.S. Fish and Wildlife Service (USFWS) to calculate the estimated bald eagle and golden eagle fatalities associated with Phase 1 of the Chokecherry Sierra Madre Wind Energy Project. The methods used by the USFWS generally followed recommendations in the Eagle Conservation Plan Guidance (ECPG 2013), such as using data from points counts that fall within 1 kilometer of the project footprint (ECPG 2013, p. 57).

The number of estimated eagle fatalities was calculated using long-watch data collected from April 2011 to July 2012 and 800-meter (0.5 mile) point count data collected from August 2012 to August 2013. The data were collected over two and a half years using varying methods (i.e., observer distances, eagle flight heights, surveys periods, and number of survey points); therefore, the data could not be easily combined into a single model run. Because of the varying survey effort and volumes, the data were stratified by sampling methodology.

Data from April 2011 to July 2012 were collected using similar long-watch methods, so data from the 16 months were combined into one year of data (Year1) and were run independently of the other four survey periods (Fall 2012, Winter 2012, Spring 3013, Summer 2013). Because the eagle fatality model uses a Bayesian framework, the posterior from Year1 was used to inform Year2 as the new prior.

The second "year" (Year2, August 2012 to August 2013) was collected over 13 months from different numbers of survey points using different eagle flight heights. Data from the 13 months of Year2 were pooled and used to predict fatalities for one 12-month year; however, the code in the eagle fatality model was modified to account for different survey volumes and hazardous area volumes. In model runs for both years, daylight hours were adjusted to account for curtailment of 17 turbines during the spring.

Estimates of golden eagle fatalities and bald eagle fatalities were calculated for Chokecherry and for Sierra Madre using two different turbine sizes. Using the largest on-shore turbine anticipated (120-meter diameter blade), the 80 percent upper credible interval (80% UCI) from the USFWS peer-reviewed model predicts 14 golden eagle fatalities and 2 bald eagle fatalities annually for Phase 1 of the Chokecherry and Sierra Madre Wind Energy Project. Using a smaller turbine (103-meter blade), the model predicts the 80% UCI for 500 turbines of Phase 1 will result in 10 golden eagle and 1.4 bald eagle fatalities annually.

POINT COUNTS TO INCLUDE/EXCLUDE FROM EAGLE FATALITY MODELING

Decision Criteria

(1) Data from point counts were included in the eagle fatality model runs if the 800-meter circle overlapped turbines or if the circle occurred within 1 kilometer (km) of at least one turbine.

Rationale: This approach assumes that at a distance of 1 km, there is a close association between the sampling sites and the turbine locations such as a similarity of habitat types and/or eagle use (ECPG 2013, p. 57).

Exception to Criterion #1: Data from point counts along the eastern side of the "interior rim" of Chokecherry were excluded from the analysis even though turbines occurred within 1 km of the 800-meter circle.

Rationale: Data from point counts can be excluded if topographic features and vegetation types are not representative of the project footprint.

Exception to Criterion #1: Data from point counts on the periphery of the project footprint could be excluded if: (a) spatial coverage approached 30 percent, (b) turbines did not overlap the 800-meter circle, and (c) removing data from these point counts did not create a gap in spatial coverage.

Rationale: Eagle activity on the periphery of the project may be substantially different than within the project footprint; therefore, data from points on the periphery might not reflect project-related risk to eagles. However, without other data, points on the periphery may represent the best available information about risk to eagles and should be included.

Data from points on the periphery should only be considered for exclusion if: (a) removing the points does not substantially reduce spatial coverage from 30 percent, (b) turbines do not overlap the 800-meter circle (otherwise there is a direct relationship between turbines and eagle use within the point count); and (3) removing the points does not leave a gap in spatial coverage and data from adjacent points are representative of conditions on the periphery of the project footprint.

(2) If data from the point counts in criterion #1 provided less than 30 percent spatial coverage of the project footprint, point counts farther than 1 km were also included in the analysis if the point counts were representative of conditions within the project footprint.

Rationale: The sampling design should provide a minimum spatial coverage of at least 30 percent of the project footprint (ECPG 2013, p. 54). When available eagle use data from point counts did not meet the minimum recommendations from the ECPG, adding data from nearby point counts can be used to compensate for the lack of data, provided the points are representative of topographic features and vegetation types that characterize turbine strings within the project footprint.

Chokecherry-Specific Modifications to Decision Criteria

(See Figures 1 through 4 in Appendix A)

(A) Points RM5 and RM11 (April 2011 to March 2012) and RM21 (Summer 2012) occur along the "interior rim" and data from these points were removed from Phase 1 eagle fatality estimates for the following reasons:

(a1) **RM 5** is along eastern side of the "interior rim," away from Phase 1 development. No turbines occur within the point count or within 1 km of the 800-meter circle around RM5. While data from RM5 could be included due to less than 30 percent spatial coverage (criterion #2), the eastern face of the "interior rim" is a unique topographic feature that is not representative of the project footprint; therefore, data from RM5 were excluded.

(a2) **RM11** One turbine is located within 1 km of the 800-meter circle; therefore, data from RM11 could be included due to criterion #1; however, RM 11 is located along the eastern cliff face of the "interior rim," away from Phase 1 development. Furthermore, almost all eagle observations within the 800-meter point count occur along the eastern face of the rim, and the majority of eagle observations occur outside of Phase 1 development. Data from RM11 were excluded because the topographic feature and pattern of eagle use are not representative of the project footprint.

(a3) **RM21** was a long-watch site during May to July 2012 and replaced the points along the "interior rim" (RM5, RM6 and RM11). Five turbines occur within 1-km of the 800-meter point count, so data from RM21 could be included due to criterion #2. However, data from RM21 were excluded because the point count is located on the eastern face of a unique topographic feature and most eagle movements along the "interior rim" were north-south and did not overlap Phase 1. Data from RM21 were excluded because the topographic feature and pattern of eagle use are not representative of the project footprint.

(B) **RM 6** occurs along the western side of the "interior rim" nearest Phase 1. Even though RM6 is on the periphery of the project footprint and all eagle observations from this point count occur within the PCW avoidance area, data from RM6 were included because spatial coverage was considerably less than 30 percent and because two turbines occur within the 800-meter point count and 8 turbines are within 1 km of the circle (criterion #1).

(C) Data from RM12, CC8 and CC13 (the points are located in the SW corner of Chokecherry near Sheep Mountain) were included in the initial model runs, because turbines occur within 1 km of the 800-meter point count circles (criterion #1). In addition, kernel density analysis of the 2011 to 2012 data identified the SW corner of Chokecherry (near RM12) as a "high eagle use" area. In the current project layout, PCW removed turbines from the SW corner of Chokecherry. Because RM12, CC8 and CC13 are now on the periphery of the project footprint, they were considered for exclusion.

(c1) Data from **RM12** were included in the survey period from April 2011 to March 2012, because spatial coverage during this time was considerably less than 30 percent and because removing these data would leave only two point counts to represent eagle use for 202 turbines.

(c2) Data from **RM12** were included in the data from summer of 2012 (May to July), because spatial coverage was considerably less than 30 percent and because removing these data would leave only one point count to represent eagle use for 202 turbines.

(c3) Data from **CC8** (Aug to Nov 2012) were removed from analysis because there are eight other points in Chokecherry during this period and two survey points (CC2 and CC5) provide data for turbines near CC8.

(c4) Data from **CC13** and **RM12** (Dec 2012 to Aug 2013) were removed from analysis, because there are eleven other points in Chokecherry during this period and data from two survey points (CC2 and CC5) provide coverage for nearby turbines.

Sierra Madre-Specific Modifications to Decision Criteria

(See Figures 5 through 8 in Appendix A)

(A) Even though turbines are more than 1 km from **RM15**, data from this point were included in the period from April 2011 to March 2012, because spatial coverage during this period was considerably less than 30 percent and the habitat and features at RM15 are similar to those in the project footprint (criterion #2).

There are only four point count locations in Sierra Madre during April 2011 to March 2012, and only two of those points are on the eastern side of Miller Hill. Including data from RM15 adds a third point to the eastern side of Miller Hill and a fifth survey point to Sierra Madre, which has 298 turbines. Two turbines are within 1.25 km of RM15, and the vegetation and habitat are similar between RM15 and the eastern side of Sierra Madre.

Data from RM15 were not included in the survey periods between November 2012 and August 2013, because there are 18 other points in Sierra Madre during this time and spatial coverage approached 30 percent.

(B) **PG6** is located outside of the project footprint, east of the county road. Five turbines occur within 1 km of the 800-meter point count, so data from PG6 are included due to criterion #1. Because the point is on the eastern fringe of Phase 1, data from PG6 could be considered for exclusion, but doing so would substantially reduce the spatial coverage in the northeast portion of Sierra Madre and leave numerous turbines without nearby point count data. In addition, one of the largest and densest white-tailed prairie dog (WTPD) colonies in Sierra Madre occurs west of PG6; therefore, data from PG6 likely characterizes eagle use of the prey resource during the WTPD active period (about April through September).

(C) **PG3** is outside of the project footprint on the north side of Miller Hill, and only one turbine occurs near the edge of the 1 km buffer of the 800-meter point count; therefore, data from this point count were considered for exclusion. Four of the habitat types in and around PG3 (Open Water, Aspen-Mixed Conifer, and Montane Shrubland) are not representative of the project footprint. Other nearby points (PG10, PG6, and PG9) contain representative habitat types, and these points provide good spatial coverage of turbine locations; therefore data from PG3 were removed from the analysis.

Appendix B summarizes point count locations by survey period and phase of development.

CALCULATING EAGLE MINUTES FOR THE FATALITY MODEL

April 2011 to March 2012

In June of 2012, the Power Company of Wyoming (PCW) provided a summary spreadsheet of survey effort and eagle observations from the 15 long-watch raptor count locations that were surveyed between April 2011 and March 2012. The dataset included eagle observations out to 6.4 km (4.0 miles), but eagle observations from the long-watch data were truncated at 800-meters due to concerns about detectability falling below assumed 100% beyond 800-meters and to be consistent with survey recommendations in the ECPG (ECPG 2013, pp. 54-59). The truncated dataset (i.e., at 800-meters) for both Phase 1 and Phase 2 included 729 golden eagle minutes, 73 bald eagle minutes and 3 unidentified eagle minutes. Total survey effort included 129,750 minutes or 2,163 hours of observation. These same data were also used in PCW's draft Eagle Conservation Plan and in numerous reports from PCW.

In comparing eagle minutes in the summary spreadsheet with detailed eagle observations in the GIS data file (Raptors201104_201203), it became apparent that the summary spreadsheet had substantially more eagle minutes within 800-meters than could be accounted for in the GIS data. The GIS file included start and end times for each eagle observation, so minutes for each eagle observation could be directly calculated from the GIS file. In contrast, the summary spreadsheet only contained a single column for eagle minutes without any record of how minutes were derived. Upon further review, it was determined that the summary spreadsheet ascribed minutes from the entire flight path to each point in the path instead of just the time for that segment of the flight path. In addition, eagle minutes outside the 800-meter point count were included in the spreadsheet if part of the flight path crossed the point count.

Because the GIS file represents the best available data and because the results from the GIS file can be repeated, the summary spreadsheet and the associated data were not used in the analysis to predict eagle fatalities.

The start and end times in the GIS file were recorded in hours and minutes but did not include seconds (e.g., 08:01 to 08:02 a.m.). Recommendations in the ECPG include rounding time of each eagle observation to "the next highest integer (e.g., an eagle observed flying within the plot for about 15 seconds is 1 eagle minute, another observed within for about 1 minute 10 seconds is 2 eagle-minutes, and so on…)" (ECPG 2013, p. 56). Because seconds were not provided, the number of eagle minutes was rounded to include all minutes in which the eagles were observed. In the above example, the observation occurred at both 08:01 and 08:02, resulting in a total of two eagle minutes. In some cases, this method may inflate the number of eagle minutes, but it ensures the number of eagle minutes is not underestimated. Using this method, the dataset from the GIS file includes 198 golden eagle, 39 bald eagle, and 0 unidentified eagle minutes for Phase 1 (Table 1; GOEA Minutes; BAEA Minutes).

In GIS, eagle observations with corresponding flight paths for Phase 1 were reviewed point by point. Using best professional judgment, eagle minutes were reduced if the eagle flew out of the 800-meter point count. For example, if a three-minute observation of an eagle started at the edge of the point count (i.e., at 800-meters) and the eagle flew away from the circle, that three-minute observation became one eagle minute. This analysis reduced golden eagle minutes for Phase 1 from 198 to 189 minutes and bald eagle from 39 to 34 minutes (Table 1; Flight Adjusted).

The ECPG recommends eagle minutes be "recorded as ≤ 200 m (at or below conservative approximation of maximum height of blade tip of tallest turbine) or > 200 m" (ECPG 2013, p. 56). In the GIS file, heights of eagle observations were recorded as above or below150 meters, therefore, it is impossible to know whether an eagle minute recorded as 150+ meters was between 150 and 200 meters or above 200 meters. To address this issue, all eagle minutes with heights greater than 150 meters were removed. This adjustment reduced golden eagle minutes for Phase 1 from 189 to 145 minutes and bald eagle minutes from 34 to 32 minutes (Table 1; Height Adjusted). Because flight heights were truncated at 150 meters, the prior for exposure in the model was modified to account for sampling volume and the sampled volume term in the model code was adjusted from 200 to 150 meters.

Table 1. Summary of raw, flight-adjusted, and height-adjusted golden eagle (GOEA; orange color) and bald eagle (BAEA; blue color) minutes for Chokecherry (CC) and Sierra Madre (SM) Phase1, based on data from the GIS file.

Phase / Location	GOEA Minutes	Flight Adjusted	Height Adjusted	BAEA Minutes	Flight Adjusted	Height Adjusted
CC Phase 1	50	50	37	13	10	10
SM Phase 1	148	139	108	26	24	22
Total	198	189	**145**	39	34	**32**

May 2012 to August 2013

For five survey periods between May 2012 and August 2013, the PCW provided spreadsheets containing detailed descriptions of eagle observations within the 800-meter point counts, including start and end times for each eagle observation. Start and end times were recorded in hours and minutes but did not include seconds (e.g., 10:05 to 10:07 a.m.). Recommendations in the ECPG include rounding time of each eagle observation to "the next highest integer" (ECPG 2013, p. 56). Similar to treatment of the earlier GIS data, the number of eagle minutes was rounded to include all minutes in which the eagles were observed. In the above example, the observation occurred in 10:05, 10:06 and 10:07, resulting in a total of three eagle minutes. In some cases, this method may inflate the number of eagle minutes, but it ensures the number of eagle minutes is not underestimated.

For the Summer 2012 dataset and a portion of the Fall 2012 dataset, eagle minutes were recorded as above or below 150 meters instead of 200 meters as recommended (ECPG 2013, p. 56). To address this issue, all eagle minutes with heights greater than 150 meters were removed, and then sampled volume in the model code was adjusted from 200 to 150 meters. For the second half of the Fall 2012 dataset, and the Winter 2012, Spring 2013 and Summer 2013 datasets, eagle observations were recorded as above or below 200 meters.

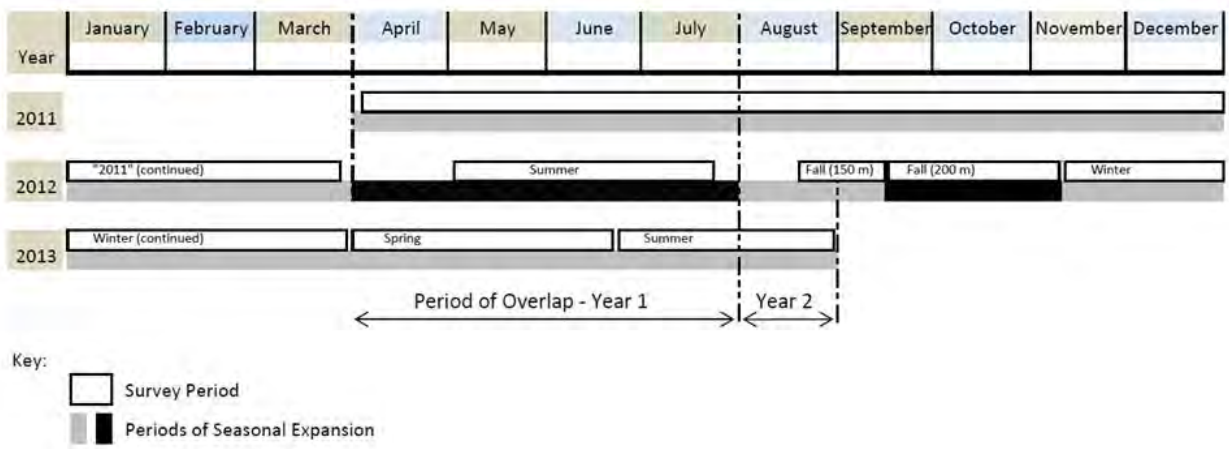
Periods of Sampling Overlap for "Year1" and "Year2"

Data from the first year (April 2011 to March 2012) and data from the summer of 2012 (May 2012 to July 2012) were collected using the same methods. Even though the number and location of points differed, the data from the 16 months can be combined into one year (Year1) for use in the model, because the data were collected using similar methods. Data from the 16 months of "Year 1" were pooled and used to predict fatalities for one 12-month year (Figure 1).

The second year of data (August 2012 to August 2013) was collected over thirteen months from different numbers of survey points (i.e., 40 and 60) and using different eagle flight heights (i.e., 150 and 200 meters). Because of the varying survey effort and different volumes, the data were stratified by sampling methodology. The sampling periods from Year2 are "Fall2012-150m" (40 points, 150 meters), "Fall2012-200m" (40 points, 200 meters) and "Winter2012 / Spring2013 / Summer2013" (60 points, 200 meters).

Data from the 13 months of "Year2" were pooled and used to predict fatalities for one 12-month year; however, the code in the eagle fatality model was modified to account for different survey volumes and hazardous area volumes (Figure 1).

Figure 1. Survey effort (and period of expansion) overlapped from April 2011 through July 2012 (collectively "Year 1") and from August 2012 to August 2013(collectively "Year 2").



Appendix C summarizes survey effort and eagle minutes for individual survey points during each survey period.

Appendix D summarizes total survey effort and eagle minutes for Chokecherry and Sierra Madre during each survey period based on the decision criteria whether to include or exclude survey points.

ADJUSTMENTS DUE TO AVOIDANCE AREAS

In general, eagle minutes observed at observation points that overlapped the PCW-avoidance areas were not subtracted from the model runs by USFWS. The avoidance areas are primarily a concern for the April 2011 to March 2012 dataset, because later point count locations were placed outside of the avoidance areas. Earlier attempts by USFWS and PCW to exclude eagle minutes that occurred within the avoidance areas were based on data from the summary spreadsheet (rather than GIS data), and resulted in removal of between 40 to 75 percent of eagle minutes depending on method used.

Using data from the GIS file (instead of the summary spreadsheet) for those points included in the decision criteria results in the removal of a small percentage of eagle minutes from Phase 1 survey points. One possible reason to exclude data within the avoidance areas is that they are

areas where turbines will not be built and so risk to eagles should be lower; however, in most cases there are not enough eagle observations to conclude that eagle activity differs between areas within an 800-meter survey point. Furthermore, removing eagle minutes within the avoidance areas may result in a higher eagle fatality estimate due to the corresponding subtraction of survey area within the avoidance areas.

RM5, RM11, and RM21 occur within the avoidance areas. As discussed earlier, eagle minutes from RM5, RM11, and RM21 were not included, because the points occur along the eastern face of the "interior rim," a unique topographic feature that does not represent the project footprint. In addition, most eagle movements occur within the avoidance areas. All eagle minutes from RM5, RM11, and RM21 are excluded from the model.

ADJUSTMENTS TO ANNUAL DAYLIGHT HOURS

Based on the location of Teton Reservoir, which is about halfway between Chokecherry and Sierra Madre, the daylight hour function (author: M. Otto, USFWS) calculated 4,458 daylight hours on an annual basis (Appendix E). Using turbine-specific information, the percent of daylight operational periods for each of the 500 turbines ranges from 70 to 98 percent, with an annual average of 91.9 percent for all 500 turbines combined (AWS Truepower 2014). Operational hours for each turbine were provided by season; therefore, seasonal averages for Chokecherry range from 88.4 to 96.3 percent and from 85.1 to 94.5 percent for Sierra Madre (Appendix E).

Based on a project-wide average of an eight percent non-operational period, and based on the seasonal curtailment of 17 turbines near nest "162" for 89.25 days between 1 February and 30 April, the annual daylight hours were adjusted from 4,458 to 4,064 daylight hours per year (Appendix E).

Fatality estimates were also run separately for Phase 1 of Chokecherry and Phase 1 of Sierra Madre. Because there is no pre-planned curtailment within Chokecherry, the adjusted daylight hours (4,149.6) are based on the average season operational hours of turbines only within Chokecherry (Appendix E).

At Sierra Madre, 17 turbines near nest "162" will be curtailed during all daylight hours for 89.25 days between February 1st and April 30th. Subtracting the turbine-hours for the 17 turbines during the curtailment period, and using the average seasonal operational hours for the 298 turbines within Sierra Madre, there are 4,005 daylight hours per year (Appendix E).

VOLUME ADJUSTMENTS

The volume of the observed area in the model (the 200-meter high cylinder around each turbine) was adjusted for the April 2011 to March 2012 dataset, the Summer 2012 dataset (05/01/12 - 07/24/12) and part of the fall 2012 dataset (08/20/12 - 09/15/12), because eagle observations were recorded as above or below 150 meters rather than 200 meters recommended in the ECPG.

The eagle fatality model code was modified to compute the exposure prior and posterior and hazardous area in the expansion factor as volumes since some of the data collection did not use the recommended 200-m and below. These changes are indicated in the model code used in the USFWS analysis.

MODEL INPUTS AND RESULTS

Appendix F summarizes the data used as inputs into the eagle fatality model as well as the model results. Individual estimates of golden eagle fatalities and bald eagle fatalities were also run separately for Phase 1 of Chokecherry and Phase 1 of Sierra Madre. Fatalities for each species were predicted using turbines with 103-meter diameter blades and 120-meter diameter blades.

Due to similarity of data collection methods, the data from Year1 (April 2011 to July 2012) were combined into one model run for Chokecherry and one model run for Sierra Madre. Because the eagle fatality model uses a Bayesian framework, the posterior from Year1 informs Year2 as the new prior. Because the second "year" (Year2, August 2012 to August 2013) was collected over thirteen months using different methods, data from the Year2 were pooled and used to predict fatalities for one 12-month year (see prior discussion).

In the Bayesian framework, results from Year2 are actually a combination of the data from both Year1 and Year2. Therefore, while results are shown for Year1 in Appendix F, the results from Year2 are the "final" predicted eagle fatalities.

Using the largest on-shore turbine anticipated (120-meter diameter blade), the 80 percent upper credible interval (80% UCI) from the USFWS peer-reviewed model predicts 14 golden eagle fatalities and 2 bald eagle fatalities annually for Phase 1 of the Chokecherry and Sierra Madre Wind Energy Project. Using a smaller turbine (103-meter blade), the 80% UCI from the model predicts the 500 turbines of Phase 1 will result in 10 golden eagle and 1.4 bald eagle fatalities annually (7 bald eagles every 5 years).

The average (mean) fatality estimates are also provided in Appendix F; however, the Eagle Conservation Plan Guidance recommends using a risk-averse method such as the 80% UCI for calculating programmatic eagle take, rather than using the average (ECPG 2013, p. 29). However, the average number of predicted fatalities is 7 and 10 golden eagles and 1 and 2 bald eagles for 103-meter and 120-meter blades, respectively.

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Appendix A: Maps of Point Count Locations

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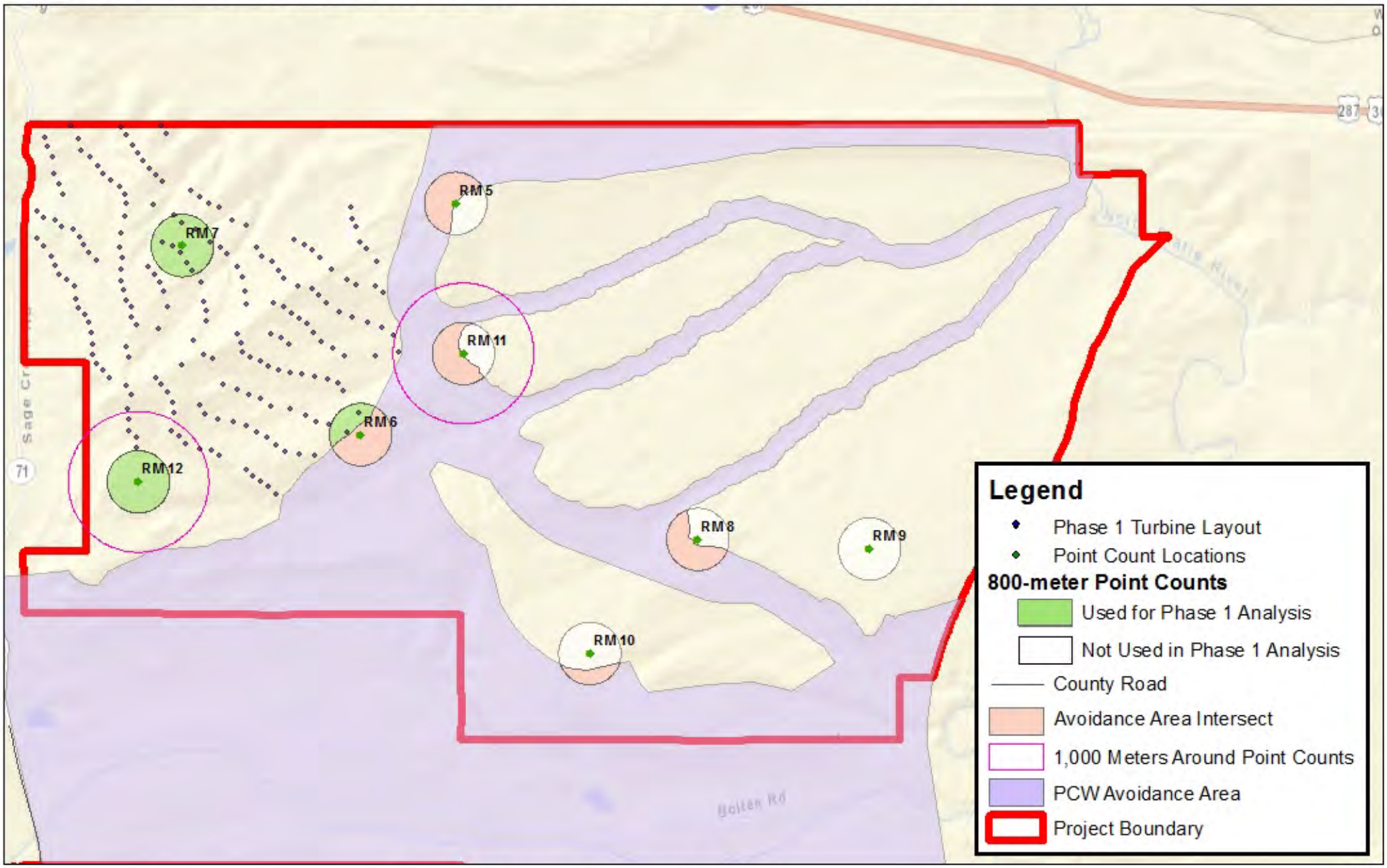
Figure 1. Chokecherry Survey Locations, April 2011 through March 2012



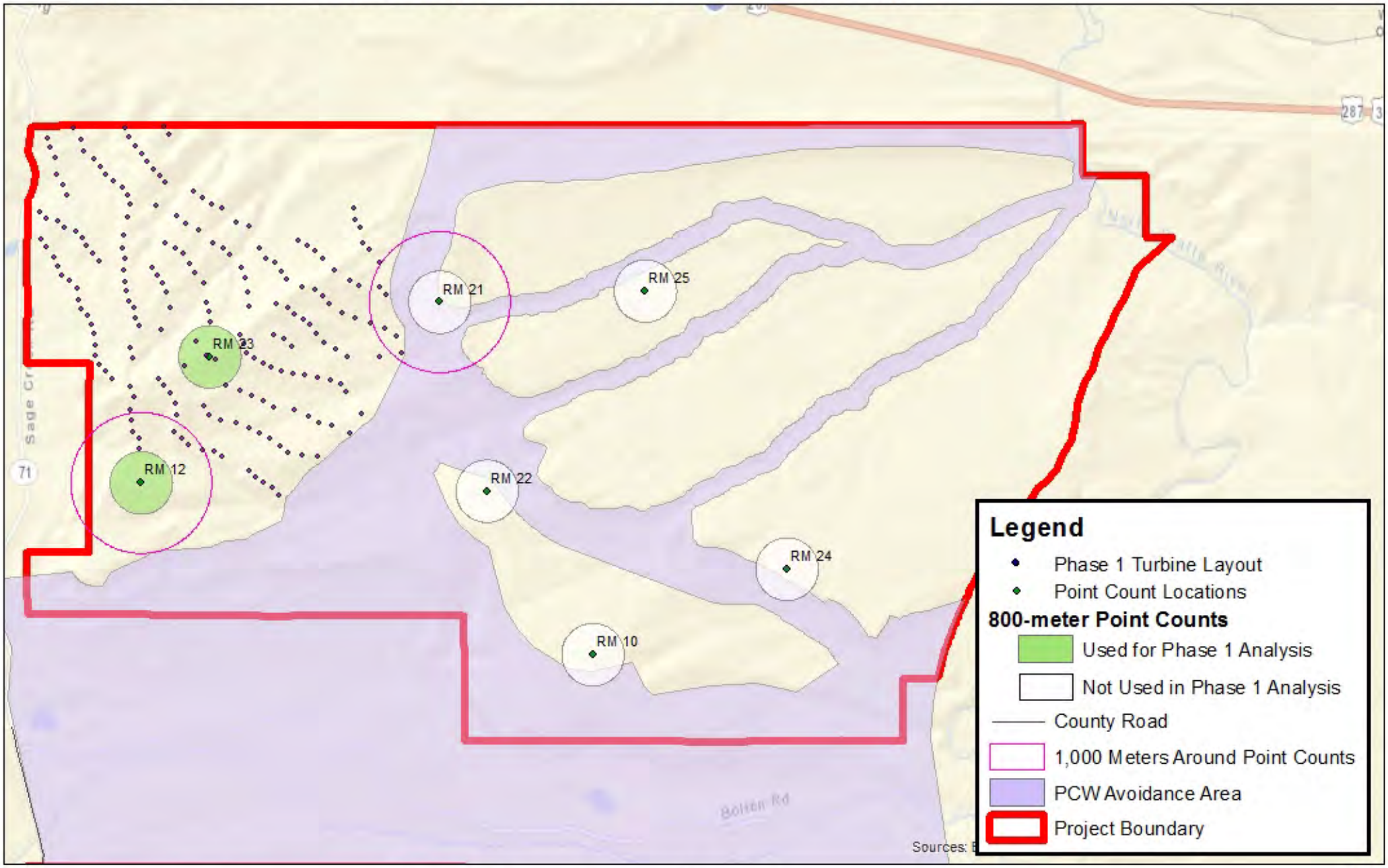
Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

U.S. Fish & Wildlife Service Wyoming Ecological Services

Figure 2. Chokecherry Survey Locations, May 2012 through July 2012

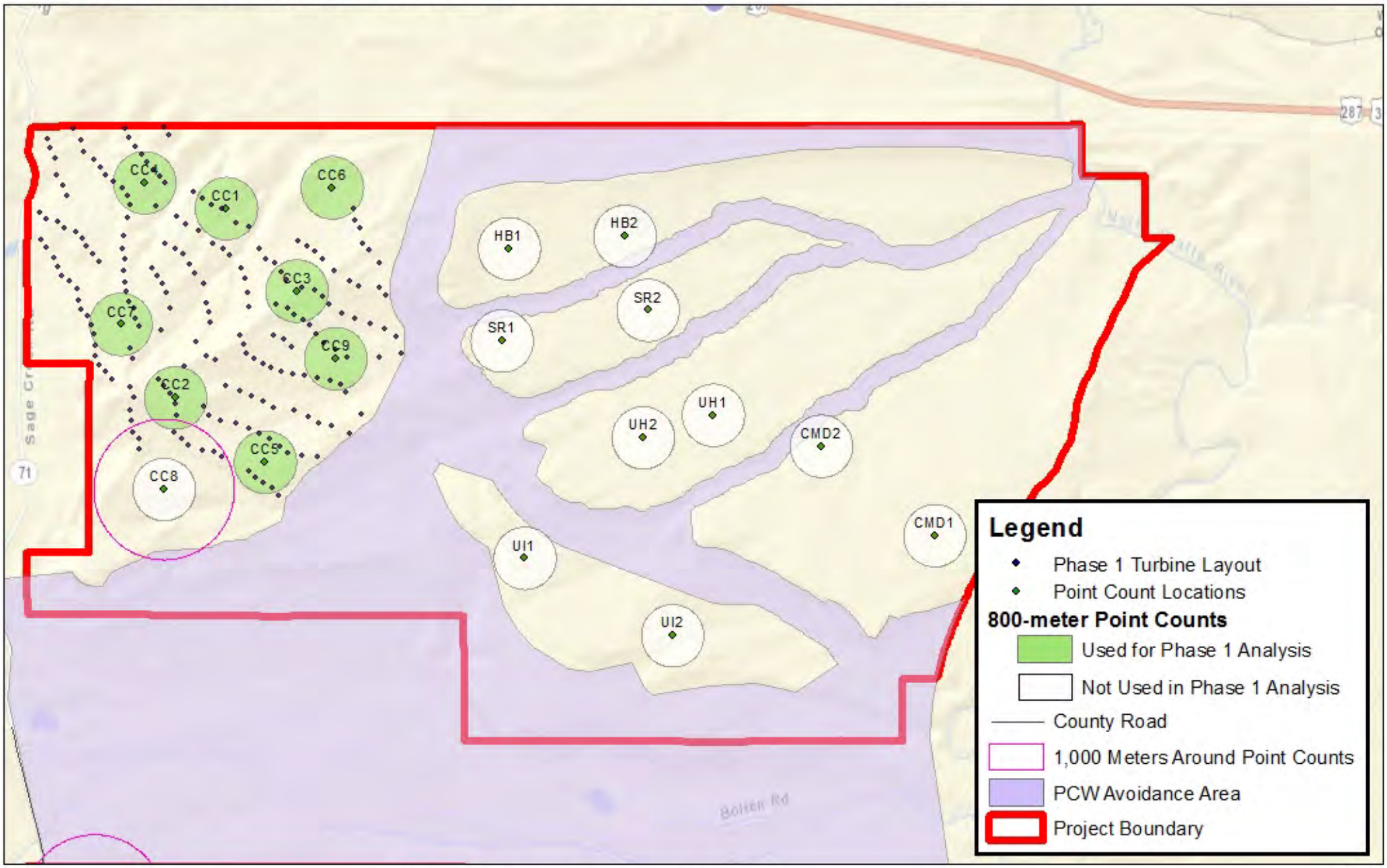


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

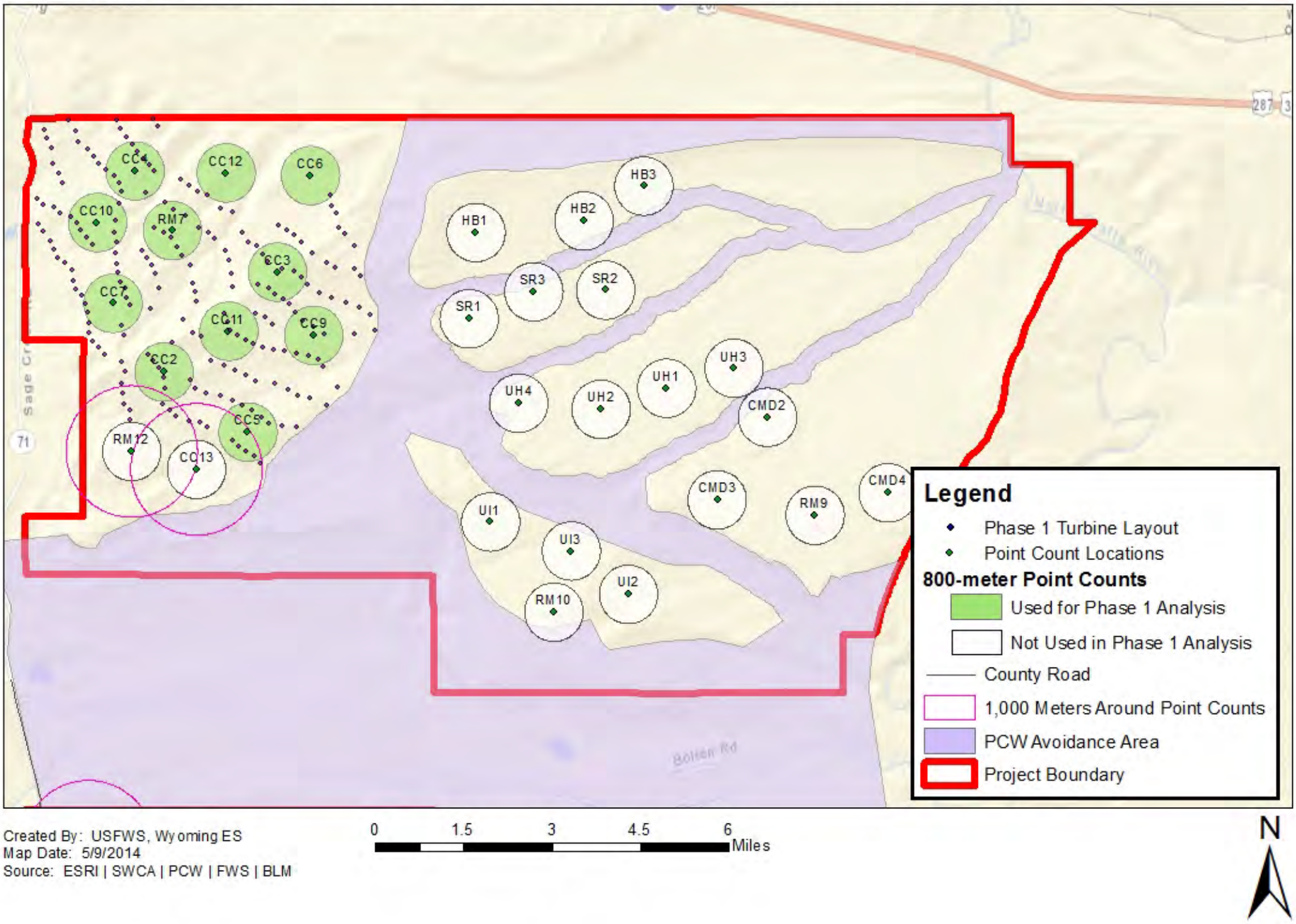
N

Figure 3. Chokecherry Survey Locations, August through November 2012



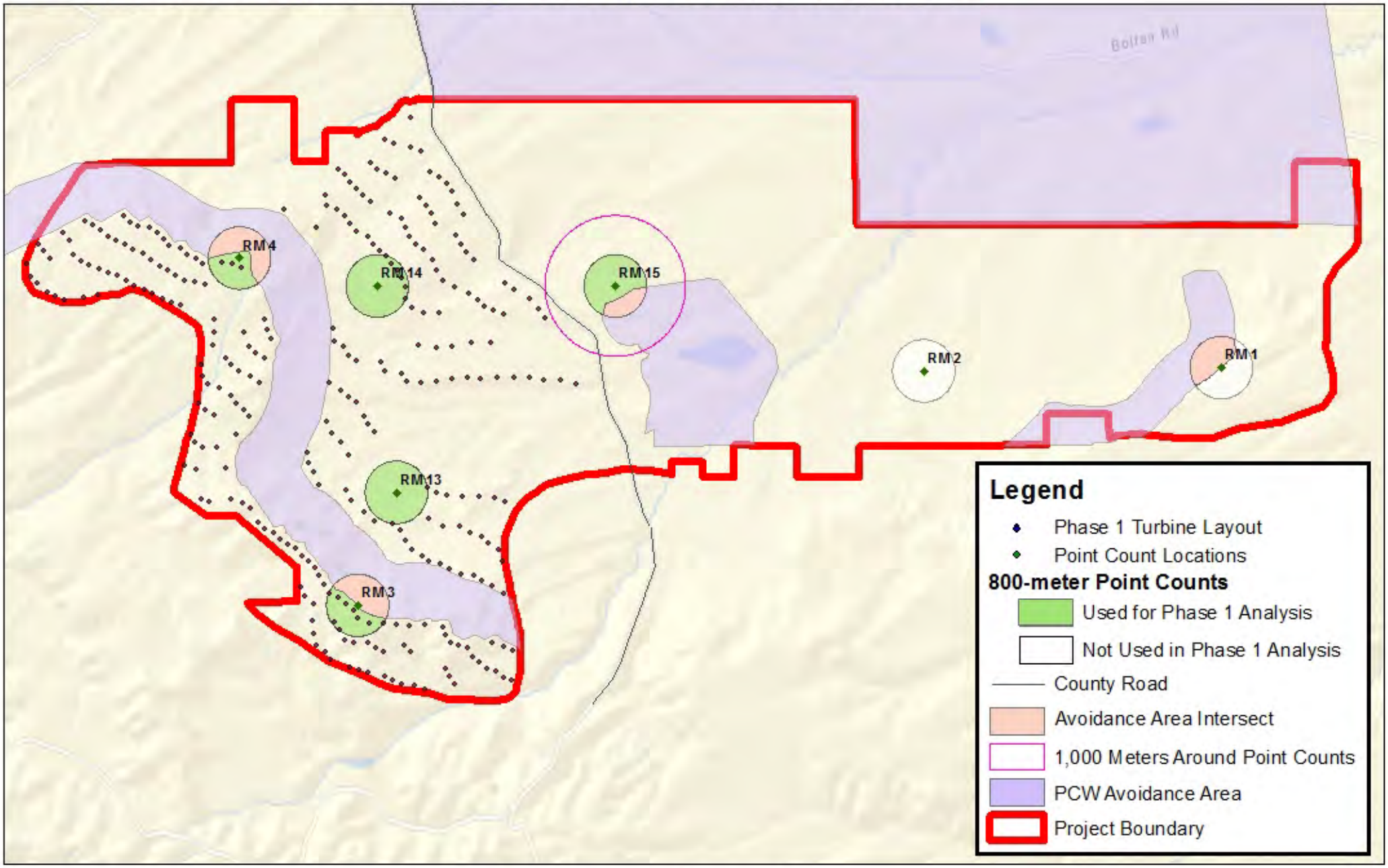
Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

Figure 4. Chokecherry Survey Locations, November 2012 through August 2013



Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

Figure 5. Sierra Madre Survey Locations, April 2011 through March 2012

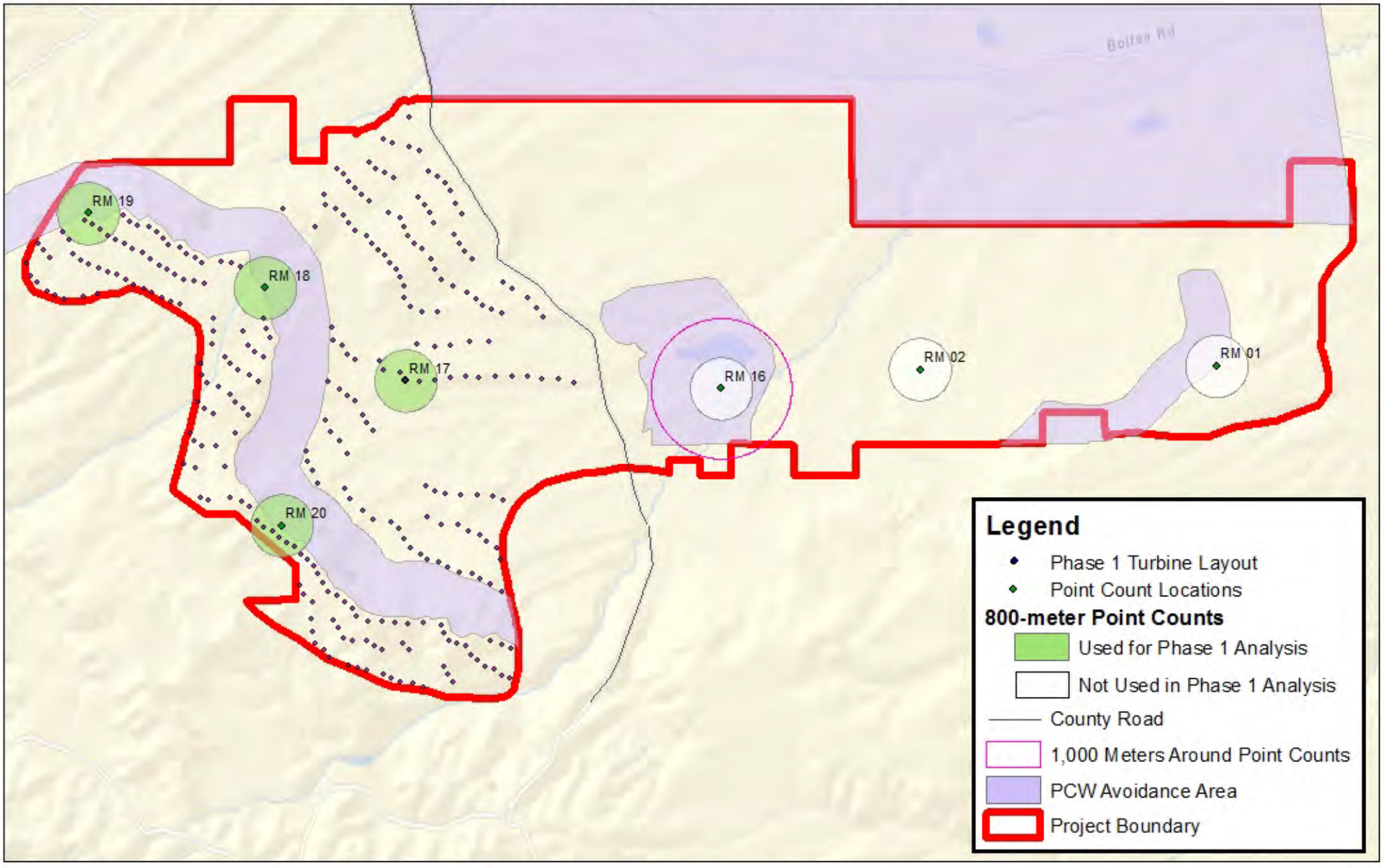


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

Figure 6. Sierra Madre Survey Locations, May 2012 through July 2012

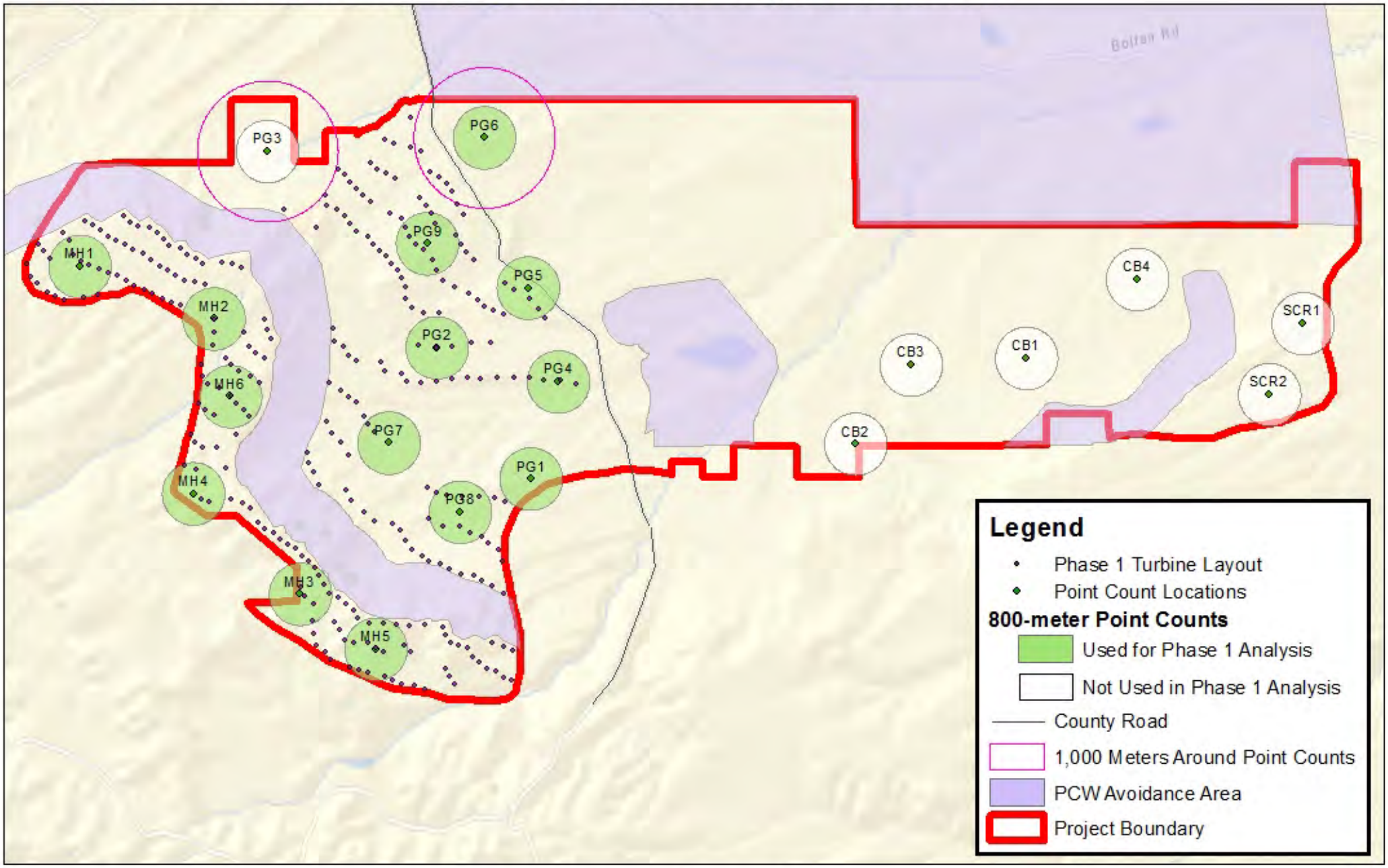


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

Figure 7. Sierra Madre Survey Locations, August through November 2012

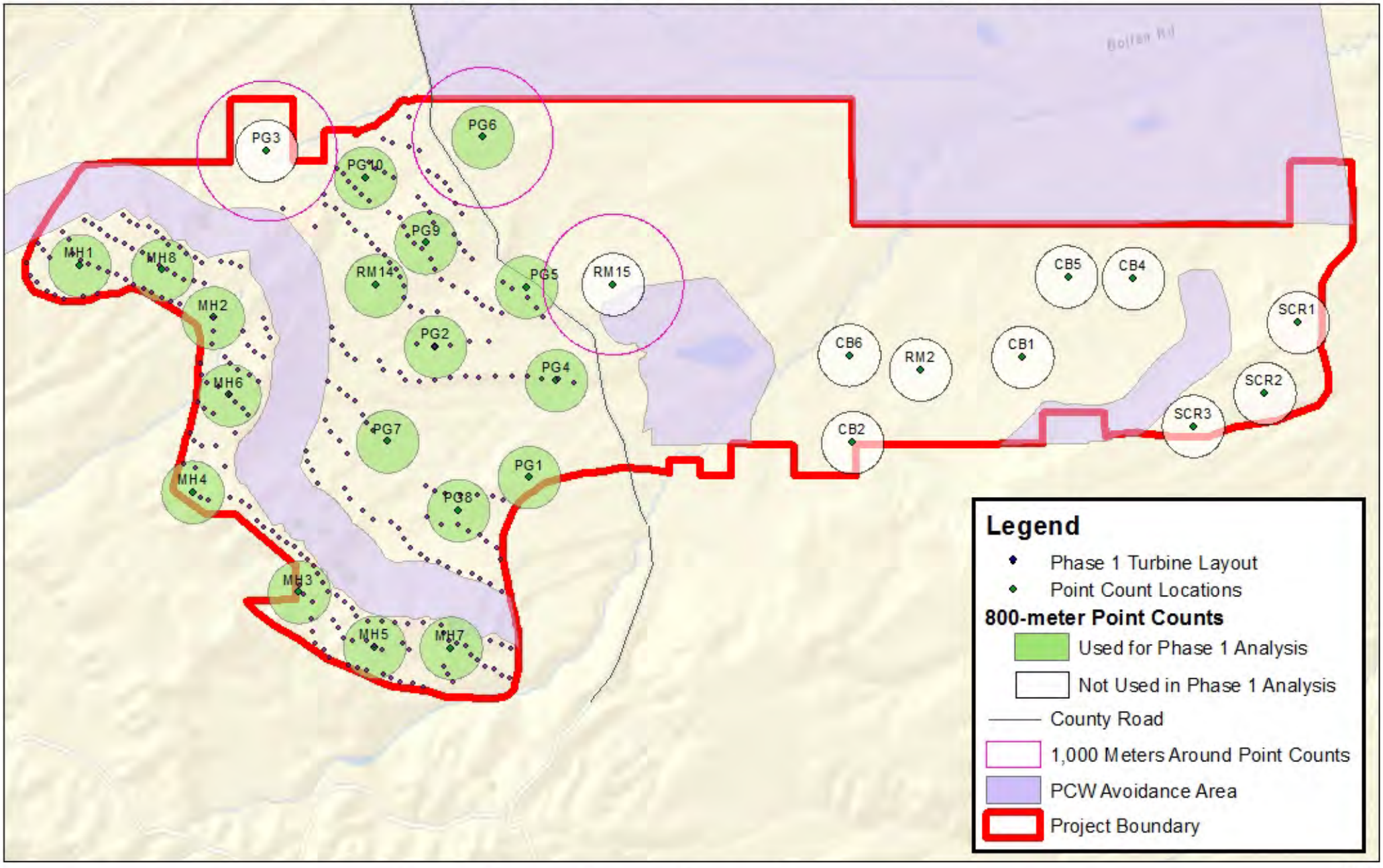


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

Figure 8. Sierra Madre Survey Locations, November 2012 through August 2013



Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

Appendix B: Summary Table of Point Count Locations in Phase 1 for Each Survey Period

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Geographic Location of Survey Points by Survey Period - Phase 1

15 SURVEY POINTS 04/04/11 - 03/27/12		**14 SURVEY POINTS** 05/01/12 - 07/24/12		**40 SURVEY POINTS** 08/20/12 - 11/09/12		**60 SURVEY POINTS** 11/12/12 - 08/30/13	
PHASE 1		PHASE 1		Phase 1		PHASE 1	
CC	SM	CC	SM	CC	SM	CC	SM
RM6	RM13	RM12	RM17	CC1	MH1	CC10	MH1
RM7	RM14	RM23	RM18	CC2	MH2	CC11	MH2
RM12	RM3		RM19	CC3	MH3	CC12	MH3
	RM4		RM20	CC4	MH4	CC13	MH4
	RM15			CC5	MH5	CC2	MH5
				CC6	MH6	CC3	MH6
				CC7	PG1	CC4	MH7
				CC8	PG2	CC5	MH8
				CC9	PG3	CC6	PG1
					PG4	CC7	PG10
					PG5	CC9	PG2
					PG6	RM12	PG3
					PG7	RM7	PG4
					PG8		PG5
					PG9		PG6
							PG7
							PG8
							PG9
							RM14
3	5	2	4	9	15	13	19

In this period, data from RM15 are included in Sierra Madre Phase 1

Data from CC8, CC13 and RM12 excluded from Chokecherry Phase 1 starting Fall 2012

Data from PG3 excluded from Sierra Madre starting Fall 2012

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Appendix C: Eagle Minutes and Survey Effort by Survey Point and Sampling Period

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Survey Data by Point Count by Survey Period

** GOEA = Golden Eagle; BAEA = Bald Eagle; Obs = Observation
** Eagle minutes are rounded up.
** Eagle observations recorded as 150+ meters are not included.
** Fall 2012 data are split at 9/16 due to different methods used to record eagle altitude.

2011 Spring to 2012 Spring Data (04/04/11 - 03/27/12) (<150 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	RM 6	24	5	9041	2.01	0.00132
CC - West	RM 7	0	5	7790	2.01	0.00000
CC - West	RM 12	13		7970	2.01	0.00081
SM - West	RM 3	1	1	7173	2.01	0.00007
SM - West	RM 4	13		8171	2.01	0.00079
SM - West	RM 13	20	4	10563	2.01	0.00094
SM - West	RM 14	50	17	8264	2.01	0.00301
SM - West	*RM 15*	24		8558	2.01	0.00140
SM-East	RM 1	29		8889	2.01	0.00162
SM-East	RM 2	49		8606	2.01	0.00283
CC - East	RM 5	41		8480	2.01	0.00241
CC - East	RM 8	59	1	8913	2.01	0.00329
CC - East	RM 9	9		9290	2.01	0.00048
CC - East	RM 10	4		8729	2.01	0.00023
CC - East	RM 11	101	5	9313	2.01	0.00540

2011 Spring to 2012 Spring Summary of Minutes by Phase			
Phase	**GOEA**	**BAEA**	**Obs**
CC - East	214	6	44,725
CC - West	37	10	24,801
SM - West	108	22	42,729
SM-East	78		17,495
Grand Total	**437**	**38**	**129,750**

2012 Summer Data (05/01/12 - 07/24/12) (eagle minutes <150 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	RM12			1080	2.01	0.00000
CC - West	RM23			1044	2.01	0.00000
SM - West	RM17	5		1082	2.01	0.00230
SM - West	RM18	3		1088	2.01	0.00137
SM - West	RM19	9		1080	2.01	0.00415
SM - West	RM20	2		1080	2.01	0.00092
CC - East	RM10			1080	2.01	0.00000
CC - East	RM21			1080	2.01	0.00000
CC - East	RM22			1082	2.01	0.00000
CC - East	RM24			1080	2.01	0.00000
CC - East	RM25	2		1083	2.01	0.00092
SM-East	RM01	4		1140	2.01	0.00175
SM-East	RM02			1140	2.01	0.00000
SM-East	RM16			1080	2.01	0.00000

2012 Summer Data Summary of Minutes by Phase			
Phase	**GOEA**	**BAEA**	**Obs**
CC - East	2		5,405
CC - West			2,124
SM - West	19		4,330
SM-East	4		3,360
Grand Total	**25**	**0**	**15,219**

2012 Fall Data (in part) (08/20/12 - 09/15/12) (eagle minutes <150 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC1			240	2.01	0.00000
CC - West	CC2			240	2.01	0.00000
CC - West	CC3			240	2.01	0.00000
CC - West	CC4			240	2.01	0.00000
CC - West	CC5			240	2.01	0.00000
CC - West	CC6			240	2.01	0.00000
CC - West	CC7			300	2.01	0.00000
CC - West	CC8	0		240	2.01	0.00000
CC - West	CC9			240	2.01	0.00000
SM - West	MH1	7		240	2.01	0.01451
SM - West	MH2			240	2.01	0.00000
SM - West	MH3			300	2.01	0.00000
SM - West	MH4			240	2.01	0.00000
SM - West	MH5			300	2.01	0.00000
SM - West	MH6			240	2.01	0.00000
SM - West	PG1			240	2.01	0.00000
SM - West	PG2	2		240	2.01	0.00415
SM - West	PG3		2	240	2.01	0.00000
SM - West	PG4			240	2.01	0.00000
SM - West	PG5			300	2.01	0.00000
SM - West	PG6			240	2.01	0.00000
SM - West	PG7			240	2.01	0.00000
SM - West	PG8			240	2.01	0.00000
SM - West	PG9			240	2.01	0.00000
CC - East	CMD1			300	2.01	0.00000
CC - East	CMD2			240	2.01	0.00000
CC - East	HB1			240	2.01	0.00000
CC - East	HB2			240	2.01	0.00000
CC - East	SR1			240	2.01	0.00000
CC - East	SR2			240	2.01	0.00000
CC - East	UH1			300	2.01	0.00000
CC - East	UH2			240	2.01	0.00000
CC - East	UI1			240	2.01	0.00000
CC - East	UI2			240	2.01	0.00000
SM-East	CB1			300	2.01	0.00000
SM-East	CB2			240	2.01	0.00000
SM-East	CB3			240	2.01	0.00000
SM-East	CB4			240	2.01	0.00000
SM-East	SCR1	3		240	2.01	0.00622
SM-East	SCR2	6		240	2.01	0.01244

2012 Fall Data (in part)
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East			2,520
CC - West	0		2,220
SM - West	9	2	3,780
SM-East	9		1,500
Grand Total	**18**	**2**	**10,020**

2012 Fall Data (in part) (09/17/12 - 11/09/12) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC1			480	2.01	0.00000
CC - West	CC2			480	2.01	0.00000
CC - West	CC3	3		458	2.01	0.00326
CC - West	CC4	6		480	2.01	0.00622
CC - West	CC5			480	2.01	0.00000
CC - West	CC6	4		476	2.01	0.00418
CC - West	CC7			480	2.01	0.00000
CC - West	CC8	0		480	2.01	0.00000
CC - West	CC9			480	2.01	0.00000
SM - West	MH1			480	2.01	0.00000
SM - West	MH2			480	2.01	0.00000
SM - West	MH3			480	2.01	0.00000
SM - West	MH4			480	2.01	0.00000
SM - West	MH5			480	2.01	0.00000
SM - West	MH6	5		480	2.01	0.00518
SM - West	PG1	3		480	2.01	0.00311
SM - West	PG2	2		480	2.01	0.00207
SM - West	PG3			480	2.01	0.00000
SM - West	PG4			600	2.01	0.00000
SM - West	PG5	3		480	2.01	0.00311
SM - West	PG6			360	2.01	0.00000
SM - West	PG7			480	2.01	0.00000
SM - West	PG8			600	2.01	0.00000
SM - West	PG9			360	2.01	0.00000
CC - East	CMD1			480	2.01	0.00000
CC - East	CMD2			480	2.01	0.00000
CC - East	HB1			480	2.01	0.00000
CC - East	HB2			480	2.01	0.00000
CC - East	SR1			480	2.01	0.00000
CC - East	SR2			480	2.01	0.00000
CC - East	UH1			462	2.01	0.00000
CC - East	UH2			480	2.01	0.00000
CC - East	UI1			480	2.01	0.00000
CC - East	UI2			480	2.01	0.00000
SM-East	CB1			480	2.01	0.00000
SM-East	CB2			480	2.01	0.00000
SM-East	CB3			360	2.01	0.00000
SM-East	CB4			600	2.01	0.00000
SM-East	SCR1			480	2.01	0.00000
SM-East	SCR2	9		480	2.01	0.00933

2012 Fall Data (in part)
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East			4,782
CC - West	13		4,294
SM - West	13		7,200
SM-East	9		2,880
Grand Total	**35**	**0**	**19,156**

2012 Winter Data (11/12/12 - 03/29/13) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC10			540	2.01	0.00000
CC - West	CC11			540	2.01	0.00000
CC - West	CC12			540	2.01	0.00000
CC - West	CC13	14		540	2.01	0.01290
CC - West	CC2			540	2.01	0.00000
CC - West	CC3			510	2.01	0.00000
CC - West	CC4			540	2.01	0.00000
CC - West	CC5			420	2.01	0.00000
CC - West	CC6			480	2.01	0.00000
CC - West	CC7	8		480	2.01	0.00829
CC - West	CC9			480	2.01	0.00000
CC - West	RM12	0		540	2.01	0.00000
CC - West	RM7			540	2.01	0.00000
SM - West	MH1			300	2.01	0.00000
SM - West	MH2			480	2.01	0.00000
SM - West	MH3			480	2.01	0.00000
SM - West	MH4			300	2.01	0.00000
SM - West	MH5			480	2.01	0.00000
SM - West	MH6			540	2.01	0.00000
SM - West	MH7			480	2.01	0.00000
SM - West	MH8	3		540	2.01	0.00276
SM - West	PG1			540	2.01	0.00000
SM - West	PG10			540	2.01	0.00000
SM - West	PG5			540	2.01	0.00000
SM - West	PG2			540	2.01	0.00000
SM - West	PG3	12		540	2.01	0.01106
SM - West	PG4	7		540	2.01	0.00645
SM - West	PG6	3		540	2.01	0.00276
SM - West	PG7			480	2.01	0.00000
SM - West	PG8			480	2.01	0.00000
SM - West	PG9			480	2.01	0.00000
SM - West	RM14	9		480	2.01	0.00933
CC - East	CMD2			480	2.01	0.00000
CC - East	CMD3			400	2.01	0.00000
CC - East	CMD4			540	2.01	0.00000
CC - East	HB1			600	2.01	0.00000
CC - East	HB2			540	2.01	0.00000
CC - East	HB3	4		480	2.01	0.00415
CC - East	RM10			540	2.01	0.00000
CC - East	RM9			480	2.01	0.00000
CC - East	SR1	6		540	2.01	0.00553
CC - East	SR2			540	2.01	0.00000
CC - East	SR3			540	2.01	0.00000

2012 Winter Data
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East	20		9,313
CC - West	22		6,690
SM - West	34		9,300
SM-East	32		5,220
Grand Total	**108**	**0**	**30,523**

CC - East	UH1			513	2.01	0.00000
CC - East	UH2			600	2.01	0.00000
CC - East	UH3			540	2.01	0.00000
CC - East	UH4	2		480	2.01	0.00207
CC - East	UI1	2		420	2.01	0.00237
CC - East	UI2	6		600	2.01	0.00498
CC - East	UI3			480	2.01	0.00000
SM-East	CB1	7		540	2.01	0.00645
SM-East	CB2			420	2.01	0.00000
SM-East	CB4	5		540	2.01	0.00461
SM-East	CB5			540	2.01	0.00000
SM-East	CB6	8		480	2.01	0.00829
SM-East	RM15	12		600	2.01	0.00995
SM-East	RM2			540	2.01	0.00000
SM-East	SCR1			540	2.01	0.00000
SM-East	SCR2			480	2.01	0.00000
SM-East	SCR3			540	2.01	0.00000

2013 Spring Data (04/01/13 - 06/21/13) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC10			360	2.01	0.00000
CC - West	CC11			360	2.01	0.00000
CC - West	CC12			300	2.01	0.00000
CC - West	CC13	0		300	2.01	0.00000
CC - West	CC2			360	2.01	0.00000
CC - West	CC3	2		360	2.01	0.00276
CC - West	CC4			300	2.01	0.00000
CC - West	CC5			300	2.01	0.00000
CC - West	CC6			300	2.01	0.00000
CC - West	CC7			360	2.01	0.00000
CC - West	CC9			360	2.01	0.00000
CC - West	RM12	0		300	2.01	0.00000
CC - West	RM7			300	2.01	0.00000
SM - West	MH1			360	2.01	0.00000
SM - West	MH2			360	2.01	0.00000
SM - West	MH3			360	2.01	0.00000
SM - West	MH4			300	2.01	0.00000
SM - West	MH5			300	2.01	0.00000
SM - West	MH6			360	2.01	0.00000
SM - West	MH7			360	2.01	0.00000
SM - West	MH8			300	2.01	0.00000
SM - West	PG1			360	2.01	0.00000
SM - West	PG10			300	2.01	0.00000
SM - West	PG5			360	2.01	0.00000

2013 Spring Data Summary of Minutes by Phase			
Phase	**GOEA**	**BAEA**	**Obs**
CC - East			5,940
CC - West	2		4,260
SM - West	1		6,360
SM-East	4		3,314
Grand Total	**7**	**0**	**19,874**

SM - West	PG2		300	2.01	0.00000
SM - West	PG3		360	2.01	0.00000
SM - West	PG4		360	2.01	0.00000
SM - West	PG6		300	2.01	0.00000
SM - West	PG7		360	2.01	0.00000
SM - West	PG8		300	2.01	0.00000
SM - West	PG9		300	2.01	0.00000
SM - West	RM14	1	360	2.01	0.00138
CC - East	CMD2		360	2.01	0.00000
CC - East	CMD3		360	2.01	0.00000
CC - East	CMD4		360	2.01	0.00000
CC - East	HB1		300	2.01	0.00000
CC - East	HB2		300	2.01	0.00000
CC - East	HB3		300	2.01	0.00000
CC - East	RM10		300	2.01	0.00000
CC - East	RM9		360	2.01	0.00000
CC - East	SR1		300	2.01	0.00000
CC - East	SR2		360	2.01	0.00000
CC - East	SR3		300	2.01	0.00000
CC - East	UH1		300	2.01	0.00000
CC - East	UH2		300	2.01	0.00000
CC - East	UH3		360	2.01	0.00000
CC - East	UH4		360	2.01	0.00000
CC - East	UI1		300	2.01	0.00000
CC - East	UI2		360	2.01	0.00000
CC - East	UI3		360	2.01	0.00000
SM-East	CB1	4	300	2.01	0.00663
SM-East	CB2		270	2.01	0.00000
SM-East	CB4		360	2.01	0.00000
SM-East	CB5		360	2.01	0.00000
SM-East	CB6		360	2.01	0.00000
SM-East	RM15		360	2.01	0.00000
SM-East	RM2		300	2.01	0.00000
SM-East	SCR1		360	2.01	0.00000
SM-East	SCR2		360	2.01	0.00000
SM-East	SCR3		284	2.01	0.00000

2013 Summer Data (06/24/13 - 08/30/13) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC10			300	2.01	0.00000
CC - West	CC11			300	2.01	0.00000
CC - West	CC12			300	2.01	0.00000
CC - West	CC13	4		300	2.01	0.00663
CC - West	CC2			300	2.01	0.00000
CC - West	CC3	2		300	2.01	0.00332
CC - West	CC4			300	2.01	0.00000
CC - West	CC5	2		300	2.01	0.00332
CC - West	CC6			300	2.01	0.00000
CC - West	CC7			300	2.01	0.00000
CC - West	CC9			300	2.01	0.00000
CC - West	RM12	0		300	2.01	0.00000
CC - West	RM7			300	2.01	0.00000
SM - West	MH1			300	2.01	0.00000
SM - West	MH2			300	2.01	0.00000
SM - West	MH3			300	2.01	0.00000
SM - West	MH4			300	2.01	0.00000
SM - West	MH5			300	2.01	0.00000
SM - West	MH6			300	2.01	0.00000
SM - West	MH7			300	2.01	0.00000
SM - West	MH8			300	2.01	0.00000
SM - West	PG1			300	2.01	0.00000
SM - West	PG10			300	2.01	0.00000
SM - West	PG5			300	2.01	0.00000
SM - West	PG2			300	2.01	0.00000
SM - West	PG3			300	2.01	0.00000
SM - West	PG4			300	2.01	0.00000
SM - West	PG6			300	2.01	0.00000
SM - West	PG7			300	2.01	0.00000
SM - West	PG8			300	2.01	0.00000
SM - West	PG9			300	2.01	0.00000
SM - West	RM14	2		300	2.01	0.00332
CC - East	CMD2			300	2.01	0.00000
CC - East	CMD3	1		300	2.01	0.00166
CC - East	CMD4			300	2.01	0.00000
CC - East	HB1			300	2.01	0.00000
CC - East	HB2			300	2.01	0.00000
CC - East	HB3			300	2.01	0.00000
CC - East	RM10			300	2.01	0.00000
CC - East	RM9			300	2.01	0.00000
CC - East	SR1			300	2.01	0.00000
CC - East	SR2			300	2.01	0.00000
CC - East	SR3			300	2.01	0.00000

2013 Summer Data
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East	1		5,400
CC - West	8		3,900
SM - West	2		5,700
SM-East	5		3,000
Grand Total	**16**	**0**	**18,000**

CC - East	UH1		300	2.01	0.00000
CC - East	UH2		300	2.01	0.00000
CC - East	UH3		300	2.01	0.00000
CC - East	UH4		300	2.01	0.00000
CC - East	UI1		300	2.01	0.00000
CC - East	UI2		300	2.01	0.00000
CC - East	UI3		300	2.01	0.00000
SM-East	CB1		300	2.01	0.00000
SM-East	CB2		300	2.01	0.00000
SM-East	CB4		300	2.01	0.00000
SM-East	CB5		300	2.01	0.00000
SM-East	CB6		300	2.01	0.00000
SM-East	RM15	3	300	2.01	0.00498
SM-East	RM2	2	300	2.01	0.00332
SM-East	SCR1		240	2.01	0.00000
SM-East	SCR2		300	2.01	0.00000
SM-East	SCR3		360	2.01	0.00000

Appendix D: Summary of Eagle Minutes and Survey Effort for Each Survey Period Based on the Decision Criteria

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Summary of Survey Data for Chokecherry Sierra Madre

** GOEA = Golden Eagle; BAEA = Bald Eagle; Obs = Observation; Min = Minutes
** Eagle minutes are rounded up.
** # = Eagle minutes >150 meters are not included; adjust volume to 150 meters.
** Fall 2012 data are split at 9/16 due to different methods for eagle altitude.
** Data are based on final decision criteria.

2011 Spring to 2012 Spring Data

(04/04/11 - 03/27/12) (15 points) (>150 meters are not included) #

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	Notes
CC - West	1	3	24801	37	10	
SM - West	1	5	42729	108	22	RM15 included
Total		8	67,530	145	32	

2012 Summer Data

(05/01/12 - 07/24/12) (14 points) (18 eagle minutes >150 meters not included) #

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	2	2124	0	0	
SM - West	1	4	4330	19	0	
Total		6	6,454	19	0	

2012 Fall Data (in part)

(08/20/12 - 09/15/12) (40 points) (23 eagle minutes >150 meters not included) #

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	9	1980	0	0	CC8 excluded
SM - West	1	15	3540	9	0	Exclude PG3
Total		24	5,520	9	0	

2012 Fall Data (in part)

(09/17/12 - 11/09/12) (40 points) (eagle minutes <200 meters)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	9	3814	13	0	CC8 excluded
SM - West	1	15	6720	13	0	Exclude PG3
Total		24	10,534	26	0	

2012 Winter Data

(11/12/12 - 03/29/13) (60 points)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	13	5610	8	0	CC13, RM12 Excluded
SM - West	1	21	8760	22	0	Exclude RM15, PG3
Total		34	14,370	30	0	

2013 Spring Data

(04/01/13 - 06/21/13) (60 points)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	13	3660	2	0	CC13, RM12 Excluded
SM - West	1	21	6000	1	0	Exclude RM15, PG3
Total		34	9,660	3	0	

2013 Summer Data

(06/24/13 - 08/30/13) (60 points)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	13	3300	4	0	CC13, RM12 Excluded
SM - West	1	21	5400	2	0	Exclude RM15, PG3
Total		34	8,700	6	0	

All Data Combined

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min
CC - West	1	n/a	45289	64	10
SM - West	1	n/a	77479	174	22
Total		0	122,768	238	32

"Year1 "Split (April 2011-July2012)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min
CC - West	1	n/a	26925	37	10
SM - West	1	n/a	47059	127	22
Total			73,984	164	32

"Year2" Split (August 2012-August 2013)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min
CC - West	1	n/a	18364	27	0
SM - West	1	n/a	30420	47	0
Total			48,784	74	0

Appendix E: Adjustments to Daylight Hours

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The following is an example of the model code used to calculate annual and seasonal daylight hours.

```
## Define seasonal strata and calculate daylight hours
LatLng<-c(41.6038693,-107.261601)

# Annual Daylight Hours
SeasonType<-"Annual"
DayLtHr<-DayLen(LatLng[2],LatLng[1],Type=SeasonType)
colnames(DayLtHr)[1]<-"Season"
DayLtHr$AveDayLen<-with(DayLtHr,DayLtHr/Days)

# Seasonal Daylight Hours (to determine total daylight hours during curtailment period)
SeasonEndDay<-c(Winter="1/31",Curtail="4/30",Spring="6/30",Summer="8/15",Fall="11/15")
DayLtHr<-DayLen(-107.128973,41.767919,Type=SeasonEndDay,
Labels=names(SeasonEndDay))
DayLtHr$AveDayLen<-with(DayLtHr,DayLtHr/Days)

# Day length based on National Oceanic and Atmospheric Administration solar calculator:
#       http://www.esrl.noaa.gov/gmd/grad/solcalc/calcdetails.html
```

Daylight Operational Hours

Percent of Daylight Operational Hours by "Season" for All Turbines

Row Labels	Average of Winter (Nov 16 - Jan 31)	Average of Curtailment Season (Feb 1 - Apr 30)	Average of Active Nest Season (May 1 - Jun 30)	Average of Summer (Jul 1 - Aug 15)	Average of Fall (Aug 16 - Nov 15)	Average of Entire Year (Jan 1 - Dec 31)
Chokecherry	96.258%	94.582%	94.049%	88.434%	91.543%	93.072%
Sierra Madre	94.468%	93.539%	92.019%	85.087%	89.543%	91.126%
Project Average	95.191%	93.960%	92.839%	86.439%	90.351%	91.912%

Percent of Daylight Operational Hours by "Season" for All Turbines with Seasonal Curtailment

Row Labels	Average of Winter (Nov 16 - Jan 31)	Average of Curtailment Season (Feb 1 - Apr 30)	Average of Active Nest Season (May 1 - Jun 30)	Average of Summer (Jul 1 - Aug 15)	Average of Fall (Aug 16 - Nov 15)	Average of Entire Year (Jan 1 - Dec 31)
Chokecherry	96.258%	94.582%	94.049%	88.434%	91.543%	93.072%
Sierra Madre	94.468%	93.496%	92.019%	85.087%	89.543%	91.126%
Project Average	95.191%	93.951%	92.839%	86.439%	90.351%	91.912%

Seasonal values are an average of percent operational time during daylight hours of individual turbines provided by AWS Truepower, May 2014.

Highlighted values include the curtailment of 17 turbines in Sierra Madre from 1 Feb to 30 April.

Daylight Hours Adjustment for Seasonal Curtailment

	Location Latitude	Longitude
Teton Reservoir	41.604	-107.261601

Season	cRange	Days	AveDayLen	DayLtHr
Annual	01/01-12/31	365.25	12.20462	4457.739
Base Annual Daylight Hours for Teton Reservoir				

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	500	95.191%	344,858.18
Curtail	02/01-04/30	89.25	12.020020	1072.7868	500	93.960%	503,996.84
Spring	05/01-06/30	61.00	14.864888	906.7582	500	92.839%	420,911.98
Summer	07/01-08/15	46.00	14.604142	671.7905	500	86.439%	290,344.26
Fall	08/16-11/15	92.00	11.762141	1082.1170	500	90.351%	488,851.57
Calculating Annual Daylight Hours				4458.013		sum=	2,048,962.83
For 500 turbines without Curtailment							4,097.926

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	500	95.191%	344,858.18
Curtail	02/01-04/30	89.25	12.020020	1072.7868	483	93.951%	486,810.25
Spring	05/01-06/30	61.00	14.864888	906.7582	500	92.839%	420,911.98
Summer	07/01-08/15	46.00	14.604142	671.7905	500	86.439%	290,344.26
Fall	08/16-11/15	92.00	11.762141	1082.1170	500	90.351%	488,851.57
Annual Daylight Hours for **500 Turbines** (CC & SM)						sum=	2,031,776.25
With **17 Turbines Curtailed** for 89.25 Days in Sierra Madre							4,063.552

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	298	94.468%	203,973.84
Curtail	02/01-04/30	89.25	12.020020	1072.7868	281	93.496%	281,847.99
Spring	05/01-06/30	61.00	14.864888	906.7582	298	92.019%	248,646.83
Summer	07/01-08/15	46.00	14.604142	671.7905	298	85.087%	170,338.32
Fall	08/16-11/15	92.00	11.762141	1082.1170	298	89.543%	288,749.36
Annual Daylight Hours for **298 Turbines** (Only SM)						sum=	1,193,556.34
With **17 Turbines Curtailed** for 89.25 Days in Sierra Madre							4,005.223

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	202	96.258%	140,884.34
Curtail	02/01-04/30	89.25	12.020020	1072.7868	202	94.582%	204,962.27
Spring	05/01-06/30	61.00	14.864888	906.7582	202	94.049%	172,265.15
Summer	07/01-08/15	46.00	14.604142	671.7905	202	88.434%	120,005.94
Fall	08/16-11/15	92.00	11.762141	1082.1170	202	91.543%	200,102.21
Annual Daylight Hours for **202 Turbines** (Only CC)						sum=	838,219.90
No pre-planned curtailment in Chokecherry							4,149.603

*TurbineHours = DayLtHr*Turbines*%Operational

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Appendix F: Eagle Fatality Model Inputs and Results

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Predicted Fatalities

Golden Eagle, Chokecherry Sierra Madre combined, 103-m blade

Golden Eagle, Chokecherry Sierra Madre combined, 120-m blade

Bald Eagle, Chokecherry Sierra Madre combined, 103-m blade

Bald Eagle, Chokecherry Sierra Madre combined, 120-m blade

Golden Eagle, Chokecherry, 103-m blade

Golden Eagle, Sierra Madre, 103-m blade

Golden Eagle, Chokecherry, 120-m blade

Golden Eagle, Sierra Madre, 120-m blade

Bald Eagle, Chokecherry, 103-m blade

Bald Eagle, Sierra Madre, 103-m blade

Bald Eagle, Chokecherry, 120-m blade

Bald Eagle, Sierra Madre, 120-m blade

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Eagle Fatality Model Inputs and Results

Model inputs and results are combined for Chokecherry and for Sierra Madre.
Posterior from Year1 becomes the prior for Year2.
Results from Year2 are a combination of data from Year1 and Year2.
Results from Year2 are the "final" predicted eagle fatalities.
Fatalities are predicted for two different turbine blade lengths: 103-meter and 120-meter diameter blades.

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
164	4,063.6	103/2	500	0.443	0.0345	8.7	5.7	13
74	4,063.6	103/2	500	0.346	0.0224	6.8	4.5	10
Golden Eagle annual predicted fatalities with 103-m diameter blade =								**10**

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
164	4,063.6	120/2	500	0.443	0.0344	12	7.8	17
74	4,063.6	120/2	500	0.347	0.0224	9.2	6.1	14
Golden Eagle annual predicted fatalities with 120-m diameter blade =								**14**

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
32	4,063.6	103/2	500	0.0886	0.0154	1.7	1.2	2.6
0	4,063.6	103/2	500	0.0478	0.0084	0.94	0.79	1.4
	Bald Eagle annual predicted fatalities with 103-m diameter blade =							**1.4**

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
32	4,063.6	120/2	500	0.0884	0.0154	2.3	1.6	3.5
0	4,063.6	120/2	500	0.0477	0.0083	1.3	0.87	1.9
	Bald Eagle annual predicted fatalities with 120-m diameter blade =							**2**

Eagle Fatality Model Inputs and Results - GOLDEN EAGLE

Model inputs and data results are run separately for Chokecherry and for Sierra Madre.
Posterior from Year1 becomes the prior for Year2.
Results from Year2 are a combination of data from Year1 and Year2.
Results from Year2 are the "final" predicted eagle fatalities.
Fatalities are predicted for two different turbine blade lengths: 103-meter and 120-meter diameter blades.

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	GOEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
37	4,149.6	103/2	202	0.279	0.0455	2.3	1.5	3.3
127	4,005.2	103/2	298	0.540	0.0476	6.2	4.2	9.2
27	4,149.6	103/2	202	0.254	0.315	2.1	1.4	3.0
47	4,005.2	103/2	298	0.402	0.0304	4.6	3.1	6.8
Golden Eagle annual predicted fatalities with 103-m diameter blade =								**10**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	GOEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
37	4,149.6	120/2	202	0.280	0.0454	3.1	2.1	4.5
127	4,005.2	120/2	298	0.540	0.0477	8.5	5.6	12
27	4,149.6	120/2	202	0.254	0.0315	2.8	1.9	4.1
47	4,005.2	120/2	298	0.402	0.0304	6.3	4.1	9.2
Golden Eagle annual predicted fatalities with 120-m diameter blade =								**15**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

Eagle Fatality Model Inputs and Results - BALD EAGLE

Model inputs and data results are run separately for Chokecherry and for Sierra Madre.
Posterior from Year1 becomes the prior for Year2.
Results from Year2 are a combination of data from Year1 and Year2.
Results from Year2 are the "final" predicted eagle fatalities.
Fatalities are predicted for two different turbine blade lengths: 103-meter and 120-meter diameter blades.

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	BAEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
10	4,149.6	103/2	202	0.0807	0.0244	0.65	0.53	0.97
22	4,005.2	103/2	298	0.0969	0.0202	1.1	0.78	1.6
0	4,149.6	103/2	202	0.0429	0.013	0.35	0.26	0.51
0	4,005.2	103/2	298	0.0528	0.0111	0.61	0.51	0.9
	Bald Eagle annual predicted fatalities with 103-m diameter blade =							**2**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	BAEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
10	4,149.6	120/2	202	0.0808	0.0245	0.89	0.66	1.3
22	4,005.2	120/2	298	0.0969	0.0203	1.5	1.3	2.2
0	4,149.6	120/2	202	0.0427	0.013	0.47	0.35	0.7
0	4,005.2	120/2	298	0.0527	0.011	0.82	0.58	1.2
Bald Eagle annual predicted fatalities with 120-m diameter blade =								**3**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

Appendix G: Example of Model Code Used to Predict Eagle Fatalities

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The following is an example of the model code and inputs used by the U.S. Fish and Wildlife Service to predict the number of bald eagle and golden eagle fatalities at the Chokecherry Sierra Madre Phase 1 Project. The description, inputs and results of the twelve different model runs are presented in Appendix F.

In the example below, differences between the model runs are identified. Comments and other explanatory notes that may differ between model runs are highlighted in yellow. Changes to the model inputs or the model code are identified by red, bolded text and are highlighted in yellow. These changes, which are also identified by sequential numerals surrounded by asterisks and parentheses, are further explained here:

(*1*) – Description of the model run, including area (e.g., Chokecherry) and year (e.g., Year 1)
(*2*) – Number of turbines (i.e., 500, 298, or 202)
(*3*) – Blade length (i.e., 120- or 103-meter blade)
(*4*) – Description of the run,
Number of eagle minutes
Number of counts (total observation minutes / 60)
Daylight hours (see Appendix E)
(*5*) – Adjust sample volume (e.g., 150 or 200 meters / 100)
(*6*) – For all 12 runs, the priors for Year 1 were adjusted to account for non-standard volume
(*7*) – The posteriors for Year 1 were used as the priors for Year 2

```
# Example Code for Model Run
# CC & SM West for GOEA with 120-m rotor blade Yr1Pooled and Yr2Pooled
# all eagle observations were recorded up to 150-m
# requires FWS functions R2Gamma.R, FatalFcns.R, and RVSmry.R and the R packages rv and
#     maptools

### Chokecherry Sierra Madre West Yr1 - below 150m ###

cProject<-"CCSM_West_Yr1_150m"      #project ID                                          (*1*)
nTurbine<-c(500)                    #number of turbines                                  (*2*)
HazRadKm<-c(120/2/1000)     #radius of hazardous area around each turbine(in kilometers)  (*3*)
HzKM2<-(nTurbine*pi*HazRadKm^2)   # hazardous area will be converted to volume later
CntHr<-c(1)                         # count duration (in hours)

## Create the "ExpSvy" data frame (Eagle Minutes observed, number of counts conducted,
#         the area observed at each observation point, and the future daylight hours),
#         includes some observed EMin with no ht recorded

# (*4*)
ExpSvy<-data.frame(row.names=c("CCSM_Y1-150m"),
            EMin=c(164),
            nCnt=c(1233.067),
            CntKM2=c(pi*0.8^2),
            DayLtHr=c(4063.552))

# DayLtHr includes ~8% non-operational hours annually (17 turbines curtailed 89.25 days in spring)

AddTot<-FALSE          #Add strata for total (TRUE) or not (FALSE)
## Analysis Inputs ##
UCI<-c(0.5,0.8,0.9,0.95)
nSims<-100000
setnsims(nSim)
PlotFile<-NULL

## Survey Inputs ##
nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

## Modified expansion and offset calculations
# we multiply the "offset" (the sampling effort that goes with the eagle minutes observed
#     and is used to calculate the exposure) by 150-m (0.15 km) to give us eagle mins per hr*km^3
# (*5*)
Height <- c(0.15)
SmpHrKM3<- with(ExpSvy,nCnt*CntHr*CntKM2*Height)

# we multiply the "expansion factor" (the product of operational daylight hours and
```

```
#      hazardous area) by 200-m (0.2 km)
ExpFac<- ExpSvy$DayLtHr*HzKM2*.2

# Calculate the fatalities and store as a temporary object.                    (*6*)
tmp<-with(ExpSvy,mapply(simFatal,EMin=EMin,SmpHrKM2=SmpHrKM3,ExpFac=ExpFac,
                aPriExp=0.9684375,bPriExp=0.5519703,aPriCPr=2.31,bPriCPr=396.69,
                SIMPLIFY=FALSE))

# Put the survey specific simulations in an rv vector.
Fatalities<-rvnorm(nSvy)
Exp<-data.frame(Mean=rep(NA,nSvy),SD=NA,row.names=cSvy)
for(i in 1:nSvy){
  # i<-1
  Fatalities[i]<-tmp[[i]]
  Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize
nSvy<-length(Fatalities)
if(is.null(nSvy))nSvy<-1
FatalStats<-RVSmry(cSvy,Fatalities,probs=UCI)
if(AddTot){
  FatalStats<-rbind(
    FatalStats,
    RVSmry("Total",sum(Fatalities),probs=UCI))}
# Determine Yr2 exposure prior parameters from the Yr1 exposure posterior
Prior2<-N2Gamma(mn=Exp$Mean,sd=Exp$SD)

# define objects to pull into the simFatal function for Year2
aPriExpY2<-Prior2[1]
bPriExpY2<-Prior2[2]

### Chokecherry Sierra Madre West Yr2 ###

cProject<-"CCSM_West_Yr2"          #project ID to associate with model outputs          (*1*)
nTurbine<-c(500)                   #number of turbines                                  (*2*)
HazRadKm<-c(120/2/1000)      #radius of hazardous area around each turbine (in kilometers)  (*3*)
HzKM2<-(nTurbine*pi*HazRadKm^2)   # hazardous area will be converted to volume

# (*4*) (*5*)
## Create the "ExpSvy" data frame by pooling data
EMinPooled<-sum(9,26,30,3,6)
SmpHr<-c(5520/60,10534/60,14370/60,9660/60,8700/60)
SmpKM2<-pi*0.8^2
```

```
SmpHt<-c(0.15,0.2,0.2,0.2,0.2)
SmpHrKM3Pooled<-sum(SmpKM2*SmpHr*SmpHt)

ExpSvy<-data.frame(row.names=c("Yr2_Pooled"),
            Emin=EminPooled,
            SmpHrKM3=SmpHrKM3Pooled,
            DayLtHr=4063.552)

# DayLtHr includes ~8% non-operational hours annually (17 turbines curtailed 89.25 days in spring)

AddTot<-FALSE        #Add strata for total (TRUE) or not (FALSE)

## Analysis Inputs (if different than Year 1)##
## Survey Inputs ###
nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

## Modified expansion and offset calculations
ExpFac<- ExpSvy$DayLtHr*HzKM2*.2

# Calculate the fatalities and store as a temporary object.                    (*7*)
tmp<-mapply(simFatal,EMin=ExpSvy$EMin,SmpHrKM2=ExpSvy$SmpHrKM3,ExpFac=ExpFac,
        aPriExp=aPriExpY2,bPriExp=bPriExpY2,aPriCPr=2.31,bPriCPr=396.69,
        SIMPLIFY=FALSE)

# Put the survey specific simulations in an rv vector.
Fatalities<-rvnorm(nSvy)
Exp<-data.frame(Mean=rep(NA,nSvy),SD=NA,row.names=cSvy)
for(i in 1:nSvy){
 # i<-1
 Fatalities[i]<-tmp[[i]]
 Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize the surveys, including a total if needed.
nSvy<-length(Fatalities)
if(is.null(nSvy))nSvy<-1
FatalStats<-RVSmry(cSvy,Fatalities,probs=UCI)
if(AddTot){
 FatalStats<-rbind(
  FatalStats,
  RVSmry("Total",sum(Fatalities),probs=UCI)
 )}
```

Appendix J

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EDWARD K. LOVE FOUNDATION

Date: October 14, 2014

To: Garry Miller, Vice President, Land and Environmental Affairs, Power Company of Wyoming LLC, 555 Seventeenth Street, Suite 2400, Denver, CO 80202

From: Dr. Joshua J. Millspaugh, O'Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, 302 Natural Resources Building, Columbia, MO 65211

Subject: Expert Report – Estimates of Eagle Fatalities

I. Executive Summary and Expert Opinions

Using the U.S. Fish and Wildlife Service (USFWS or Service) Eagle Fatality Model, I was asked to estimate golden eagle and bald eagle fatalities for the final project design for Phase I of the Chokecherry and Sierra Madre Wind Energy Project. I also completed an evaluation of certain aspects of the model and how the Service applied eagle data collected on the site to estimate eagle fatalities. Given issues I identified with assumptions of the Service's model, as applied to the project site, which were first outlined in my report dated September 7, 2012, I modified several assumptions in the Service's model to account for site-specific characteristics of the project site to provide an estimate of eagle fatalities. I compared these eagle fatality estimates from the modified model to estimates provided by the Service for the final Phase I project design. My opinions are based upon my training, experience, education, and expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues.

The Service's Eagle Fatality Model maintains assumptions with questionable applicability to the Project. My examination of the model shows that the Service appropriately modified two assumptions I discussed in my report dated September 7, 2012, namely (1) the assumption that turbines operate during all daylight hours, all year long was modified to more accurately reflect the amount of time that turbines are operational; and (2) the assumption that eagles are at risk whether they fly above, below, or at rotor height was modified to exclude eagles flying above the rotor height. While I believe that it is also appropriate to assume that eagles flying below the rotor height are not at risk, the Service's modified assumption is more realistic than previously applied. However, while these two assumptions were improved, my present examination shows that the model continues to assume an infinite population of eagles exposed on the site, which has the effect of overestimating the number of predicted eagle fatalities for Phase I of the Chokecherry and Sierra Madre Wind Energy Project.

Further, my examination of the Service's model for the final project design reveals that: (1) the Service's approach to modeling curtailment could be refined to be more realistic and (2) there is a need to model season-specific risk of mortalities to obtain a more realistic fatality estimate. Data are available to address the infinite population assumption, the proper modeling of curtailment and the season-specific risk; therefore, my estimates of eagle fatalities detailed below incorporated these three assumptions. Further, the Service's model requires only slight modification to account for these more appropriate assumptions.

In addition to concerns regarding model assumptions, I have reservations about how the Service applied eagle use data from the site to estimate eagle fatalities using their model. I evaluated how eagle minute use data were applied in the model based on the final Phase I project design. In particular, my review determined that (1) the Service's summary of eagle minutes is biased upwards, which is acknowledged by the Service, but is not adjusted; and (2) the rules used by the Service to include and exclude data are ambiguous, which leads to the inclusion of eagle minute use data which are not appropriate.

Start and end times of eagle observations were recorded in hours and minutes and did not include seconds. The Eagle Conservation Plan Guidance recommends including rounding time of each eagle observation to the next highest integer. Thus, an eagle observed for 1 minute and 10 seconds would equate to 2 eagle minutes (U.S. Fish and Wildlife Service Summary Document for Review of Eagle Use Data and Eagle Fatality Prediction Analysis for the Chokecherry and Sierra Madre Wind Energy Project Phase 1, hereafter referred to as Summary Document, page 5). Because seconds were not provided, the number of eagle minutes was rounded to include all minutes in which eagles were observed (see Summary Document, page 5). As noted by the Service, "this method may inflate the number of eagle minutes, but it ensures the number of eagle minutes is not underestimated" (see Summary Document, page 5). Such an approach, when added to other assumptions of the Service's model, demonstrates a high emphasis on being risk averse, which causes the model to further overestimate the number of predicted eagle fatalities. To address this issue, simulations were run to address the expected bias in eagle minutes using this approach. Assuming start seconds and end seconds within an integer minute are random and that counts contain at least 2 integer minutes (e.g., 13:10 - 13:11), the straight subtraction approach (e.g., 13:10 - 13:11 = 1 minute) underestimates eagle minutes by about 1 second every time a count is conducted. The Service's approach (e.g., 13:10 - 13:11 = 2 minutes) overestimates eagle minutes by about 59 seconds every time a count is conducted. Given the level of expected bias, I adjusted eagle minutes to obtain a more realistic estimate of eagle minutes given the available data.

Last, I have general concerns related to some decisions made by the Service regarding which eagle minute data to include or exclude. My main concern is related to the inclusion of eagle use data recorded in areas that do not have turbines in the final Phase I project layout. Because turbines were not placed in these avoidance areas, due to potentially high eagle activity within those areas, eagle minutes within those areas should not contribute to estimated mortality. As currently applied, the estimated fatalities will be the same whether or not turbines are actually placed within avoidance areas with relatively high eagle activity. Although there are actually fewer eagle minutes when eagle minute data from these areas are

removed, the exposure rate is greater because many point counts outside the project footprint did not have any observed eagle minutes, thus estimated fatalities increase by excluding these data in the model.

Using the Service's model as a basis for estimating annual eagle fatalities, I modified the Service's model to provide a more realistic estimate of eagle fatalities. I maintained the structure and general approach taken by the Service in developing the model, but made biologically reasonable and supportable modifications. To more appropriately reflect the final Phase I project conditions: (1) I modified the Service's Model to directly account for abundance on the site rather than assuming an infinite population (the number of fatalities is a function of the number of eagles at risk); (2) I modeled curtailment by removing minutes from point counts within 800 m of turbines that will be shut down during the curtailment season; (3) I modeled season-specific risk of fatality by estimating fatalities for each season instead of annually; (4) I applied a bias correction to eagle minute use data; and (5) I removed eagle minutes recorded within areas that do not have turbines in the final layout.

I produced eagle fatality estimates, for both golden eagles and bald eagles separately, by modifying all assumptions simultaneously. I then compared the model output based on more appropriate assumptions for the project site and available eagle minute use data to eagle fatality estimates generated by the Service at the 80% quantile, which is used by the Service to estimate risk to eagles. The median number of estimated fatalities is also provided. The interpretation of a value at the 80% quantile means there is an 80% chance that *x* number of eagles *or fewer* are predicted to be removed at the wind energy site each year. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities that will occur each year. Reliance on the 80% quantile value is very conservative and model results suggest the actual number of eagle fatalities is likely to be fewer than the 80% quantile value in most model runs. This conservative benchmark is added on top of the already risk-averse approach taken to develop the model.

Assuming a 120 meter turbine blade, and the more appropriate modifications of the data and assumptions described above, the 80% quantile value was 9 *or fewer* golden eagle fatalities. The median estimated number of annual fatalities was 7 golden eagles. The Service estimated 14 golden eagle fatalities, at the 80% quantile, using the same scenario. Using the same assumptions, the 80% quantile value was 2 *or fewer* bald eagle fatalities, with a median estimated number of annual fatalities of 1. The Service estimated 2 bald eagle fatalities, at the 80% quantile, using the same scenario. In my opinion, model estimates when assumptions are modified to reflect project conditions results in a more realistic estimate of eagle fatalities for the Phase I project site.

II. Relevant Experience and Expertise

My experience and expertise are in wildlife ecology and the application of statistical techniques and models to address conservation issues. I am providing a summary here of my relevant experience and expertise. Currently, I am a full professor and the Pauline O'Connor Distinguished Professor of Wildlife Management in the School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri. I have a Ph.D. in

Wildlife Ecology from the College of Forest Resources, University of Washington, Seattle. I did postdoctoral studies in quantitative ecology at the School of Aquatic and Fishery Sciences, University of Washington. Selected honors and awards include being named a Fellow of The Wildlife Society in 2014, a 2008 award from the U.S. Department of Agriculture for National Teacher of the Year, a 2007 award from the Wildlife Society for Best Article (with Steve Buskirk), and a 2005 award from the Missouri Department of Conservation for "Outstanding Research Collaborator of the Year." In 2013, I was the inaugural recipient of the Southeastern Athletic Conference Faculty Achievement Award at the University of Missouri which "honors professors with outstanding records in teaching and scholarship who serve as role models for other faculty and students."

I have obtained about 60 grants and contracts as either PI or Co-PI since starting my faculty position in 1999 from diverse funding sources such as the U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, National Science Foundation, U.S. Forest Service, National Park Service, and the National Renewable Energy Lab. One recent grant is for the period 2011-2016 to study the *Ecology of Greater Sage-grouse in Relation to Wind Energy Development in Wyoming*. This study is being funded by the U.S. Forest Service, National Renewable Energy Lab, National Fish and Wildlife Foundation, Power Company of Wyoming (PCW), Wyoming Game and Fish Department, Bureau of Land Management, Western Association of Fish and Wildlife Agencies, and National Wind Coordinating Collaborative.

I have published 4 books and about 185 peer-reviewed journal articles and book chapters. Three books are directly applicable: (1) *Models for Planning Wildlife Conservation in Large Landscapes*, 2009, Millspaugh, J.J. and F.R. Thompson, III, editors, Academic Press, 674 pages; (2) *Design and Analysis of Long-Term Ecological Monitoring Studies*, 2012, Gitzen, R.A., J.J. Millspaugh, A.B. Cooper, and D.S. Licht, editors. Cambridge University Press, 600 pages; and (3) *Wildlife Demography: Analysis of Sex, Age, and Count Data*, 2005, Skalski, J.R., K.E. Ryding, and J.J. Millspaugh, Elsevier Science, 656 pages. In addition to these publications, I have been an invited plenary speaker at national and international conferences to discuss the application of statistical techniques and models in wildlife ecology and management.

I have applied and evaluated statistical techniques and models in addressing conservation issues for a broad range of species, including mammals, avifauna, reptiles, and amphibians. For example, at the request of the Wisconsin Department of Natural Resources, I chaired an international panel of experts in evaluating data and models the agency uses to monitor and estimate white-tailed deer population demographics. Specifically, we evaluated the validity of the assumptions of their population reconstruction model, assessed adjustments made in the model by state personnel, and offered guidance on future applications. I was the senior author on a paper published in the *Journal of Wildlife Management* in 2009 that summarized our findings. A second example relates to my continued development of animal movement and habitat models. In addition to applying these statistical models to diverse taxa ranging from hellbenders to elephants, I have collaboratively developed new statistical approaches to analyzing such data and rigorously evaluated methodology. Specifically, my colleagues and I were among the first to apply discrete choice models in a wildlife context and we pioneered

the development of resource utilization functions, both of which have become standard modeling tools for ecologists over the past decade. Thus, my experience and expertise are directly applicable to the analysis I was asked to perform.

III. Review and Critical Analysis of the Assumptions and Estimates of the Eagle Fatality Model for the Chokecherry and Sierra Madre Wind Energy Project

In September 2014, I was asked to perform a review and critical analysis of the assumptions of U.S. Fish and Wildlife Service's (USFWS or Service) Eagle Fatality Model and the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service. Given issues I identified with the data used in the Service's model and the assumptions of the Service's model, as applied to the project site, I modified the input data and the Service's model to make the assumptions more appropriate and reflective of project conditions to estimate eagle fatalities. I then generated eagle fatality estimates and compared the estimates from the modified model to the Service's estimates created using the Service's data and assumptions.

My current review estimates golden eagle and bald eagle fatalities for the final project design. My opinions are based upon my training, experience, education and my expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues.

A. Documents and Data Examined and Scope of Review

In this review, I examined several documents, site-specific data used in the model, and the Service's model which has been modified since my last review. Further, I considered my firsthand knowledge of the site and discussions with SWCA personnel. Below I detail the specific materials I reviewed and considered in my evaluation.

(1) Draft Eagle Conservation Plan Guidance released by the Service in January 2011 that describes a process for wind energy developers when preparing an Eagle Conservation Plan (ECP) to assess the risk of projects to eagles and assess how siting, design, and operational modifications can mitigate that risk, specifically, Appendix D, Description of the Service's Model;
(2) Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012 that updated the technical appendices in the Draft Eagle Conservation Plan Guidance;
(3) U.S. Fish and Wildlife Service Summary Document for Review of Eagle Use Data and Eagle Fatality Prediction Analysis for the Chokecherry and Sierra Madre Wind Energy Project Phase 1 produced by the U.S. Fish and Wildlife Service, Region 6,Wyoming Ecological Services Field Office and Region 6 Migratory Bird Management Office dated May 27, 2014 (hereafter referred to as Summary Document);
(4) Power Company of Wyoming's Eagle Conservation Plan (draft dated August 2014);
(5) The site-specific eagle data collected at the project site;
(6) Service's model and their list of assumptions used in the model;
(7) Service's model as applied to the final project design;

(8) Discussions with SWCA about data collection and data analysis; and
(9) Papers that were cited by the Service as support for model development and assumptions.

B. Experience with the Project and Eagle Data Collected

I am familiar with the Chokecherry and Sierra Madre Wind Energy Project, how the eagle data were collected by SWCA, and how the data were analyzed by SWCA. I have previously reviewed the Service's eagle fatality model and provided a report to PCW and the Service in September 2012.

I am currently leading a study at the Chokecherry and Sierra Madre Wind Energy Project that investigates the ecology of male Greater sage-grouse in relation to construction of the wind energy facility. I have also been collaborating on a companion female Greater sage-grouse project on the site since the spring of 2010 and leading the habitat component of that project. Given my role in these sage-grouse projects, I have made extensive site visits across the project site. I recently completed one graduate student, and currently supervise one graduate student and one research associate in association with this sage-grouse research. I have also made a few separate trips to Denver, Colorado to meet and discuss my collaborative sage-grouse research with SWCA and PCW personnel.

Because of site visits and my research activities at the project site, I am knowledgeable of the topography, landscape, and location where the eagle data were collected. I was accompanied by SWCA personnel during most of my time on the project site and we discussed how and where the eagle data were collected.

I reviewed the raptor survey program implemented by SWCA including the long watch raptor survey methodology.

C. Assumptions and Data Used in the Service's Eagle Fatality Model

My September 12, 2012 report to PCW and the Service described the Service's eagle fatality model, its assumptions, and implications of applying those assumptions to estimating eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. Since that report, the Service has modified their model to account for two issues that I raised. Specifically, the Service modified their model for current estimates of eagle fatalities to address the assumption (1) that eagles are not vulnerable to collision when their flight height is above the turbine blades and (2) that turbines do not rotate all daylight hours, for 365 days per year. These modifications were appropriate, resulting in more realistic estimates of fatality than were previously presented. My present examination has shown that the model continues to assume an infinite population of eagles exposed on the site. Further, my examination revealed that modifications to the project design required the Service to modify their model to account for curtailment of turbine activity.

In addition to evaluating model assumptions in light of the current project design, I evaluated how the Service applied eagle minute use data in their eagle fatality model with emphasis on

two key areas including (1) how data were summarized and (2) which data were included and excluded by the Service to estimate eagle fatalities for the project.

Set out below is a discussion of the assumptions of the Service's model that should be modified to more appropriately model eagle fatalities at the site. Further, I discuss how data were summarized and rules for including and excluding eagle minute data as applied by the Service to estimate eagle fatalities for Phase I. This section identifies modifications to the Service's Model that are required to ensure the model is more appropriately applied to the project.

i. *Assumptions*

(1) *There is an infinite population of eagles exposed on the site*. The Service assumes an open population in the Model. It is more accurate to state that the Model assumes an infinite number of eagles at the site, and immediate replacement of an eagle with another eagle after a fatality event, because in the Model fatality due to turbine collision does not reduce eagle abundance. The open population assumption might provide a mechanism for the assumption of an infinite population, and immediate replacement due to a fatality, but what matters in the model is that eagle abundance, or more specifically potential eagle exposure, does not decline as a result of eagle fatalities. This assumption has the practical influence of each eagle fatality resulting in immediate replacement by another eagle (i.e., the exposure rate does not change with an eagle fatality). The stated open population assumption assumes we know the process that leads to an infinite population and immediate replacement due to an eagle fatality. The implication of this assumption is that it is possible to predict more eagle fatalities on the site than eagles that exist currently on the site.

(2) *The daylight hours used to calculate exposure rate are accurately represented by a mean value for each turbine across the entire year* (Summary Document, page 40). This assumption relates to the methods applied by the Service to model proposed curtailment of turbine activities. This approach accounts for reduced daylight hours due to 17 turbines shut down near nest 162 for 89.25 days, but it further spreads the reduction in daylight hours equally among all turbines. To fully account for decreased risk, any surveys that overlap with these 17 turbines both spatially and temporally should be treated as 'unrepresentative' habitat.

(3) *The model assumes that risk of fatality is the same across the year*. Given available eagle minute use data, it is apparent that risk of fatality is not equal across the year, but the model assumes an average value of risk across the year. Information is lost when eagle minutes are pooled across the entire year. For example, the peak number of golden eagle minutes in year 2 occurs in winter (Summary Document, page 35). This time coincides with the greatest percent daylight operational hours (see Summary Document, page 39). It would be more appropriate to consider distinct seasonal conditions of both eagle use and daylight operational hours rather than spreading that risk out across the entire year.

(4) *The Service assumes that the 80% quantile is an appropriate measure of the risk of eagle fatalities on a site*. Output of the Service's Model is a probability distribution of predicted

eagle fatalities on an annual basis. The Service has used the 80% quantile as a basis for interpretation. In August 2012, the Service acknowledged that focus on the 80% quantile is conservative and was a policy decision. Most importantly, the interpretation of a value at the 80% quantile means there is an 80% chance that *x* number of eagles *or fewer* are predicted to be removed at the wind energy site. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities. This conservative benchmark is added on top of the already risk averse approach taken to develop the Model.

In conclusion, my examination of the Service's Eagle Fatality Model revealed that although some of the previous assumptions have been appropriately modified in current estimates of eagle fatalities (i.e., eagles are not considered at risk when flight height is above the rotor swept region and it is not assumed turbines rotate during all daylight hours, 365 days per year), there remain a few questionable assumptions given the final project design and currently available data. This report, however, focuses on 3 specific assumptions made by the Service's Model (1) that there is an infinite population of eagles exposed on the site each year; (2) how curtailment activities are modeled; and (3) that risk to eagles is constant across the year. By not verifying the validity and reasonableness of these assumptions, the Model might result in an unrealistic number of predicted eagle fatalities for Phase I of the Chokecherry and Sierra Madre Wind Energy Project. I focused on these 3 assumptions because (1) they are questionable; (2) data are available to address these assumptions; and (3) the Service's model requires only slight modification to account for these assumptions so that they more appropriately reflect the project conditions, resulting in a more realistic estimate of eagle fatalities for Phase I.

ii. *Data Used*

1. *How eagle minute data were summarized to estimate eagle fatalities*. A primary issue related to the eagle minute data relates to the "rounding up" of eagle use minutes to estimate eagle fatalities. Start and end times of eagle observations were recorded in hours and minutes and did not include seconds. The Eagle Conservation Plan Guidance recommends including rounding time of each eagle observation to the next highest integer. Thus, an eagle observed for 1 minute and 10 seconds would equate to 2 eagle minutes (see Summary Document, page 5). Because seconds were not provided, the number of eagle minutes was rounded to include all minutes in which eagles were observed (see Summary Document, page 5). So, if an observation was recorded at 08:01 and 08:02, the total number of minutes would be 2. As noted by the Service, "this method may inflate the number of eagle minutes, but it ensures the number of eagle minutes is not underestimated" (see Summary Document, page 5). Such an approach, when added to other assumptions of the Service's model, demonstrates a high emphasis on being risk averse and highly conservative, which errs on the side of overestimating the number of predicted eagle fatalities. The degree of risk that is tolerable should be made transparent, not embedded repeatedly in a non-quantifiable way in the building of a model to predict outcomes. The best scientific practice would be to develop the most realistic model possible, apply the model, and explain to the policy makers how to interpret and use model output as they determine the acceptable degree of risk. It is important to avoid confusing best scientific practices with policy when developing a model.

To address this issue, simulations were run to address the expected bias in eagle minutes using this approach (Appendix A). Assuming start seconds and end seconds within an integer minute are random and that counts contain at least 2 integer minutes (e.g., 13:10 - 13:11), the straight subtraction approach (e.g., 13:10 - 13:11 = 1 minute) underestimates eagle minutes by about 1 second every time a count is conducted. The Service approach (e.g., 13:10 - 13:11 = 2 minutes) overestimates eagle minutes by about 59 seconds every time a count is conducted. Given the level of expected bias and the available data, it is possible to adjust eagle minutes based on this level of bias to obtain a more realistic estimate of eagle minutes.

2. *Which data were included and excluded by the Service to estimate eagle fatalities for the project*. The rules used by the Service to include and exclude data seem ambiguous and non-repeatable. It would be appropriate to provide rules that a third party could objectively apply and arrive at the same conclusion about which data to include or exclude. Further, it would be appropriate to apply the rules in the same manner across years. Below are examples of concerns regarding the inclusion and exclusion of some point-count data:

(A) It is unclear why data from point-counts conducted in turbine avoidance areas are not treated as "unrepresentative" habitat. Because turbines were not placed in these avoidance areas, due to potentially high eagle activity within those areas, eagle minutes within those areas should not contribute to estimated mortality. This approach seems counter-intuitive if a goal is to reduce eagle fatalities. As currently applied, the estimated fatalities will be the same whether or not turbines are actually placed within high avoidance areas or not.

(B) There is ambiguity related to the definition of the project footprint from which "30% spatial coverage" is required. Without a clear understanding of how the Service defines the project footprint it becomes difficult to apply the rules established by the Service.

(C) There is no clear statistical or biological justification for the 30% spatial coverage rule.

(D) The 30% spatial coverage rule is being applied to justify excluding data from some point-counts in some years, but not others. For example, data from point count RM12 (Summary Document, pages 3, 4, 13, 14, 16) were used in some years but not in other years. Data should either be used in all years or not used in any years.

In conclusion, my examination of the data used by the Service to model estimated eagle fatalities revealed some questions in how data were summarized and which data were included or excluded. This report focuses on two specific modifications that were made to more appropriately reflect the data available to estimate eagle fatalities on the site including (1) a bias correction to the summary of eagle minute use data and (2) exclusion of eagle use data recorded outside areas where turbines will be located.

IV. Eagle Fatality Modeling for the Chokecherry and Sierra Madre Wind Energy Project: Consideration of Assumptions and Data Used

Given the discussion above about model assumptions and data used to estimate eagle fatalities, I used the Service's Model as a basis for estimating annual eagle fatalities, but I produced fatality estimates by modifying questionable assumptions. Further, I modified how data were summarized and which data were included in my estimates of eagle fatalities. I maintained the structure and general approach taken by the Service in developing the model, but made biologically reasonable and supportable modifications to address these assumptions.

A. Overview, Scope of Analysis and Background

I focused on the following 3 specific assumptions made by the Service's model (1) that there is an infinite population of eagles exposed on the site each year; (2) that the daylight hours used to calculate exposure rate are accurately represented by a mean value for each turbine across the entire year; and (3) the model assumes that risk of fatality is the same across the year.

To address these assumptions, I did the following: (1) to account for the infinite population assumption, I modified the Service's Model to directly account for abundance on the site (the number of fatalities is a function of the number of eagles at risk); (2) to account for the mean exposure rate, I treated the area around the 17 turbines that were curtailed as 'unrepresentative' habitat; and (3) to account for the same risk of fatality throughout the year, I modeled estimates of fatality using distinct seasonal conditions of both eagle use and daylight operational hours rather than spreading that risk out across the entire year. All of these assumptions were integrated in one model run.

In addition to addressing these 3 specific assumptions of the Service's model, I also (1) adjusted eagle minutes to obtain a more realistic estimate of eagle minutes given the available data by applying a bias correction and (2) treated turbine avoidance areas as "unrepresentative" habitat.

B. Eagle Fatality Estimates

I produced eagle fatality estimates, for both golden eagles and bald eagles separately, by modifying all assumptions simultaneously. I then compared model output when assumptions were made more realistic for the project site and available eagle minute use data to eagle fatality estimates generated by the Service. Modifications to the model and data are described below.

1. Eagle fatality estimates for the project accounting for a finite population of eagles

To account for the infinite population assumption, the Service's model was directly modified to directly consider abundance. More specifically, the Service's model was made to explicitly make the number of fatalities a function of the number of eagles at risk of death. Define the following variables:

λ = the expected number of eagle minutes per hour per km^2
C = collision probability per eagle minute spent in hazardous areas
A = abundance of eagles in the project site
DH = the total number of daylight hours in a year
HA = the total hazardous area in units of km^2
F = number of eagle fatalities
π = proportion of time turbines are rotating
α = proportion of time flying at rotor height

Both λ and C are specified by the same distributions outlined in Appendix D – Stage 3 document of the ECP Guidance report. A can be specified as a distribution or as a constant. For purposes of this report, we have assumed a mean abundance of 30 golden eagles and 8 bald eagles, which was estimated by SWCA during their monitoring program.

The probability a single eagle collides with a turbine per eagle-minute spent in hazardous areas is:

$$\gamma = 1 - (1 - C)^{\frac{\lambda}{A}}.$$

Note that the expected number of eagle minutes per hour per km^2 is divided by the total abundance so the collision probability is represented on a per-eagle basis. Assuming the collision probability is constant across space and time, the annual probability of a single eagle colliding with a wind turbine is:

$$\psi = 1 - (1 - \gamma)^{DH \times HA}.$$

Finally, assuming a constant annual collision probability across all eagles:

$$F \sim binomial(A, \psi).$$

In addition to other assumptions made in the Service's model, our binomial model assumes that eagle minutes are evenly spread among all eagles in the project site. The abundance is assumed to be known or is known with some level of certainty. Specifying an unreasonably large abundance (e.g., infinite population) will overestimate fatality risk, while specifying an unreasonably small abundance (e.g., 1 eagle) will underestimate fatality risk.

In summary, this approach is identical to the Service's model but this modification allows an explicit representation of the number of eagles at risk of death. Using the Service's model which assumes an infinite number of trials, it was modified as an equivalent binomial model without altering any other aspect of the Service's model except for the mean abundance which is made explicit. Such an approach allows for the evaluation of the effect of a more realistic value of abundance on estimated eagle fatalities rather than assuming an infinite population of eagles exposed on the site and immediate replacement of an eagle with another eagle after a fatality event.

2. The daylight hours used to calculate exposure rate are accurately represented by a mean value for each turbine across the entire year

This assumption relates to the methods applied by the Service to model proposed curtailment of turbines. This approach accounts for reduced daylight hours due to 17 turbines shut down near nest 162 for 89.25 days, but it further spreads the reduction in daylight hours equally among all turbines. To fully account for decreased risk, surveys that overlap with these 17 turbines both spatially and temporally should be treated as 'unrepresentative' habitat, resulting in the exclusion of eagle minute data and modification to the exposure rate.

Thus, I excluded eagle minutes and observation hours from point counts within 800 meters of any of the 17 turbines scheduled to be shut down during the curtailment period. Specifically, I excluded eagle minutes and observation hours from point counts MH3, MH5, RM3 during the curtailment season, defined as February 1 – April 30 (see Summary Document, p. 39). Finally, I reduced the number of turbines to 483 during the curtailment season.

3. The model assumes that risk of fatality is the same across the year

To accommodate for differential risk of fatality across the year, I considered distinct seasonal conditions of both eagle use and daylight operational hours rather than spreading that risk out across the entire year.

I summarized eagle minutes and observation hours by the seasons defined in the Summary Document, page 39. I included observations from "Year 1" and "Year 2" (see Summary Document pages 6-7). I calculated season-specific daylight hours as the product of seasonal daylight hours and the percent of time each turbine is expected to operate (see Summary Document, page 40).

4. *How eagle minute data were summarized to estimate eagle fatalities.*

The primary issue here relates to the "rounding up" of eagle use minutes to estimate eagle fatalities. As discussed above in Section C, ii, 1, the Service's method for recording eagle minutes (e.g. observing an eagle from 13:10 – 13:11 = 2 eagle minutes) introduces an average bias of 59 seconds every time a count is conducted (0.98 minutes). Rounding minutes to 1 when they start and stop within the same integer minute (e.g. observing an eagle from 13:10 – 13:10 = 1 eagle minute) introduces an average bias of 40 seconds (0.67 minutes). Thus, I subtracted 0.98 minutes for every observation that lasted ≥2 minutes and 0.67 minutes for every observation that lasted 1 minute to correct this bias.

5. *Which data were included and excluded by the Service to estimate eagle fatalities for the project.*

It is unclear why data from point-counts conducted in turbine avoidance areas are not treated as "unrepresentative" habitat. Because turbines were not placed in these avoidance areas, due to potentially high eagle activity within those areas, eagle minutes within those areas should not contribute to estimated mortality. This approach seems counter-intuitive if a goal of these avoidance areas is to reduce eagle fatalities. As currently applied, the estimated

fatalities will be the same whether or not turbines are actually placed within these avoidance areas or not.

To accommodate this issue, I included only eagle minutes and observation hours from point counts within 800 meters of an active turbine. Specifically, I only included eagle minutes and observation hours from the following point count stations: CC1, CC2, CC3, CC4, CC5, CC6, CC7, CC9, CC10, CC11, CC12, MH1, MH2, MH3, MH4, MH5, MH6, MH7, MH8, PG2, PG4, PG5, PG7, PG8, PG9, PG10, RM3, RM4, RM6, RM7, RM13, RM14, RM17, RM18, RM19, RM20, and RM23.

Based on the available data, I applied the following correction: at point count RM4, during 2011 Spring to 2012 Spring, the Service recorded 13 golden eagle minutes (Summary Document, page 25). My review suggested there should be 17 minutes: a 1-minute and a 2-minute count of May 23, 2011, a 9-minute count on June 23, 2011, a 2-minute count on July 10, 2011, and a 3-minute count on July 24, 2011. Thus, I used 17 minutes in the model.

I produced eagle fatality estimates, for both golden eagles and bald eagles separately, by modifying all assumptions simultaneously. I then compared Model output when assumptions were made more appropriate for the project site and available eagle minute use data to eagle fatality estimates generated by the Service. Further, I considered eagle fatality numbers at the 80% quantile, which is used by the Service to estimate risk to eagles. The median number of estimated fatalities is also provided. The interpretation of a value at the 80% quantile means there is an 80% chance that *x* number of eagles *or fewer* are predicted to be removed at the wind energy site each year. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities that will occur each year. Reliance on the 80% quantile value is very conservative and model results suggest the actual number of eagle fatalities is likely to be fewer than the 80% quantile value in most model runs. This conservative benchmark is added on top of the already risk-averse approach taken to develop the model.

Assuming a 120 meter turbine blade, the 80% quantile value was 9 *or fewer* golden eagle fatalities (Table 1 and Figures 1 and 2). The median estimated number of annual fatalities was 7 golden eagles. The Service estimated 14 golden eagle fatalities, at the 80% quantile, using the same scenario. Using the same assumptions, the 80% quantile value was 2 *or fewer* bald eagle fatalities, with a median estimated number of annual fatalities of 1 (Table 2 and Figures 3 and 4). The Service estimated 2 bald eagle fatalities, at the 80% quantile, using the same scenario. A complete summary of these modeling results, including a summary of the data used, is presented in Tables 1 and 2 and Figures 1-4 below.

V. Conclusion

In conclusion, it is my opinion that:

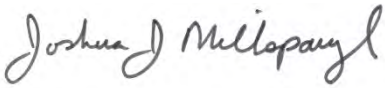
- There are a number of assumptions inherent in the Service's eagle fatality Model that are questionable for the project site and modification of these

assumptions as used in the Model results in a more realistic estimate of eagle fatalities. In particular, the Service's model assumes there is an infinite population of eagles exposed on the site, which has the effect of overestimating the number of predicted eagle fatalities for Phase I of the Project. Further, my examination of the Service's model for the final project design has revealed that their approach to modeling curtailment should be refined and there is a need to model season-specific risk of estimated mortalities. Both adjustments to the model result in a more realistic estimate of eagle fatalities at the site.

- Further, there were general concerns and uncertainty related to some decisions made by the Service regarding which eagle minute data to include or exclude and how data were summarized. A main concern related to the inclusion of eagle use data recorded in the turbine avoidance areas. Because turbines were not placed in these avoidance areas, due to potentially high eagle activity within those areas, eagle minutes within those areas should not contribute to estimated mortality. Second, the rounding of minute data as conducted by the Service overestimates eagle minutes. Consideration of these issues results in a more realistic estimate of eagle fatalities at the site.

- The Service's model can be modified to reflect more appropriate assumptions for the project site. Doing so maintains the structure and general approach taken by the Service in developing and applying the Model. However, doing so makes the model a more realistic reflection of project conditions.

- When considering the final project design, assuming a 120 meter turbine blade, and consideration of the assumptions and modifications to input data as described above, the 80% quantile value was 9 *or fewer* golden eagle fatalities. The median estimated number of annual fatalities was 7 golden eagles. The Service estimated 14 golden eagle fatalities, at the 80% quantile, using the same scenario. Using the same assumptions, the 80% quantile value was 2 *or fewer* bald eagle fatalities, with a median estimated number of annual fatalities of 1. The Service estimated 2 bald eagle fatalities, at the 80% quantile, using the same scenario. In my opinion, model estimates when assumptions are modified and input data are modified to reflect project conditions results in a more realistic estimate of eagle fatalities for Phase I of the Chokecherry and Sierra Madre Wind Energy Project.



Dr. Joshua J. Millspaugh
O'Connor Distinguished Professor of Wildlife Management
Department of Fisheries and Wildlife Sciences
University of Missouri

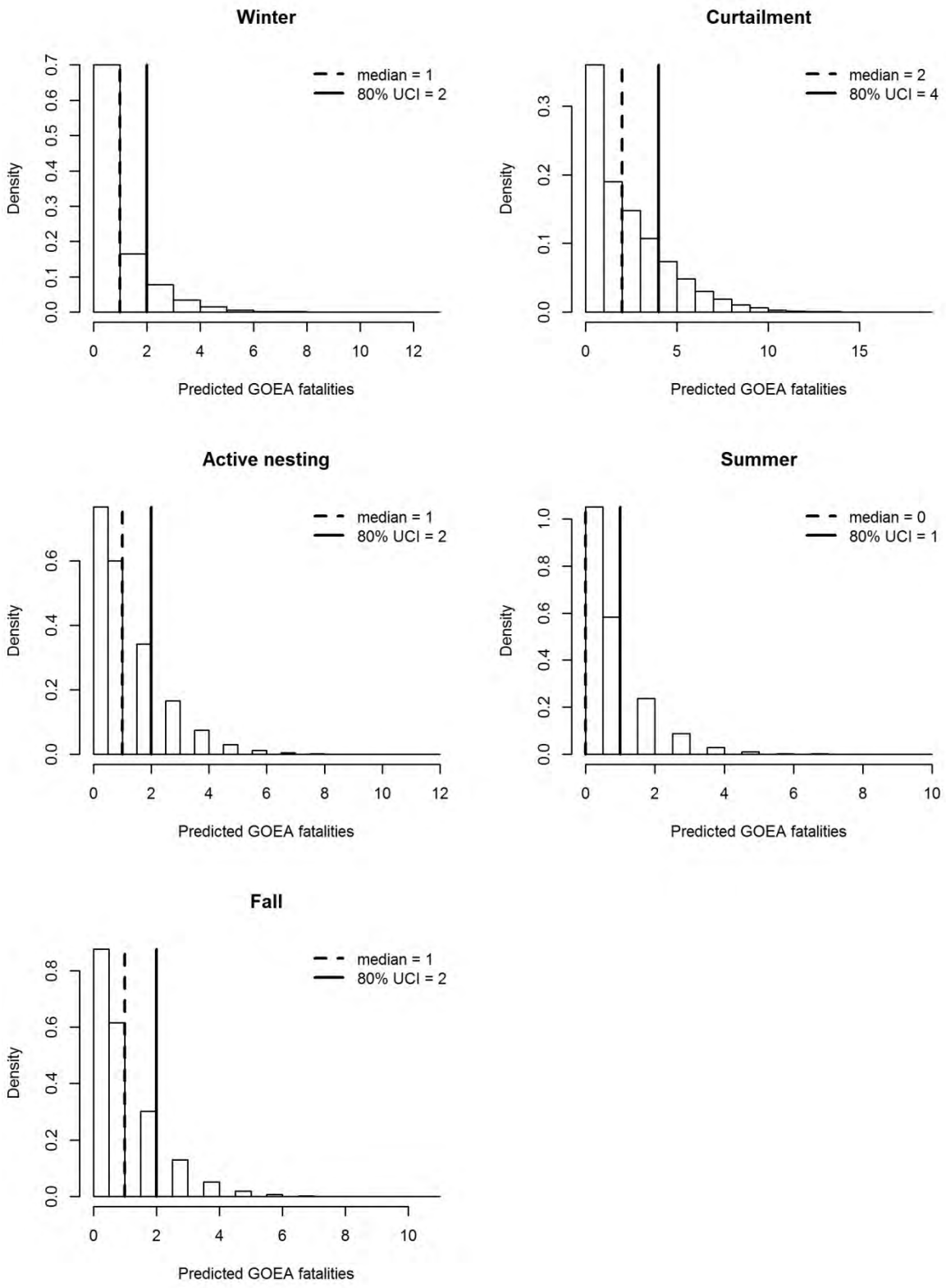


Figure 1: Summary of season-specific posterior distribution of golden eagle fatalities.

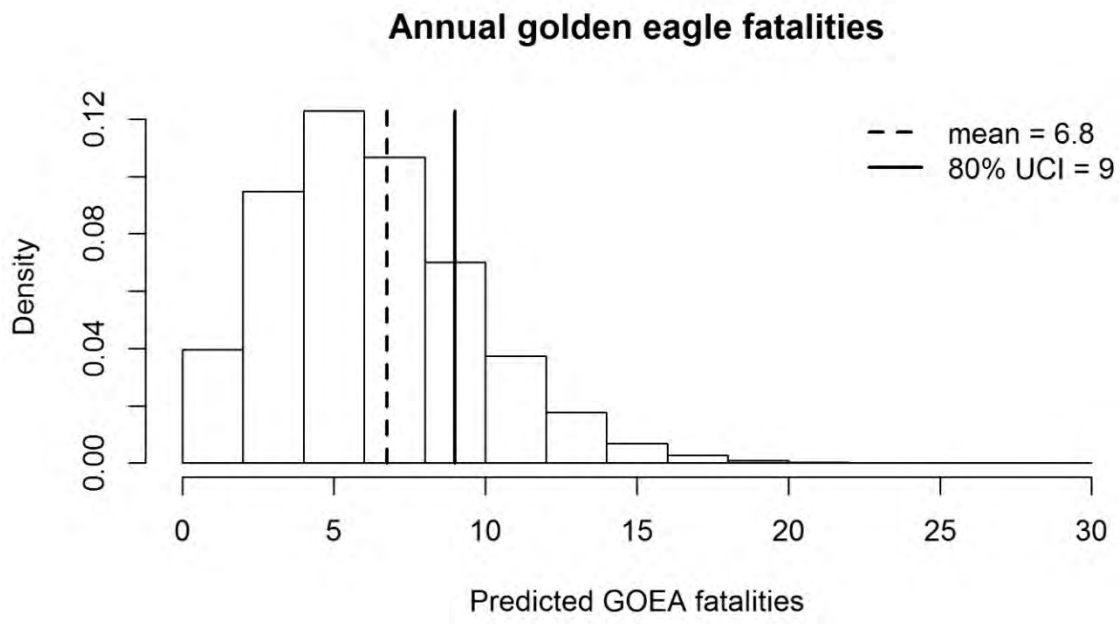


Figure 2: Summary of annual posterior distribution of golden eagle fatalities.

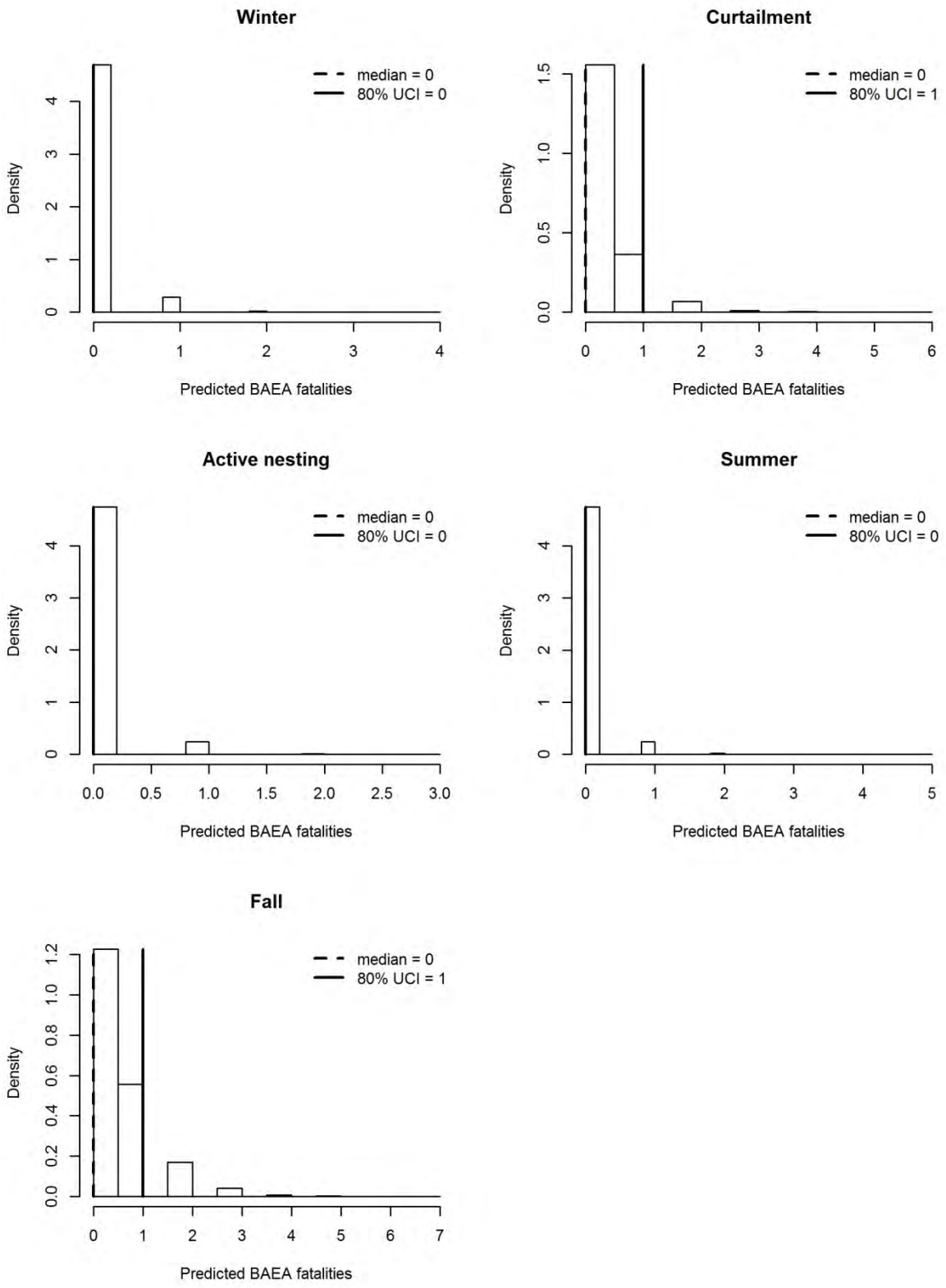


Figure 3: Summary of season-specific posterior distributions of bald eagle fatalities.

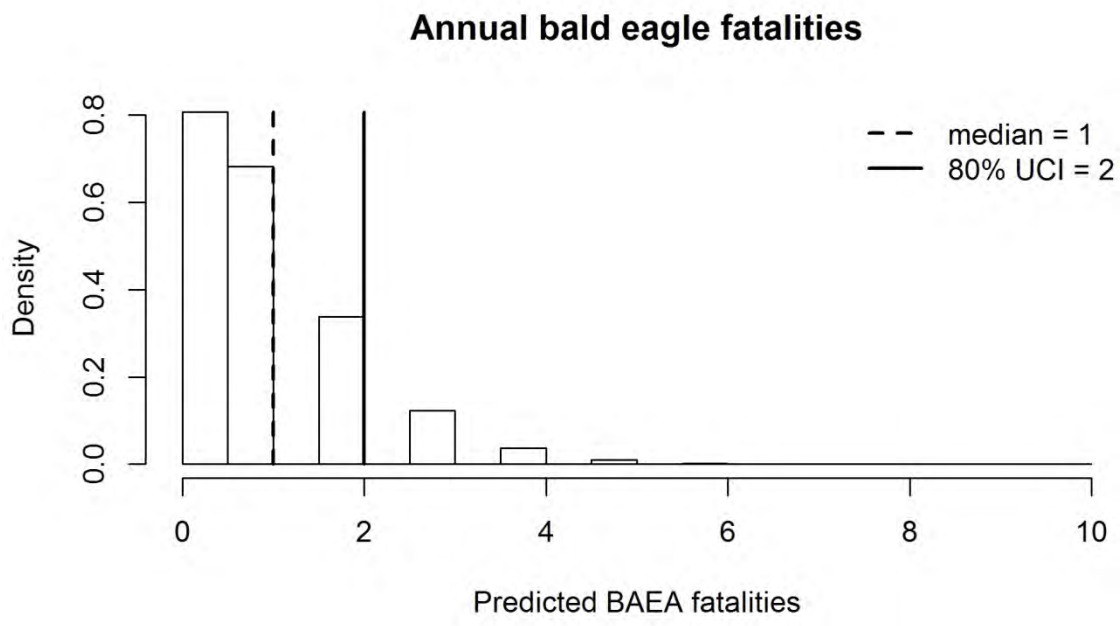


Figure 4: Summary of annual posterior distribution of bald eagle fatalities.

Table 1: Summary of predicted golden eagle fatalities and data used in the model.

Season	Golden Eagle Minutes	Survey hours per km^3	Daylight Hours	Blade Length (m)	No. Turbines	Eagle Exposure	Exposure SD	Avg. Fatality	Fatality SD	80% UCI Fatality
Winter	15.7	64.3	689.7	120	500	0.2575	0.063	1.13	1.29	2
Curtailment	44.6	99.8	1008.0	120	483	0.4545	0.067	2.72	2.31	4
Active Nest	28.2	132.1	841.8	120	500	0.2198	0.041	1.18	1.32	2
Summer	12.5	66.4	580.7	120	500	0.2008	0.055	0.75	1.00	1
Fall	31.3	205.6	977.7	120	500	0.1564	0.028	0.98	1.17	2
Annual	-		-	-	-	-	-	6.76	3.34	9

Table 2: Summary of predicted bald eagle fatalities and data used in the model.

Season	Bald Eagle Minutes	Survey hours per km^3	Daylight Hours	Blade Length (m)	No. Turbines	Eagle Exposure	Exposure SD	Avg. Fatality	Fatality SD	80% UCI Fatality
Winter	0.0	64.3	689.7	120	500	0.0149	0.015	0.07	0.27	0
Curtailment	3.4	99.8	1008.0	120	483	0.0434	0.021	0.27	0.55	1
Active Nest	0.3	132.1	841.8	120	500	0.0098	0.009	0.05	0.24	0
Summer	0.0	66.4	580.7	120	500	0.0145	0.015	0.05	0.24	0
Fall	16.8	205.6	977.7	120	500	0.0860	0.020	0.52	0.77	1
Annual	-		-	-	-	-	-	0.97	1.05	2

Appendix A. R code used to assess bias in “rounding up” eagle minutes.

```
# Bias (in seconds) when not rounding up.  Assumes eagle minutes
consist of two
# complete integer minutes (e.g., 13:10 - 13:11)

# Total seconds in integer minute 1
sta <- 60 - sample(0:59, 100000, T)
# Total seconds in integer minute 2
end <- 60 - sample(0:59, 100000, T)


# mean bias from SWCA approach (in seconds)
# SWCA would treat this as 1 minute
mean(60 - (sta + end))

# mean bias from FWS approach (in seconds)
# FWS would treat this as 2 minutes
# mean bias approximately 59 seconds
mean(120 - (sta + end))


# Bias (in seconds) for 1-minute surveys (e.g., 13:10 - 13:10)
# assume 1-second minimum survey length - e.g., if a survey starts
at 13:10:59,
# it will end at 13:11:60 at the earliest.  Thus, all surveys start
by 13:10:58

# assume all time intervals equally likely
# e.g., second 0 - 1 is as likely as second 11 - 45
# total number of possibilities is sum of integers 1:59.
# calculate like this: 1-s intervals can be 0-1, 1-2, ..., 58-59 (59
total)
# 2-s intervals can be 0-2, 1-3, ..., 57-59 (58 total), etc.
# mean bias approximately 40 seconds

# initializing a vector where each element is 1 equally-likely time
interval.
total.possibilities <- sum(1:59)

# each element of total.possibilities is the total length of the
time interval.
# i.e. there are 59 possible 1-s intervals, 58 possible 2-s
intervals, etc.
sec.ind <- numeric(total.possibilities)
for(i in 1:59){
  s <- sum(sec.ind > 0) + 1
  e <- (59:1)[i] + sum(sec.ind > 0)
  sec.ind[s:e] <- rep(i, (59:1)[i])
}
```

```
# randomly sampling survey lengths
len.s <- sample(sec.ind, 100000, T)
hist(len.s, main = '', xlab = 'Survey length (s)', freq = F);
mean(len.s)
bias <- 60 - len.s; mean(bias)
```

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Appendix K

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APPENDIX K

Summary of BLM Environmental Constraints, Applicant Committed Measures, Applicant Committed Best Management Practices, and Proposed Mitigation Measures

This appendix contains a copy of Appendix D from the Chokecherry and Sierra Madre (CCSM) Wind Energy Project Record of Decision (ROD) published in 2012. *See BLM 2012a*. This appendix identifies the Bureau of Land Management (BLM) environmental constraints, Applicant committed measures, Applicant committed best management practices, and proposed mitigation measures for the CCSM Project. This appendix is included in this Phase I ECP for ease of reference to the design features and mitigation measures incorporated into the CCSM Project, including Phase I.

Appendix D

Summary of BLM Environmental Constraints, Applicant Committed Measures, Applicant Committed Best Management Practices, and Proposed Mitigation Measures

Appendix Table D-1 Summary of BLM Environmental Constraints

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source
			Private Land[3]	State Land	Public Land		
Cultural – Historic Trails	Within either 0.25-mile or the visual horizon (whichever is closer) of a cultural property/ historic trails.	No surface disturbing activities. Management actions resulting in visual elements that diminish the integrity of the property's setting will be managed in accordance with the Wyoming State Protocol and BMPs.	Yes[4]	Yes	Yes	1	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines; Wind Energy Programmatic EIS ROD Policies and BMPs.
Recreation Sites	Within 0.25-mile of developed and undeveloped recreation sites.	Lands closed to operation of public land laws.	Yes[4]	Yes[4]	Yes[4]	1	2008 Rawlins RMP ROD.
Soils – Slopes	Steep slopes >25 percent.	Surface disturbance will be prohibited. No turbines, staging or substations.	Yes[5]	Yes[5]	Yes[5]	1	Wyoming BLM Mitigation Guidelines.
Special Management Areas – Designated Areas	Designated areas part of the National Landscape Conservation System (e.g., Continental Divide National Scenic Trail [CDNST]).	Lands will be excluded from wind energy site monitoring and testing and development on lands on which wind energy development is incompatible with specific resource values. *(0.25-mile swath centered on the trail)*	n/a	Yes[4]	Yes	1	Wind Energy Programmatic EIS ROD Policies and BMPs.
Water – Ephemeral Channels	Within 100 feet from the inner gorge of ephemeral channels.	Avoidance areas for surface-disturbing and disruptive activities and linear crossings. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No[5]	No[5]	Yes[5]	1	2008 Rawlins RMP ROD.
Water – Floodplains	Identified 100-year floodplains.	Surface disturbing activities will be avoided. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No	No	Yes	1	2008 Rawlins RMP ROD.
Water – Perennial Waters, Springs, Wetlands, Riparian	Within 500 feet of perennial waters, springs, and wetland and riparian areas.	Surface disturbing activities will be avoided. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No[4,5]	No[4,5]	Yes[5]	1	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines; Executive Orders (EOs) 11990 and 11988.
Water – Unstable Areas	Unstable areas (such as landslides, slopes >25 percent, slumps, and areas exhibiting soil creep).	Surface disturbing activities will be avoided. Reclamation practices and BMPs will be applied as appropriate for surface disturbing activities.	No	No	Yes	1	2008 Rawlins RMP ROD.
Water – Wetlands	Wetlands identified on National Wetlands Inventory (NWI) or proper functioning condition (PFC).[6]	No disturbance.	No	No	Yes	1	EOs 11990 and 11988.
Wildlife – Amphibians	Identified 100-year floodplains; within 500 feet of perennial waters, springs, wells, and wetlands; and within 100 feet of the inner gorge of ephemeral channels.	Surface disturbing and disruptive activities will be avoided.	No	No	Yes	1	2008 Rawlins RMP ROD.
Wildlife – Fish	Waterbodies that potentially support fish for a portion of the year.	Design road crossings to simulate natural stream processes.	No	No	Yes	1	2008 Rawlins RMP ROD.
Wildlife – Raptors	825 feet of active raptor nests (ferruginous hawks, 1,200 feet).	Well locations, roads, ancillary facilities, and other surface structures requiring a repeated human presence will not be allowed. Distance may vary depending on factors such as nest activity, species, natural topographic barriers, and line-of-sight distances.	Yes	Yes	Yes	1	2008 Rawlins RMP ROD.
Wildlife-Columbian Sharp-tailed Grouse	0.25 mile to 1 mile of an occupied or undetermined Columbian sharp-tailed grouse lek.	High-profile structures (e.g., buildings, storage tanks, overhead powerlines, wind turbines, towers, and windmills) would be authorized on a case-by-case basis from one-quarter mile to 1 mile of an occupied greater sage-grouse and sharp-tailed grouse lek.	No	No	Yes	1	2008 Rawlins RMP ROD.
Wildlife – Greater Sage-grouse	Inside Core Areas: 0.60 mile NSU from lek perimeter (includes occupied and undetermined leks). Outside Core Areas: 0.25 mile NSU from lek perimeter (includes occupied and undetermined leks).	Surface disturbing activities or surface occupancy is prohibited or restricted.	Yes	Yes	Yes	1	BLM IM No. WY-2012-019

Appendix Table D-1 Summary of BLM Environmental Constraints

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source
			Private Land[3]	State Land	Public Land		
Wildlife – Greater Sage-grouse	Inside Core Areas.	Limit development to one disturbance location per 640 acres. Cumulative value of one location and existing disturbance to not exceed 5 percent of sagebrush habitat within 640 acres	No	No	Yes	1	BLM IM No. WY-2012-019
Wildlife – Greater Sage-Grouse	0.25-mile to 1 mile of an occupied sage-grouse lek.	High-profile structures (e.g., buildings, storage tanks, overhead power lines, wind turbines, towers, and windmills) will be authorized on a case-by-case basis.	No	No	Yes	1	2008 Rawlins RMP ROD.
Wildlife – Greater Sage-grouse	Inside Core Areas: Within 0.60-mile of the perimeter of an occupied or undetermined greater sage-grouse lek. Outside Core Areas: Within 0.25-mile of the perimeter of an occupied or undetermined greater sage-grouse lek.	Disruptive activities are restricted between 6:00 p.m. and 9:00 a.m. from March 1 to May 20.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; BLM IM No. WY-2012-019.
Wildlife – Greater Sage-grouse	Inside Core Areas: In suitable greater sage-grouse nesting and early brood-rearing habitat. Outside Core Areas: In suitable greater sage-grouse nesting and early brood-rearing habitat within 1) mapped habitat important for connectivity, or 2) within 2 miles of any occupied or undetermined lek.	Surface disturbing and/or disruptive activities are prohibited or restricted from March 1 – July 15.	No[7]	No[7]	Yes	2	BLM IM No. WY-2012-019; 2008 Rawlins RMP ROD.
Wildlife – Greater Sage-grouse	Greater sage-grouse delineated winter concentration areas.	Surface disturbing and/or disruptive activities in mapped or modeled greater sage-grouse winter habitats/concentration areas that support Core Area populations, are prohibited or restricted from November 15 – March 14.	No[7]	No[7]	Yes	2	BLM IM No. WY-2012-019; 2008 Rawlins RMP ROD.
Wildlife – Columbian Sharp-tailed Grouse	Within 0.25-mile of the perimeter of an occupied or undetermined Columbian sharp-tailed grouse lek.	Surface disturbing activities or occupancy are prohibited. Disruptive activities are prohibited between 6:00 p.m. and 9:00 a.m. from March 1 to May 20.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Barn Owl	Within 0.75-mile of barn owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Big Game	Big game crucial winter range.	Surface disturbing and disruptive activities will not be allowed during the period of November 15 to April 30. Disruptive activities will require the use of BMPs designed to reduce the amount of human presence and activity during the winter months.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines.
Wildlife – Big Game	Big game parturition areas.	Surface disturbing and disruptive activities will not be allowed during the period of May 1 to June 30.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines.
Wildlife – Burrowing Owl	Within 0.75-mile of burrowing owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 15–September 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Cooper's Hawk	Within 0.75-mile of Cooper's hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Ferruginous Hawk	Within 1-mile buffer of ferruginous hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Golden Eagle	Within 1-mile buffer of golden eagle nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Goshawk	Within 0.75-mile of Goshawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–August 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Great-Horned Owl	Within 0.75-mile of great-horned owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Kestrel	Within 0.75-mile of kestrel nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Long-Eared Owl	Within 0.75-mile of long-eared owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.

Appendix Table D-1 Summary of BLM Environmental Constraints

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source
			Private Land[3]	State Land	Public Land		
Wildlife – Merlin	Within 0.75-mile of Merlin nests.	Seasonal wildlife stipulation April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Mountain Plover	Potential and occupied habitat Mountain plover.	Habitat will be avoided where practical. All surface-disturbing activities will be restricted from April 10 to July 10. Additional protection measures will be applied if this area is later determined to be within occupied habitat. Occupied habitat is defined as areas where broods and adults have been found.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Northern Harrier	Within 0.75-mile of northern harrier nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Osprey	Within 0.75-mile of osprey nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Peregrine Falcon	Within 0.75-mile of peregrine falcon nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Prairie Falcon	Within 0.75-mile of prairie falcon nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Raptor	Defined raptor and game bird winter concentration areas.	Activities or surface use will not be allowed from November 15 to April 30.	No[7]	No[7]	Yes	2	Wyoming BLM Mitigation Guidelines.
Wildlife – Raptor	Raptor nesting habitat.	Activities or surface use will not be allowed from February 1 to July 31.	No[7]	No[7]	Yes	2	Wyoming BLM Mitigation Guidelines.
Wildlife – Raptors	Within 0.75-mile of other raptor nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Red-Tailed Hawk	Within 0.75-mile of red-tailed hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Screech Owl	Within 0.75-mile of screech owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Sharp-Shinned Hawk	Within 0.75-mile of sharp-shinned hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Short-Eared Owl	Within 0.75-mile of short-eared owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Swainson's Hawk	Within 0.75-mile of Swainson's hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.
Wildlife – Western Yellow-billed Cuckoo	Within 0.5 mile radius yellow-billed cuckoo nest.	Seasonal wildlife stipulation April 15–August 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.

[1] Sources of information for application of stipulations for private and state lands include *Applicant Proposed Alternative and BLM Response Letter* (April 23, 2010), *PCW Response and Data on BLM Alternatives* (December 2009), and the *Plan of Development for the Chokecherry and Sierra Madre Wind Energy Project* (January 12, 2012).
[2] 1 = Restriction; 2 = Seasonal.
[3] As indicated in PCW's submittal entitled *Applicant Proposed Alternative and BLM Response Letter* (April 23, 2010).
[4] Applicant imposes more restrictive measures or applies measure to a specific area, see summary table of PCW ACMs.
[5] Per the *PCW Response and Data on BLM Alternatives* (December 2009) footnotes to Alternatives Summaries #18, "No Surface Uses (NSUs), as provided by BLM, were avoided to the extent practicable; however, some NSUs could not be completely avoided in a small number of discreet instances (mainly ephemeral streams, slope, and perennial streams/springs/wetlands/riparian). An example of an exception to the NSUs is where a turbine is located in an area that cannot be accessed without crossing an ephemeral stream. If it is determined that the stream is a Water of the U.S., then a Section 404 permit will be obtained thereby allowing an access road to be constructed. Another example is the slope criteria. The accuracy of the digital terrain model used for this analysis is insufficient for micro-siting. Engineering judgment was used to determine in a limited number of cases that it may be possible to grade a resource road to design criteria."
[6] See Chapter 8.0, Glossary.
[7] Per the *PCW Response and Data on BLM Alternatives* (December 2009) footnotes to Alternatives Summaries #10, "seasonal timing restrictions were not applied to construction activities on private land."

Appendix D. Applicant Committed Measures

Appendix Table D-2. Summary of Applicant Committed Measures

Item	Environmental Resource	Applicant Committed Measure
A-1-01	ESA, sensitive species, and other wildlife and fish species	Site-specific surveys and/or monitoring for ESA threatened and endangered species, BLM sensitive species and other wildlife and fish species will take place during each phase of construction. Survey and monitoring approaches will be developed in coordination with USFWS, BLM, and WGFD and will be identified in the site-specific PODs developed for each construction right-of-way grant.
A-1-02	Avian and Bat Species, Golden and Bald Eagles	PCW will develop an Avian Protection Plan (APP), a Bat Protection Plan (BPP) and an Eagle Conservation Strategy (ECS) to identify measures to avoid, minimize, and mitigate project impacts through siting, operations, and monitoring.
A-1-03	Greater Sage-grouse	PCW will comply with EO 2011-5 and commit to no construction activities within Wyoming's SGCA as they are identified in EO 2011-5 (Core Area Version 3 Map).
A-1-04	Wildlife Habitat Management Areas	PCW will not construct any facilities within portions of the Red Rim-Grizzly WHMA and Upper Muddy Creek Watershed-Grizzly WHMA that are within the Wyoming Sage-Grouse Core Management Area Version 3 Map (EO 2011-5).
A-1-05	Mule Deer	PCW will continue to coordinate with WGFD on ongoing mule deer monitoring efforts on the Ranch.
A-1-06	Colorado River Fishes – bluehead sucker, flannelmouth sucker, roundtail chub, Colorado River cutthroat trout	PCW will continue to work with WGFD and BLM to develop conservation and monitoring strategies for native fish species in the Upper Muddy Creek watershed.
A-1-07	Fish species, amphibian species, other stream obligates; water quality	PCW will monitor watershed and stream conditions throughout the Application Area to document hydrologic conditions and stream channel characteristics (see Appendix H – Watershed Monitoring Plan).
A-1-08	Other wildlife species	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate impacts to wildlife species.
A-1-09	Wildlife Stipulations	PCW will adhere to the timing and spatial stipulations and exception processes as they are described in the Project ROD.
A-1-10	Wildlife Stipulations	Timing and spatial stipulations will be used on public lands.
A-1-11	Avian and Bat Monitoring	PCW will develop a project Avian Protection Plan, Bat Protection Plan and Eagle Conservation Strategy that will each describe post-construction monitoring efforts for avian and bat species.

Item	Environmental Resource	Applicant Committed Measure
A-1-12	Wildlife Monitoring and Survey	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate **impacts** to sensitive wildlife species.
A-1-13	Vegetation	Vegetation datasets developed by PCW will be used during project design to identify sensitive vegetation types for avoidance, minimization or mitigation and to optimize the reclamation plans for each construction phase.
A-1-14	Colorado butterfly plant and Ute ladies'-tresses orchid	Site-specific surveys for both plant species will be completed prior to surface disturbing activities in suitable habitat.
A-1-15	Revegetation and Reclamation	PCW will develop detailed reclamation plans for each of the construction phases and right-of-way grants. These plans will consider site-specific conditions and design considerations to maximize reclamation success.
A-1-16	Wetland Resources	Facilities would be sited to avoid and/or minimize impacts.
A-1-17	Wetland Resources	Any construction that occurs in or adjacent to wetlands and streams would use BMPs to protect surface water quality and minimize impacts to those resources.
A-1-18	Cultural Resources	Class III inventories of all proposed disturbance areas associated with the site-specific POD will be conducted prior to construction.
A-1-19	Cultural Resources	All cultural resource identification, evaluation, and treatment, including as a result of unexpected discovery at such time that construction has been permitted, will follow the stipulations of the Programmatic Agreement (PA) established for the project.
A-1-20	Paleontological Resources	In the event that fossils are discovered on public lands during construction activities, PCW will suspend work in that area, have an on-call paleontologist review the fossils, and notify the BLM. PCW expects the significance of the discovery and the resulting course of action to be determined within 48 hours of discovery.
A-1-21	Watershed Resources	PCW has implemented a watershed monitoring program to evaluate potential impacts of project construction and operations. PCW commits to continue watershed monitoring efforts for three years post-construction.
A-1-22	Greater Sage-Grouse	PCW will work cooperatively with BLM and WGFD to perform annual lek monitoring within the Ranch in accordance with approved WGFD protocols during pre-construction, construction and for five years post-construction.

Item	Environmental Resource	Applicant Committed Measure
A-1-23	Greater Sage-Grouse	PCW will work with BLM and private landowners to identify fences that pose a significant collision risk to sage-grouse. Identified fences will be removed or marked as practicable. To date PCW and TOTCO have removed over 10 miles of fence and have marked an additional 16 miles of fence with reflective bird diverters.
A-1-24	Greater Sage-Grouse	PCW will work with BLM and private landowners to evaluate proposed new fences and determine the risk of such fences to sage-grouse. If significant risk exists, new fence construction will be deferred where possible; if fences must be constructed they will be marked with reflective bird diverters.
A-1-25	Avian Species including Bald and golden Eagles and Greater Sage-Grouse	Guy wires on meteorological towers will be marked with reflective bird diverters. To date PCW has marked all guy wires on Project meteorological towers with reflective bird diverters.
A-1-26	Wildlife including Greater Sage-Grouse, Other Avian Species and Small Mammals	PCW will work with private landowners to install metal mesh escape ladders in water tanks that pose a risk to wildlife species. To date, PCW and TOTCO have installed metal mesh escape ramps on many Ranch water tanks.
A-1-27	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to stabilize and rehabilitate burned areas to promote the biological integrity of the site and limit expansion of invasive species. In 2010 PCW and TOTCO pursued stabilization and recovery of a burned area in the Chokecherry site with an emphasis on rapid recovery and use of the area by sage-grouse and other species.
A-1-28	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private landowners and water right owners to pursue water improvement conservation projects to benefit greater sage-grouse and other wildlife species in accordance with all applicable rules and regulations.
A-1-29	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private land owners to enhance fallow agricultural fields on the Ranch located east of the North Platte River. Enhancements include vegetation treatments to improve forage and cover for greater sage-grouse.
A-1-30	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	To minimize habitat fragmentation PCW will work with BLM and private landowners to close unnecessary roadways and reclaim such roads where practicable.
A-1-31	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to control the spread of noxious and invasive plant species.
A-1-32	Greater Sage-Grouse	PCW will work with private landowners to suspend the hunting of sage-grouse on private lands within the Ranch

Item	Environmental Resource	Applicant Committed Measure
A-1-33	Greater Sage-Grouse	PCW will cooperate with agencies and private land owners to evaluate and implement predator control techniques to benefit sage-grouse as appropriate.

Appendix Table D-2. Summary of Applicant Committed Measures

			Jurisdiction			Applies To			
Item	Resource Concern	Restriction Distance	Private	State	BLM	WTGs	Subs	Roads Collection T-Line	Notes
A-2-01	Cultural Historic Trails	1 mile WTGs, 0.25 mile surface of the Overland Trail	Y	Y	Y	Y	Y	No, minimize crossings, cross at right angles	1 mile setback from the center of the Overland Trail as presently mapped (2008 RMP/ROD) in all areas except the following sections, where the BLM's RMP requirement of 0.25 miles were used: T18N R87W S6; T18N R88W S1; T18N R88W S2; T18N R88W S4; T18N R88W S7; T18N R88W S9; T18N R89W S11; T18N R89W S12; T18N R89W S13; T18N R89W S14; and the unmapped Overland Trail alternative route located in T18N R88W S6, T18N R89W S1, T18N R89W S2, T18N R89W S11, and T18N R89W S10.
A-2-02	Lands and Realty - City/Town Limits	Structure base 0.5 mile setback	Y	Y	Y	Y	Y	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead
A-2-03	Lands and Realty Homes/ Occupied Buildings	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure
A-2-04	Lands and Realty - ROW Setback	5D from ROW boundary	N	N	Y	Y	N	No	Waiver may be granted

			Jurisdiction			Applies To			
Item	Resource Concern	Restriction Distance	Private	State	BLM	WTGs	Subs	Roads Collection T-Line	Notes
A-2-05	Lands and Realty - Subdivisions	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	Y	Yes, except underground	Setback applies to all above-ground construction, underground appears permissible within setback
A-2-06	Lands and Realty - WTGs	Tower base 1.1 times total structure height from external property lines	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure
A-2-07	Lands and Realty - WTGs	Tower base 1.1 times total structure height from any public ROWs	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure
A-2-08	Recreation - Teton Reservoir	1 mile boundary WTGs of Teton Reservoir	Y	Y	Y	Y	N	No	WTG placement would be prohibited within one mile of the Teton Reservoir Recreation Site.
A-2-09	Water - North Platte River	1 mile high water mark WTGs of the North Platte River	Y	Y	Y	Y	Y	No, avoid if possible	WTG placement would be prohibited within one mile of the ordinary high water mark of the North Platte River.

			Jurisdiction			Applies To			
Item	Resource Concern	Restriction Distance	Private	State	BLM	WTGs	Subs	Roads Collection T-Line	Notes
A-2-10	Wildlife - Red Rim Grizzly Wildlife Habitat Area (WHMA)	No development within Red Rim-Grizzly WHMA within the Wyoming Sage-Grouse Core Management Areas Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes	The Wyoming Game and Fish Department's (WGFD) Red Rim-Grizzly WHMA is approximately 37,630 acres in total, of which approximately 1,200 acres (3%) lie outside Sage-Grouse Core Management Areas Version 3. The area outside Sage-Grouse Core Management Areas Version 3 is located in the northeast corner of the Grizzly WHMA and is a part of or adjacent to Miller Hill. PCW may locate facilities within this area of the Grizzly WHMA.
A-2-11	Wildlife- Sage-Grouse Core Breeding Area	No facilities within the Wyoming Sage-Grouse Core Management Area Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes	No construction of any facilities (WTGs, roads, transmission lines, collector lines, substations, staging areas, etc.) in Wyoming's Sage-Grouse Core Management Areas Version 3 (finalized June 29, 2010).

Appendix Table D-3. Applicant Committed Best Management Practices

Item	Resource Concern	Measure
A-3-01	Air – Dust Control	Water would be applied twice per day, or as deemed necessary by the Environmental Inspector, to all disturbed surfaces (i.e., exposed, dry, and unfrozen) during construction. During operation, dust control would occur twice per day in those areas where vehicular traffic exceeds normal operational needs. If, for example, heavy equipment is brought on site for maintenance or if vehicular traffic exceeds a few vehicles per day, additional dust control watering would be initiated.
A-3-02	Air – Dust Control	Magnesium chloride may be applied, if necessary, for adequate dust suppression. These treatments would occur on an as-needed basis, depending on weather conditions and the amount of traffic on the road.
A-3-03	Air – Dust Control	The driving surface of all roads constructed for project access would be surfaced with gravel to further reduce potential dust emissions.
A-3-04	Air – Dust Control	Dust abatement techniques would be used on unpaved, unvegetated surfaces to minimize airborne dust. Dust abatement techniques would be employed on construction materials and stockpiled soils if they are a source of fugitive dust. Dust abatement techniques would be used before and during surface clearing, excavation, or blasting activities.
A-3-05	Air – Dust Control	Speed limits (e.g., 25 miles per hour [mph] [40 kilometers per hour [km/h]) would be posted along all access roads and enforced during construction and maintenance activities and enforced to reduce airborne fugitive dust.
A-3-06	Air – Vehicle Emissions	All construction equipment would be maintained in good working condition and would contain appropriate pollution control devices to minimize trace gas emissions.
A-3-07	Cultural and Paleontological Resources	Unexpected discovery of cultural or paleontological resources during construction would be brought to the attention of the responsible BLM authorized officer immediately. Work would be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.
A-3-08	General – Decommissioning	Prior to the termination of the right-of-way authorization, a decommissioning plan would be developed and approved by the BLM. The decommissioning plan would include a decommissioning impact analysis, site reclamation plan and monitoring program. All management plans, BMPs, and stipulations developed for the construction phase would be applied to similar activities during the decommissioning phase as agreed to between BLM and PCW.
A-3-09	General – Decommissioning	All turbines and ancillary (above-ground) structures would be removed from the site.

Item	Resource Concern	Measure
A-3-10	General – Avoidance of sensitive areas	PCW would work with the BLM to mitigate for environmentally sensitive areas. Marshy soils, drainage bottoms, and riparian areas would be avoided to the extent practicable.
A-3-11	General – Electrical Lines	All underground electrical collector lines would be buried in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance when possible).
A-3-12	General – Environmental Compliance	An Environmental Compliance Plan (ECP) would be developed and implemented to monitor implementation of mitigation measures during project construction. An Environmental Inspector would be on-site to oversee the implementation of the Project ECP.
A-3-13	General – Maintenance	The transmission lines would be inspected two times per year by ground or aerial patrols, and maintenance would be performed as necessary. Substation maintenance activities would include routine, scheduled equipment maintenance and grounds keeping. Once reclamation is complete and vegetation is stable, noxious weed surveys of the Project areas would be conducted on a regular basis. Inspection of the Project access roads and internal resource roads would include weed monitoring and treatment, as outlined in the Weed Management Plan.
A-3-14	General – Maintenance	Inoperative turbines would be repaired, replaced or removed in a timely manner.
A-3-15	General – Mitigation Measures	All control and mitigation measures established for the Project in the POD and the resource-specific management plans that are part of the POD would be maintained and implemented throughout the operational phase, as appropriate. These control and mitigation measures would be reviewed and revised, as needed, based on the mutual agreement of PCW and BLM, to address changing conditions or requirements within the Project area, throughout the operational phase. This dynamic approach would help ensure that impacts from operations are kept to a minimum.
A-3-16	General – Project Disturbance	The number and size/length of roads, temporary fences, lay-down areas, and borrow areas would be minimized.
A-3-17	General – Project Footprint	The area disturbed by construction-related activities (i.e., footprint) would be kept to a minimum.
A-3-18	General – Project Footprint	The area disturbed by operational-related activities (i.e., footprint) would be kept to a minimum.
A-3-19	Geology – Seismic Considerations	All structures will be built to appropriate seismic requirements for the local geology.
A-3-20	Hazardous Materials – SPCC Plan	A Spill Prevention, Control, and Countermeasures (SPCC) Plan would be implemented during the construction and operation phases of Project. The SPCC would define procedures to be used in the event of an accidental spill from vehicles or other equipment.

Item	Resource Concern	Measure
A-3-21	Hazardous Materials – Accidental Release	In the event of an accidental release of hazardous materials to the environment, the operator would document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event would be provided to the BLM authorized officer and other federal and state agencies, as required.
A-3-22	Hazardous Materials – ESA	A Phase I Environmental Site Assessment would be required prior to the purchase of a property and would be conducted by a trained and experienced environmental professional. If the Phase I Environmental Site Assessment identifies potential hazardous substances, a Phase II Environmental Site Assessment is usually conducted to confirm the presence and extent of contamination.
A-3-23	Hazardous Materials – Handling	Pursuant to the Project's Hazardous Materials Management Plan, all personnel handling hazardous materials would be trained appropriately on the dangers of, and safety precautions to be taken, when working with hazardous materials. Any hazardous materials used on-site would be documented and properly labeled. Material Safety Data Sheets (MSDS) and proper handling procedures would be located on-site. In the event a significant chemical spill occurs, personnel should evacuate the immediate area (as required) and report the release. The Emergency Response Team would be called to the area to assess the extent of the emergency and would determine appropriate response actions based on the Emergency Response Plan.
A-3-24	Hazardous Materials – Secondary Containment	Secondary containment would be provided for all on-site hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) would be a temporary activity occurring only for as long as is needed to support construction activities.
A-3-25	Hazardous Materials – Storage, Handling, and Disposal	Safety measures would be implemented in accordance with Occupational Safety and Health Administration (OSHA) standards and operator requirements. Petroleum products (e.g., lubricating oils and greases) and items such as touch-up paint and fiberglass blade repair materials would be stored on-site for maintenance operations. All such wastes/substances would be handled, stored in a secured location, and disposed of in accordance with applicable federal, state, and local regulations.
A-3-26	Health and Safety – Crane Operation	Crane safety training would be conducted to ensure riggers and ground workers understand the hazards of working around mobile cranes and that they watch for signs of problems at all times, especially if power lines are nearby. Standard operating procedures would be developed and implemented for safely lifting loads. A written engineered lift plan for all critical lifts would be developed and followed.

Item	Resource Concern	Measure
A-3-27	Health and Safety – Crane Operation	Crane operators would take the following steps to protect themselves and other workers when operating mobile cranes on the Project Sites: 1) the minimum clearance between power lines and the crane or load would be 10 ft. for lines rated 50-kV or below; 2) for lines over 50-kV, the minimum clearance would be 10 ft. plus 0.4 foot for each 1-kV over 50-kV; 3) operation of a crane outside of design limitations, manufacturer's specifications, or without the load charts would be prohibited; 4) cranes would be operated only when wind velocities are under the maximum speeds stipulated for safe operation (these velocities are generally stated in the manufacturer's specifications); 5) cranes would be inspected daily prior to each use, monthly, and annually, and the records of these inspections would be available on the machine; 6) rigging equipment would be inspected daily; 7) all operators of mobile cranes would have, and be familiar with, the additional requirements in the ANSI standard; 8) the latch in the hook throat opening would never be tied back; and 9) employees would not be suspended from the cranes and the use of cranes for suspended personnel platforms would be avoided.
A-3-28	Health and Safety – Crane Operation	Meteorological stations would monitor wind speeds on the job site to support safe crane operating standards.
A-3-29	Lands and Realty – Foreign Lines, Monuments, and Markers	All foreign lines would be marked. Monuments and markers (i.e., General Land Surveys and BLM Cadastral Survey Corners, reference corners, U.S. Coastal and Geodetic benchmarks) would be protected during the construction and operational phases of the Project. In the event that a monument or marker is disturbed, the employee would report the incident in writing to the Authorized Officer. PCW, in consultation with the BLM or other appropriate agency, would be responsible for re-surveying and replacing any markers that are disturbed.
A-3-30	Noise – Blasting and Noisy Activity	If blasting or other noisy activities are required during the construction period, nearby residents would be notified in advance.
A-3-31	Noise – Construction Equipment	All equipment would have sound-control devices no less effective than those provided on the original equipment. All construction equipment used would be adequately muffled and maintained.
A-3-32	Noise – Construction Equipment	All stationary construction equipment (i.e., compressors and generators) would be located as far as practicable from nearby residences.
A-3-33	Noise – Road Use	Road use specifications designed to keep traffic to a minimum would be implemented to the maximum extent practical.
A-3-34	Noise – Turbine Noise	All WTGs would be properly maintained to prevent excessive noise.

Item	Resource Concern	Measure
A-3-35	Public Health and Safety – Construction Practices	A Project Health and Safety Plan would be implemented in accordance with OSHA standards. Hard hat requirements and "authorized personnel only" signs would be posted at the entrance to the main access points during construction. Permanent signs would be posted at gates on the main access roads. Safety signs (e.g., speed limits, steep grades, etc.) would be placed along the main access roads in accordance with local, state, and federal regulations. Safety signing would be posted on all transformers, at high-voltage facilities, along roads, and around towers (if necessary) in conformance with applicable state and federal regulations.
A-3-36	Public Health and Safety – Construction Practices	A comprehensive and continuous occupational Injury and Illness Prevention Program (IIPP) would be implemented and enforce a code of safe practices (CSP) for all employees. A designated field safety person would be responsible for on-site management and administration of the IIPP and CSP. Occupational safety and health matters would be communicated to employees by written documentation, staff meetings, formal and informal training, weekly safety meetings, and posted information. Communication from employees to supervisors or safety representatives about unsafe or unhealthy conditions would be encouraged and may be verbal or written. Results of investigations of any employee safety suggestion or report of hazard would be distributed to all employees affected by the hazard or posted, as appropriate.
A-3-37	Public Health and Safety – Construction Practices	Each supervisor would conduct an inspection to identify unsafe working conditions and practices, as follows: 1) weekly in all areas; 2) whenever new substances, procedures, or equipment that may represent a new safety or health hazard are introduced to the job site; and 3) whenever a supervisor is made aware of a new or previously unrecognized hazard. A hazard checklist or hazard assessment form would be used to document inspections. Employees may not enter a hazard area without appropriate protective equipment, training, and prior specific approval by the IIPP and CSP administrator.
A-3-38	Public Health and Safety – Fire Management	Fire control would be provided pursuant to the Project's Fire Safety Plan.
A-3-39	Public Health and Safety – Fire Management	Fire prevention standards would be followed to reduce the risk of a fire, in accordance with 36 CFR 261 and the Wyoming Interagency Fire Restriction Plan. All hot work that is to occur on site would be done in accordance with OSHA Regulation 29 CFR 1910.252(a).
A-3-40	Reclamation	All areas of disturbed soil would be reclaimed using weed-free native grasses, forbs, and shrubs. Reclamation activities would be undertaken as early as possible on disturbed areas not required for operation.
A-3-41	Reclamation – Roadways	Access roads would be regraded, the topsoil replaced, and all disturbed areas would be re-vegetated. Any roadway damage due to the transport of the heavy equipment would be repaired on the public roadways upon the completion of Project construction and decommissioning.

Item	Resource Concern	Measure
A-3-42	Reclamation – Topsoil	Topsoil from all decommissioning activities would be salvaged and reapplied during final reclamation.
A-3-43	Reclamation – Vegetation	All areas of disturbed soil would be reclaimed using weed-free native shrubs, grasses, and forbs. The vegetation cover, composition, and diversity would be restored to values commensurate with the ecological setting.
A-3-44	Recreation – Public Access	Temporary fencing would be installed around staging areas and storage yards during construction to limit public access. Public access to open excavations would be limited by either installation of locked gates at public access points, or utilization of other approved means of limiting public access.
A-3-45	Recreation – Public Access	Permanent fencing would be installed and maintained around electrical substations, and turbine tower access doors would be locked to limit public access during operations.
A-3-46	Roads – General Design	DELETED[1]
A-3-47	Roads – General Design	Access roads and on-site roads would be surfaced with aggregate materials, wherever appropriate.
A-3-48	Roads – General Design	Access roads would be located to follow natural contours where possible and minimize side hill cuts.
A-3-49	Roads – General Design	DELETED[1]
A-3-50	Roads – General Design	Roads would be located upwind from WTG rows, where possible, such that drifting caused by towers or transformers is not likely to accumulate on roads.
A-3-51	Roads – General Design	Roads are designed in accordance with the BLM Gold Book (BLM 2007a) design criteria as well as the BLM Manual 9113: Roads (BLM 1985).
A-3-52	Roads – General Design	Existing roads would be used, but only if in safe and environmentally sound locations. If new roads are necessary, they would be designed and constructed to the appropriate BLM road design standards where practical and be no higher than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles).
A-3-53	Roads – General Design	Final roadway alignments will include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures will include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection. Final alignments will be ground-verified using BLM Rawlins Field Office knowledge of potentially problematic areas for road construction and/or maintenance.

[1] Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

Item	Resource Concern	Measure
A-3-54	Roads – General Design	Where road intersection improvements are required to accommodate extra long vehicles, potential upgrades could include placement of relocating signs, placement of temporary paving, and use of flaggers, as needed. All intersection improvements would be restored to their original condition upon the completion of construction.
A-3-55	Roads – General Design	Where road-cattle guard intersection improvements are required to accommodate overweight vehicles, potential road profile upgrades may be required to allow travel safely over the cattle guards. All damaged cattle guards would be replaced upon the completion of construction.
A-3-56	Roads – General Design	All existing roads that would be used as primary access locations to the Project area would need to be upgraded to accommodate the anticipated extra traffic generated by the Project. Most of these roads are county roads or two-track roads that would need to be widened to accommodate the construction traffic. All necessary federal, state, and local permits would be obtained to complete this work prior to construction.
A-3-57	Roads – General Design	During the course of construction, if excessive wear and tear to the existing roadway surface is evident, these road surfaces would be restored to their original condition upon the completion of construction. Where necessary, consultation with the UPRR would be required to change the roadway profile at specific at-grade railroad crossings to smooth the existing hump for low-profile vehicles; consultation with various utility companies would be required to elevate the risk of oversized vehicles in relation to low-hanging power lines.
A-3-58	Roads – General Design	Due to crest and sag vertical curves in the roadway profile, select locations would require re-grading prior to hauling extra long loads. Any grades greater than 10 percent would require assist vehicles on-hand for the large tractor-trailers hauling WTG components. Any grades greater than 7 percent would require assist vehicles on-hand. These locations would be verified during the final design process. In addition, any construction site with grades ranging from 5 to 7 percent on non-paved roadways would require an assist vehicle on stand-by during adverse weather or road conditions.
A-3-59	Roads – General Use	Traffic would be restricted to the roads developed for the Project. Use of other unimproved roads would be restricted to emergency situations. Signs would be placed along construction roads to identify speed limits, travel restrictions, and other standard traffic control information.
A-3-60	Roads – Maintenance	Most road maintenance would be performed on an as-needed basis. The frequency and type of maintenance that would be required would be determined by routine inspections. The inspections would be performed on a regular basis and following snowmelt or heavy or prolonged rainfall. Inspections would identify maintenance needs for reduction of ruts and holes, maintenance of crowns and outslopes to keep water off the road, replacement of surfacing materials, clearing of sediment blocking ditches and culverts, maintenance of interim reclamation, and noxious weed control.

Item	Resource Concern	Measure
A-3-61	Roads – Maintenance	All roads would be maintained in a safe and environmentally responsible manner.
A-3-62	Roads – Operation Access	Project operation would require the use of the new roads for equipment and personnel to reach the WTGs. In addition, an access road that runs adjacent to each WTG site and the project substations would be used.
A-3-63	Roads – Operation Access	Internal resource roads would be located within the project boundaries and would provide access to each WTG. All internal resource roads would be surfaced with gravel. As part of routine maintenance activities, internal resource roads would be maintained in a condition that allows for continued access to the WTGs.
A-3-64	Roads – Reclamation	Abandoned roads and roads that are no longer needed would be recontoured and revegetated.
A-3-65	Soils and Geology – Slopes	Operators would identify unstable slopes and local factors that can induce slope instability. Operators also would avoid creating excessive slopes during excavation and blasting operations. Special construction techniques would be used where applicable in areas of steep slopes, erodible soil, and stream channel crossings.
A-3-66	Soils – Erosion Control	Erosion control measures would be employed as described in the Master Reclamation Plan
A-3-67	Soils – Erosion Control	Permanent erosion control devices would be installed during project construction and may include, but are not limited to, waterbars, roadside ditches with subsurface culverts, berms, trash racks on culverts, energy-dissipating structures, mulches, and establishment of permanent vegetation. Erosion controls that comply with county, state, and federal standards would be applied. Practices such as jute netting, silt fences, and check dams would be applied near disturbed areas. The Environmental Inspector would monitor construction to ensure that erosion control devices are functioning properly.
A-3-68	Soils – Erosion Control	Final roadway alignments would include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures would include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection.
A-3-69	Soils – Erosion Control	If, during operation, it is determined that snow accumulation causes significant accelerated erosion, appropriate mitigation measures (e.g., snow fence construction) would be developed and implemented.
A-3-70	Soils – Excavation and Blasting Activities	Foundations and trenches would be backfilled with originally excavated material as much as possible. Excess excavation materials would be disposed of only in approved areas or, if suitable, stockpiled for use in reclamation activities.
A-3-71	Soils – Excavation and Blasting Activities	Borrow material would be obtained only from authorized and permitted sites. Existing sites would be used in preference to new sites when possible.

Item	Resource Concern	Measure
A-3-72	Soils – Topsoil Handling	Topsoil from all excavations and construction activities would be salvaged and reapplied during reclamation.
A-3-73	Soils – Topsoil Handling	Topsoil material suitable for site reclamation would be removed in conjunction with clearing and grading and reserved in local stockpiles. Topsoil storage areas would generally be located within staging areas and alongside roadways during construction.
A-3-74	Soils – Wet Soils During Construction	Construction activities would be suspended when soils are wet. Construction would resume when soils become dry enough to support construction equipment. The Environmental Inspector (EI) would determine when conditions are too wet to continue.
A-3-75	Transportation – Traffic Considerations	To minimize impacts on local commuters, consideration would be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute time. Consideration would also be given to opportunities for busing of construction workers to the job site to reduce traffic volumes.
A-3-76	Transportation – Transportation Planning	Ongoing ground transportation planning would be conducted to evaluate road use, minimize traffic volume, and ensure that roads are maintained adequately to minimize associated impacts.
A-3-77	Transportation – Transportation Planning	Following the finalization of site access locations and proposed roadways, a Traffic Management Plan would be developed for traffic both on and off-site. The Traffic Management Plan would discuss flagging guidelines on and off site, specifics of auxiliary lanes if needed, requirements for signage during construction of the project, passing zone and striping details for the existing public roadways, and other details specific to the individual approved access locations leading to and from, and on, the Project area.
A-3-78	Vegetation – Noxious Weed	Noxious weed surveys would be conducted to evaluate the presence and aerial extent of noxious weed and invasive species populations within the Project area. Preventative management measures would be applied as warranted pursuant to the Project's Weed Management Plan.
A-3-79	Visual Resources	Operators would reduce visual impacts during construction by clearly delineating construction boundaries and minimizing areas of surface disturbance; preserving vegetation to the greatest extent possible; utilizing undulating surface disturbance edges; stripping, salvaging and replacing topsoil; contoured grading; controlling erosion; using dust suppression techniques as required; and restoring exposed soils as closely as possible to their original contour and vegetation.
A-3-80	Visual Resources	Operators would monitor and maintain visual mitigation measures for the approved project in accordance with a visual monitoring and compliance plan. The operator would maintain revegetated surfaces until a self-sustaining stand of vegetation is reestablished and visually adapted to the undisturbed surrounding vegetation.

Item	Resource Concern	Measure
A-3-81	Waste Management – Disposal	Wastes would be properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.
A-3-82	Waste Management – Wastewater	Any wastewater generated in association with temporary, portable sanitary facilities would be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility or otherwise disposed of in accordance with applicable state and local laws and regulations. Temporary, portable sanitary facilities provided for construction crews would be adequate to support expected on-site personnel and would be removed at completion of construction activities.
A-3-83	Water – SWPPP	The Project's SWPPP would be implemented in accordance with the Wyoming Department of Environmental Quality (WDEQ) requirements to obtain National Pollutant Discharge Elimination System (NPDES) compliance under Wyoming's NPDES permit WYR10-0000. The SWPPP would describe site-specific erosion control and stream crossing measures that would be implemented during the construction and operation phases of the Project. The Environmental Inspector would direct activities to ensure compliance with the SWPPP.
A-3-84	Water – Excavation and Blasting Activities	DELETED[2]
A-3-85	Water – Excavation and Blasting Activities	Operators would avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.
A-3-86	Water – Road Design	DELETED[2]
A-3-87	Water – Road Drainage	Whenever possible, existing drainage systems would not be altered, especially in sensitive areas such as erodible soils or steep slopes. Potential soil erosion would be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts would be cleaned and maintained regularly.
A-3-88	Water – Road Locations	Roads would be located away from drainage bottoms and avoid wetlands, if practicable.
A-3-89	Water – Stream Crossings	Access roads would be located to minimize stream crossings. All structures crossing streams would be located and constructed so that they do not decrease channel stability or increase water velocity. Operators would obtain all applicable federal and state permits.

[2]Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

Item	Resource Concern	Measure
A-3-90	Water – Waterbodies and Wetlands	Waters of the U.S., including wetlands, will be avoided to the maximum extent practicable. Where these features cannot be completely avoided, impacts will be minimized through design modification, as necessary. Facilities (e.g., turbines, substations, staging areas) would be sited to avoid and/or minimize impacts; however, where impacts are anticipated (e.g., use of Project roads), minimization measures would be employed to minimize impacts (e.g., use of culverts to maintain downstream flow/drainage).
A-3-91	Water – Waterbodies and Wetlands	All impacts would be the minimum necessary to accomplish the Project, would be mitigated, and the appropriate Section 404 permit would be obtained from the U.S. Army Corps of Engineers (USACE) Wyoming Regulatory Office prior to the start of construction. To complete the Section 404 permit, a delineation of all Waters of the U.S. (WUS), including wetlands, would be performed by qualified wetland scientists to obtain current site-specific data regarding the location and extent of aquatic features within the Project area. Current resource mapping (e.g., U.S. Geological Survey (USGS) topographic maps, U.S. Fish and Wildlife Service (USFWS) NWI maps, Federal Emergency Management Agency (FEMA) floodplain maps, Natural Resources Conservation Service (NRCS) soils data, etc.) would be used to guide this future delineation effort. All aquatic features delineated in the field would be recorded using Global Positioning System (GPS) with sub-meter accuracy.
A-3-92	Water – Waterbodies and Wetlands	Any construction that occurs in or adjacent to wetlands and streams would use Applicant Committed BMPs listed in Appendix D to protect surface water quality and to minimize impacts to those resources.
A-3-93	Wildlife – Department of the Interior (DOI) Wind Turbine Guidelines	Although strictly voluntary on non-federal lands, PCW will review the DOI Wind Turbine Guidelines Advisory Committee Wind Turbine Guidelines (anticipated in late summer 2010) once they are finalized with the intention of complying with them as applicable and appropriate and to the extent they do not conflict with any requirements set out by the BLM in its ROD, any agreements entered into between PCW and the USFWS, or other controlling laws, permits, or regulations.
A-3-94	Wildlife – Disturbance and Harassment	All employees, contractors, and site visitors would be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. During construction, pets would not be permitted on site; during operation, pets would be controlled to avoid harassment and disturbance to wildlife.
A-3-95	Wildlife – Excavation and Blasting Activities	Explosives would be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the BLM or other federal and state agencies.
A-3-96	Wildlife – Habitat Restoration	In accordance with the habitat restoration plan, restoration would be undertaken as soon as practical after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

Item	Resource Concern	Measure
A-3-97	Wildlife – Vehicle Collisions	Project personnel and contractors would be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and airborne dust.
A-3-98	Wildlife – Yellow-billed Cuckoo	Yellow-billed cuckoo habitat (i.e., riparian areas) would be avoided to the maximum extent possible.

Appendix Table D-4 Proposed Mitigation Measures

Resource	Proposed Mitigation Measure
General	**GEN-1**: Phased Construction Sequencing. Limit surface disturbance to areas where turbines would be constructed within 12 months with a goal to mitigate impacts from surface disturbance to wildlife, soils, water, and vegetation (e.g., weeds). Four ROW grants would be issued for the project: 1) internal haul road; 2) transmission line between the two sites; 3) Sierra Madre development; and 4) Chokecherry development.
	GEN-2: Off-site Compensatory Mitigation. Off-site compensatory mitigation may be considered through future consultations between the BLM, Cooperating Agencies, and PCW if mitigation measures established through the project-wide EIS are later determined to not be adequate.
Air	No additional mitigation measures proposed.
Cultural	**CR-1**: To minimize unauthorized collecting of archaeological material or vandalism to known archaeological sites, PCW and its contractors, and all construction personnel, shall attend mandatory training and be educated on the significance of cultural resources and the relevant federal regulations intended to protect them.
	CR-2: Additional mitigation measures will be included in the Programmatic Agreement, which will be developed in coordination with the BLM, SHPO, ACHP, PCW; Indian tribes; and other interested parties.
Geology and Mineral Resources	No additional mitigation measures proposed.
Land Use	No additional mitigation measures proposed.
Paleontology	**PALEO-1**: If any vertebrate fossils or scientifically important fossils are discovered during construction operations on federal lands, the permittee shall cease activities immediately and notify the BLM so the agency can determine the significance of the discovery. The BLM shall evaluate or have evaluated such discoveries and shall notify PCW what action shall be taken with respect to such discoveries. Additionally, PCW also would contract with a qualified paleontologist approved by the BLM who shall be on call during all construction periods and available to travel to the site within 24 hours following notice of a discovery, and that the on-call paleontologist shall consult with the BLM to reach agreement on the significance of the discovery within 24 hours following arrival at the site by the on-call paleontologist. The BLM will then promptly notify PCW as to what actions shall be taken.
	PALEO-2: Any fossils recovered during the assessment of paleontological resources will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Wyoming Museum, University of Wyoming.
Range	**RANGE-1**: Coordinate construction schedules and ranching operations to allow sequencing of pasture use to the extent practicable within the Pine Grove/Bolten allotment and other affected allotments (Cottonwood Draw, Middlewood Hill, Grizzly, McCarty Canyon, and Sage Creek) in a manner to minimize conflicts between grazing and construction activities.

Appendix Table D-4 Proposed Mitigation Measures

Resource	Proposed Mitigation Measure
Recreation	No additional mitigation measures proposed.
Socioeconomics	No additional mitigation measures proposed.
Soils	**SOIL-1**: Road fabric, or equivalent base stabilization as determined by the BLM, will be applied where roads cross sensitive soils (wet, severely erodible soils, and soils with low soil strength).
	SOIL-2: Excess subsoil excavated from tower foundations will not be used as topsoil or spread on top of topsoil without further laboratory testing of the subsoil physical and chemical characteristics, and agency approval. PCW will identify the acceptable disposal method for excess subsoil in the final reclamation plan.
	SOIL-3: Areas identified as having limited reclamation potential (as defined in the Rawlins Instruction Memorandum No. WYD-03-2011-002) will be avoided during construction unless an acceptable site-specific reclamation plan is approved by the BLM.
	SOIL-4: To reduce impacts related to road density in the Application Area, roads that are no longer needed will be effectively reclaimed.
	SOIL-5: PCW will be required to submit a snow removal plan as part of the ROW grant application. The snow removal plan will include measures to ensure protection of soil and water resources.
	SOIL-6: Drainages, vegetated sand dunes, salt flats, steep slopes, and gullied areas will be avoided for towers, laydown areas, facilities, and roads (to the extent possible). Towers, laydown areas, and other facilities will be re-located to areas of generally stable soils. These avoidances shall be taken into consideration during site specific analyses.
Transportation	**TRANS-1**: To the extent that all governmental entities are willing to participate, PCW shall participate in a coordinated transportation planning process with the BLM, WYDOT, Carbon County, the Town of Sinclair and the City of Rawlins, to identify and develop measures to avoid, manage or mitigate transportation impacts of construction. The BLM shall coordinate with affected local governments to solicit input from the Sinclair Refinery, the CIG compressor station, affected grazing operators, and other major property owners (including the operator of the truck stop just north of I-80 Exit 221) in the affected area. The group shall meet prior to and during the construction phase of the project and in the initial year of project operations, as needed.
	TRANS-2: PCW shall develop measures to inform and update Carbon County residents and travelers on I-80 near Sinclair and WY 71 about potential delays during peak months and especially during peak hours. In coordination with WYDOT, electronic signage shall be used near I-80 Exit 221 to encourage I-80 travelers to use alternate access to Sinclair during peak hours.
	TRANS-3: PCW shall coordinate with WYDOT to identify measures to control traffic and enhance traffic flows in the vicinity of I-80 Exit 221 during shift changes and at times when oversized vehicles will be crossing the bridge over I-80, and along WY 71 within the City of Rawlins if the WY 71/CR 407 (Sage Creek Road) workforce commuting option is selected.
	TRANS-4: PCW shall implement incentives for carpooling and/ or other workforce transportation measures to reduce traffic and congestion during shift changes.

Appendix Table D-4 Proposed Mitigation Measures

Resource	Proposed Mitigation Measure
Vegetation	**VEG-1**: Survey and mark the disturbance boundary to minimize unintentional surface disturbance. Actively monitor construction to ensure construction and staff stays within the defined limits.
	VEG-2: Salvage vegetative debris and redistribute to reclaimed surface areas in order to reduce erosion and preserve native organic material and seed sources.
	VEG-3: In areas where excavating soil is not necessary, such as temporary laydown areas or temporary access roads, avoid disturbing native soil and root zones where possible to preserve soil structure and soil biology and improve the success for reclamation.
Visual	**VR-1:** Monopole and H-frame transmission structures and overhead collector line structures would be treated to have a muted, darker color than conventional galvanized steel or laminated wood to reduce color contrasts. The recommended paint color for transmission structures is Shadow Gray from the BLM Standard Environmental Colors Chart CC-00 or an equivalent color. Steel pole equivalents used in the installation of the overhead electric collector lines should be finished with paint or a self-weathering finish that will harmonize with colors of the surrounding landscape (i.e., approximate the color of wood when used with wood overhead collector lines). When not used with wood poles, the recommended paint color for powerline structures is Shadow Gray from the BLM Standard Environmental Colors Chart CC-00. Conductors would have a non-reflective finish.
	VR-2: Place vegetative debris on cut-and-fill slopes to vary texture and color of cut-and-fills until vegetation has been re-established.
	VR-3: Lighting for ancillary facilities shall be motion-activated and shielded downward to limit night lighting impacts beyond the site.
	VR-4: Audio Visual Warning System (AVWS) for aircraft detection and warning may be required to reduce day and night lighting impacts from WTGs if technologies become available that are approved by FAA, are proven reliable at the scale of CCSM, and BLM determines that systems are cost effective.
	VR-5: Substation components and fencing would be Shadow Gray from the BLM Standard Environmental Colors Chart CC-00 or a similar color in a dark gray color range. Color mitigation would not be required on facilities that are treated in accordance with safety and engineering concerns.
Wetlands	**WET-1:** Conduct on-site delineations of all waters of the U.S., including wetlands and waterbodies within the Alternative Development Area prior to construction. The surveys would be performed and documented by qualified wetland scientists to determine the types and spatial extent of site-specific wetland and riparian features. Current resource mapping (e.g., USGS topographic maps, USFWS NWI maps, FEMA floodplain maps, AECOM wetland and riparian data, NRCS soils data, etc.) would be used to guide this future delineation effort. All features would be recorded using a GPS unit with sub-meter accuracy, in addition to photographic and written documentation of each feature according to standardized USACE delineation data requirements and any additional BLM data requirements. Subsequent NEPA tiering would include the site-specific waters of the U.S. delineation results.

Appendix Table D-4 Proposed Mitigation Measures

Resource	Proposed Mitigation Measure
Water	**WR-1**: Stream water quality monitoring sites will be identified by the BLM. Stream monitoring shall continue through construction, operation, and decommissioning of the project by PCW to monitor for changes in water quality.
	WR-2: PCW will be required to submit the site-specific SWPPP as part of the ROW grant application for approval by the BLM.
Wildlife and Fisheries	**WFM–1**: Workers, with the exception of security personnel, will not be allowed to possess firearms during work activities and will attend mandatory training (provided by WGFD) on wildlife regulations and ways to reduce disturbance to wildlife.
	WFM–2: Snow fences, if used, will be limited to segments of one-quarter mile or less. In addition, escape openings will be provided along roads, every one-quarter mile or less, to facilitate exit of big game animals from snowplowed roads.
	WFM–3: : If measured bat mortality is determined to be above levels of concern for the project (as presented in section 4.14 of the EIS), measures appropriate to avoid, minimize, and mitigate impacts to bat species will be identified in the Bat Protection Plan for the Project. Thresholds of impacts to bats and appropriate responses to exceeding such impact thresholds will be determined by BLM in coordination with the WGFD, and if appropriate, the USFWS, as part of the conservation, avoidance, minimization and mitigation measures identified in the Bat Protection Plan.
	WFM-4: Instream construction (stream crossings and stream construction activities) will occur during the low flow period (July 15 to September 30).
SSS	**SSS–1**: Prior to construction activities in suitable pygmy rabbit habitat, presence/absence surveys would be conducted following appropriate protocols. Areas within 0.25 mile of proposed disturbance that show characteristics of pygmy rabbit habitat will be surveyed in accordance with the Interagency Pygmy Rabbit Working Group Survey Protocols (Ulmschneider et al. 2004). If the surveys conclude that the pygmy rabbits occur, the "Habitat Preservation and Restoration" conservation measures will apply (Keinath and McGee 2004).
	SSS–2: Prior to construction activities in suitable Wyoming pocket gopher habitat, presence/absence surveys will be conducted following appropriate protocols. If active Wyoming pocket gopher mounds are identified by the presence/absence survey, the proposed surface disturbing activities will avoid the active pocket gopher mounds by 75 m (BLM 2009f). However, if PCW does not wish to avoid the active pocket gopher mounds by 75 m, classification surveys (via live capture) must be completed to identify the pocket gopher to the species level responsible for the mounds. If the results conclude that the Wyoming pocket gopher is responsible for the mounds, the "Occupied Wyoming Pocket Gopher Habitat Protection Measures" will apply (BLM 2009f). If the results conclude that the associated species is a Northern pocket gopher, then the proposed surface disturbance may proceed without mitigation. If the classification survey fails to conclusively identify the associated pocket gopher to the species level, then it will be assumed that the species is a Wyoming pocket gopher and the "Occupied Wyoming Pocket Gopher Habitat Protection Measures" will apply (BLM 2009f).

Appendix Table D-4 Proposed Mitigation Measures

Resource	Proposed Mitigation Measure
SSS (con't)	**SSS-3:** To protect potential mountain plover habitat, prior to any surface disturbance, a presence/absence survey for active mountain plover nests will be conducted in all potential habitat within the area proposed for surface disturbance. Surveys are to be performed by a wildlife biologist familiar with mountain plover and their associated habitat. If evidence of mountain plovers is found during the preconstruction survey, then additional stipulations may apply (BLM 2009a).
Noise	**N-1**: USEPA guidance stipulates the threshold for residential noise impacts resulting from construction activities, including blasting, is reached at 55 dB(A) at 1,600 feet (USEPA 1974). When a residence is within 1,600 feet of construction activities, construction activities exceeding 55 dB(A) would only be allowed to occur between the hours of 7 a.m. and 10 p.m., and on weekdays.
	N-2: Whenever feasible, multiple construction activities (e.g., blasting and earthmoving) shall be scheduled to occur concurrently to minimize the length of time residences within 1,600 feet may be affected.

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