APPENDIX A:

AVIAN STUDIES PROTOCOLS FOR
THE KENETECH WINDPOWER, INC. WINDPLANT PROJECT

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	A-3
2.0 PASSERINE AND RAPTOR SURVEYS - FOOTE CREEK RIM	A-5
2.1 PASSERINE SURVEYS	A-5
2.1.1 Objectives	A-5
2.1.2 Methods	A-6
2.1.3 Data Analysis	A-7
2.2 RAPTOR, MOUNTAIN PLOVER, WATERFOWL, AND SHORE BIRD MAPPING	A-7
2.3 RAPTOR USE - FOOTE CREEK RIM AND REFERENCE AREA	A-7
2.3.1 Objectives	A-8
2.3.2 Methods	A-9
2.3.3 Data Analysis	A-12
2.4 RAPTOR NESTING SURVEYS	A-13
2.4.1 Objectives	A-13
2.4.2 Methods	A-14
2.4.3 Data Analysis	A-15
3.0 PASSERINE AND RAPTOR SURVEYS - SIMPSON RIDGE	A-16
3.1 OBJECTIVE	A-16
3.2 METHODS	A-16
3.3 DATA ANALYSIS	A-17
4.0 SAGE GROUSE LEK SURVEYS	A-18
4.1 OBJECTIVE	A-18
4.2 METHODS	A-18
4.3 DATA ANALYSIS	A-19
5.0 REFERENCES	A-20

LIST OF TABLES

Page

Table 1.1 1993-95 Baseline Studies Schedule A-4

LIST OF FIGURES

Page

Figure 2.1 Locations of 0.5 Mile Raptor Viewsheds on Foote Creek Rim A-10

1.0 INTRODUCTION

KENETECH Windpower, Inc. is proposing to construct a 500 megawatt (MW) Windplant™ in the area between Arlington and Hanna in Carbon County, Wyoming. The Windplant will consist of approximately 1,400 wind turbine generators and related facilities, including transmission lines, communications systems, transformers, substations, roads, and operations and maintenance facilities. An environmental impact statement (EIS) is being prepared under a third party arrangement by Mariah Associates, Inc. for the Bureau of Land Management and the Bonneville Power Administration to assess potential impacts to the human environment due to Windplant construction. One of the primary issues is impacts to avian wildlife, especially avian mortality caused by collisions with turbines, power lines, or other structures. Because this would be the first commercial-scale Windplant in Wyoming, in-depth baseline avian use studies and comprehensive monitoring studies will be needed to adequately assess impacts of Windplant development on avifauna. The purpose of this report is to document the protocols currently being used for baseline data collection.

The proposed project would be constructed in phases beginning with erection of 202 wind turbines on Foote Creek Rim north of Arlington. Subsequent phases would be built in 50-75 MW increments over the next 10-12 years on Foote Creek Rim and in the Simpson Ridge area south of Hanna. The phased development provides an opportunity to monitor impacts of initial phases, gather additional baseline data, and develop appropriate mitigations for later phases.

Baseline avifauna data collected during 1994 are included in the EIS for the proposed project. The baseline studies include:

- point-count surveys for passerines, waterfowl, and shore birds, and mapping of raptors, waterfowl, mountain plover, and other shore birds observed on Foote Creek Rim;
- passerine point count surveys and mapping of raptors, waterfowl, and shore birds observed on the Simpson Ridge area;

- raptor use surveys on Foote Creek Rim and the Shirley Mountain reference area;
- raptor nesting surveys in and adjacent to the Foote Creek Rim and Simpson Ridge areas; and
- an inventory of sage grouse leks within and adjacent to the Foote Creek Rim and Simpson Ridge areas.

The schedule for baseline studies is shown in Table 1.1.

The following set of protocols describes the objectives, methods, and data analysis procedures for each of these studies, which will be developed prior to construction of the first phase. Baseline and monitoring studies will be expanded to other portions of the project area and adjacent areas prior to development of subsequent phases.

Table 1.1 1993-95 Baseline Studies Schedule.

Period	Survey/Study	Location/Area
October 1993	Species composition surveys	Foote Creek Rim and Simpson Ridge
Mid-February 1994 - March 1995	Point-count surveys	Foote Creek Rim
	Raptor, mountain plover, waterfowl, and shore bird mapping	Foote Creek Rim, Simpson Ridge
	Passerine point count surveys	Simpson Ridge
	Reconnaissance	Eastern slope, Foote Creek Rim
April 1994	Sage grouse lek survey	Foote Creek Rim and Simpson Ridge, plus a 2 mi buffer.
May - Mid-August 1994	Raptor nesting survey	Foote Creek Rim plus a 10 mi buffer, Simpson Ridge plus a 2 mi buffer.
June 1994 - March 1995	Raptor use surveys	Foote Creek Rim and Shirley Mountain Reference Area

2.0 PASSERINE AND RAPTOR SURVEYS - FOOTE CREEK RIM

2.1 PASSERINE SURVEYS

From mid-February to May 1994, point-count surveys for passerines and other non-raptors (i.e., waterfowl and shore birds) were conducted at 110-165 points on the eastern and western edges of Foote Creek Rim (Mariah Associates, Inc. 1994). Analysis of these data suggested that a reduced effort would provide adequate baseline data for passerine use and distribution on the rim, and therefore, the number of points was reduced to 32 on each side (see Section 2.1.2). Furthermore, it was determined that passerine density estimates could be improved if each point was enlarged from a 164 ft (50 m) radius to a 328 ft (100 m) radius. The revised passerine surveys were initiated in mid-May.

2.1.1 Objectives

The objectives of the Foote Creek Rim passerine and non-raptor surveys are to:

- determine species composition, relative abundance, density, and passerine, waterfowl, and shore bird use along the rim, and
- determine species composition in the shrub/woodland habitats adjacent to the rim.

The data collected to meet these objectives will identify passerine and other non-raptor use of development areas prior to facility construction and heavily used areas that should be avoided, and will serve as a basis for impact assessment, and as a baseline for monitoring changes in passerine activity after Windplant construction.

The study area for passerines and other non-raptors includes the rim top as well as a buffer of approximately 0.25 mi (0.4 km) surrounding the rim where there is a mosaic of distinct habitat types. On the eastern side of the rim, this area is characterized by aspen stands,

shrublands, and grassy habitats in the upper and central portions of the slope. On the western side, there are patches of shrubs mixed with grassland.

2.1.2 Methods

Passerine, waterfowl, and shore bird surveys on Foote Creek Rim have been (and will continue to be) conducted using a point-count method (Hilden et al. 1991; Ralph et al. 1993). Observations are made at 984 ft (300 m) intervals (points) along the western edge of Foote Creek Rim and at 656 ft (200 m) intervals along the eastern edge; all birds seen or heard within 328 ft (100 m) of each point are recorded. There are 32 points along each edge of the rim. Data collected include species, number of individuals, distance and direction from the point, time of day, activity, flight direction, and flight height class. Flight height classes are 0-26 ft (0-8 m), 26-184 ft (8-56 m), and >184 ft (56 m), which corresponds roughly with the area below, within, and above turbine blades, respectively.

Initially, survey starting points were systematically rotated through all survey points so that each point was sampled at various times of the day. Following the reduction of total sample points in mid-May, a simpler rotation was implemented, whereby one side of the rim is surveyed from south to north while the other side is surveyed beginning at the midpoint and working north in a loop until all 32 points are completed. The pattern is alternated between east and west sides weekly. In addition to simplifying the rotation sequence, this method minimizes disturbance, interference, and duplicate sampling between concurrent east and west side surveys. At each point, observations are made for a 5-minute period. Surveys are conducted beginning within 0.5 hour of sunrise and continued until all 64 points are surveyed (generally 5-6 hours after the start of the survey). Time-of-day effects will be accounted for using the methods specified in Palmeirin and Rubaca (1994).

A general observation reconnaissance has been conducted each month since February 1994 in the aspen/brush habitats on the eastern slope. Monthly reconnaissance of this area will

continue to be conducted to develop a species list of passerines, waterfowl, and shore birds in the study area.

2.1.3 Data Analysis

Species composition, relative abundance, and relative use will be computed for both passerines and non-raptors observed on Foote Creek Rim will be computed. Species diversity will be calculated using a Shannon-Weiner index. Relative densities (or use) by species will be calculated using program DISTANCE (Laake et al. 1993), described in Buckland et al. (1993). Program DISTANCE provides robust estimators that allow: variable sighting probability, clustered populations, and truncation of data. Seasonal differences in use of Foote Creek Rim by passerines, waterfowl, and shore birds will be evaluated graphically. If sample sizes are large enough (see Addendum A, Power Calculations), species will be grouped as passerine, waterfowl, or shore birds and the null hypothesis of "no difference in use on Foote Creek Rim between seasons (nesting, migration, winter)" will be tested at a significance level of $\alpha = 0.10$. Depending on the distribution of the data, parametric or nonparametric tests will be used to test null hypotheses.

2.2 RAPTOR, MOUNTAIN PLOVER, WATERFOWL, AND SHORE BIRD MAPPING

During the point-count surveys, all raptors, waterfowl, mountain plovers, and other shore birds observed at any distance are mapped. These data will be analyzed using species use contours to determine species distribution along the rim. Contours will be generated using the graphics package SURFER (Golden Software 1990).

2.3 RAPTOR USE - FOOTE CREEK RIM AND REFERENCE AREA

Information on raptor use and distribution within the project area will assist in evaluating the potential impact of the Windplant on raptors. Pre- and post-construction monitoring in

development areas will give information on the effects of Windplant development on raptor use and distribution, but the cause of changes in use and distribution after development cannot easily be determined. Natural changes in populations may mask or inflate effects due to the project. Baseline data collection and monitoring use and distribution in a reference area will aid in isolating the effect of the project from natural variability. Therefore, a reference area has been established northwest of Hanna and west of the Shirley Mountains, Wyoming. This reference area is located within the wind corridor and to the northwest of the project area and has topographic features similar to the Simpson Ridge area, including prominent ridges (e.g., Horseshoe and Schneider Ridges) with adjacent rolling plains and a nearby riparian corridors (the North Platte River). Historical nesting data has been evaluated for the reference area, and the raptor species composition within 10 mi (16.1 km) of the reference area appears to be similar to the species composition of nests within and adjacent to Foote Creek Rim and Simpson Ridge. Finally, the reference area is more than 20 mi (32.2 km) away from the Simpson Ridge area so that it can be used for monitoring throughout the life-of-project. See Section 2.4.2 for a rationale for using 10 mi (16.1 km) buffer areas around the proposed development and reference areas.

2.3.1 Objectives

The primary goals of the baseline raptor use studies are to determine and compare the relative use of Foote Creek Rim and the Simpson Ridge area and a similar reference area. The objectives of raptor observation surveys will be to:

- determine relative use, species composition, and species diversity of raptors on Foote Creek Rim and within the reference area,
- determine seasonal variation in raptor use of selected viewpoints, and
- enable the future evaluation of Windplant effects on raptor use, species composition, and species diversity.

2.3.2 Methods

Raptor observations are made using a skyline watch technique (Mariah Associates, Inc. 1979). During all seasons, adult raptors are active for portions of each day, and thus, will be seen during the skyline watch. Vigils 3 hours in length are conducted in strategic locations on ridge tops, thus permitting the observers an unrestricted panorama over a wide area.

Viewpoints have been systematically selected to provide maximum coverage of Foote Creek Rim and a selected portion of the reference area without overlapping views. Six viewpoints have been established on Foote Creek Rim (Figure 2.1) and six within the reference area. A 360°, 0.5 mi (0.8 km) radius viewshed is monitored from each viewpoint. Each viewshed has been surveyed for prominent topographic features which will be used in conjunction with manmade landmarks for estimating distance of raptors from the viewpoint. The locations of the viewpoints and the landmarks will be mapped using a Global Positioning System (GPS). Observers have been trained to recognize landmarks and topography to accurately map the locations of observed raptors at first detection during the skyline watch. With accurately mapped locations, distance from the viewpoint of each observation can be accurately determined.

The raptor surveys are limited to the 0.5 mi (0.8 km) radius viewshed. All raptors observed are positively identified to species, if possible, with the aid of binoculars and a spotting scope, and their locations are recorded.

In addition to continuous monitoring of the 0.5 mi (0.8 km) radius viewshed, 12 (total) instantaneous counts are made at 15-minute intervals beginning 12 minutes after the start of each observation period. The 0.5 mi (0.8 km) radius viewshed is searched for a 2-3 minutes, and all raptors within the area are recorded. Instantaneous counts provide a more thorough evaluation of raptor use of the area by enabling repeated observations of

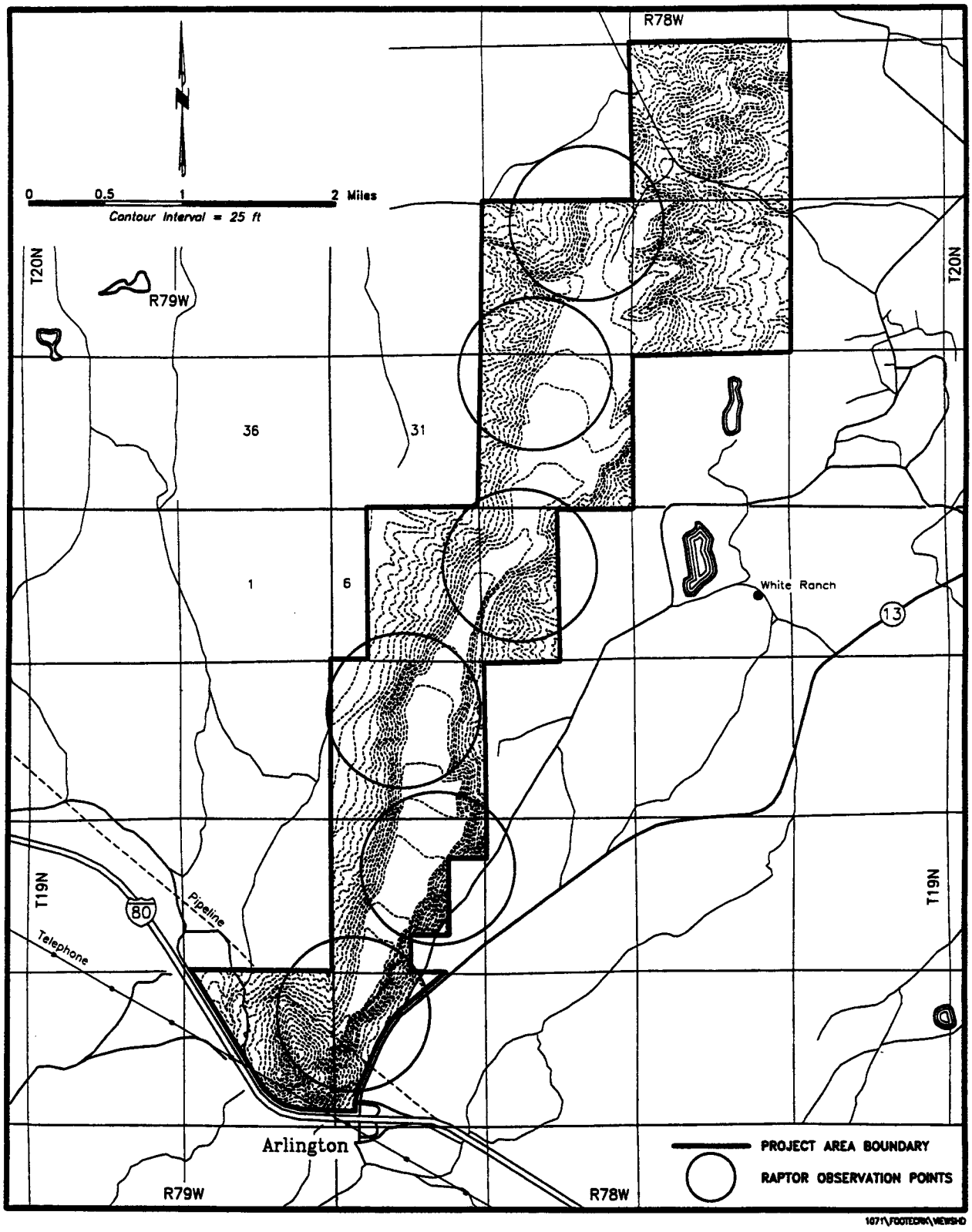


Figure 2.1 Locations of 0.5 Mile Raptor Viewsheds on Foote Creek Rim.

individuals that stay in the area during the watch period. Flyovers are recorded during the continuous monitoring.

Observations include species, number of individuals or frequency of sightings, activity, time of day, and flight direction. An estimate of the flight height class (or range of classes) is made for each individual. Flight height classes of 0-26 ft (0-8 m), 26-184 ft (8-56 m), and >184 ft (56 m) are used.

Sampling frequency is as follows:

- weekly during the raptor nesting and mitigation seasons--mid-February through October, and
- biweekly during winter--November through mid-February.

Each area is sampled in one day using three observers, each completing two 3-hour vigils. Foote Creek Rim and the Shirley Mountain reference area are sampled on consecutive days whenever possible. Sampling occurs during morning and early afternoon hours, between 8:30 am and 4:30 pm when raptors are typically most active.

Incidental data pertaining to physiographic features (e.g., the presence of canyons near ridge tops) or biological features (e.g., number of nests within or immediately adjacent to the viewpoint) will be included in the qualitative discussion of raptor use in the study and reference areas. These data will be used during monitoring to determine if certain physical or biological features affect the level of impact to raptors.

Due to topographic variability within each viewshed, a visibility bias may be inherent in the survey methods, especially if part of the 0.5 mi (0.8 km) radius viewshed is blocked by topographic features. The visibility bias will be minimized by locating viewpoints to include as much of the 0.5 mi (0.8 km) viewshed as possible. In cases where a 0.5 mi (0.8 km) viewshed cannot be obtained, observational data will be normalized to a 0.5 mi (0.8 km)

radius survey area. The actual viewshed area for each point will be estimated, and a correction factor will be applied to the data.

Measures taken to minimize the number of duplicate observations include the following:

- viewsheds do not overlap, and
- the three observers are in radio contact with one another and report all sightings.

Observers are rotated among points so that each observer spends approximately the same number of survey days at each of the 12 points.

2.3.3 Data Analysis

Species composition will be summarized, and a map of species distributions prepared. Relative abundance of each species will be computed as numbers of individual sightings per unit of observation area and/or time. Species diversity will be computed using a Shannon-Weiner index. Raptor use contours will be generated using the graphics package SURFER (Golden Software, Inc. 1990), where appropriate, to identify patterns or trends in use or distribution.

If sample sizes are large enough (see Addendum A, Power Calculations), the null hypothesis of "no difference in relative abundance of raptors on Foote Creek Rim versus the reference area" will be tested during pre-construction by season (nesting, migration, winter). Repeat observations will be pooled and stratified by season. Depending on the distribution of the data, parametric or nonparametric tests will be used to test the null hypothesis at significance level of $\alpha = 0.10$. Collection of data will allow testing of null hypotheses during post-construction as well.

Effects of topographic or other landscape features on raptor use and abundance will be assessed qualitatively or graphically, depending on the characteristics of the data set. For example, it may be observed that golden eagle relative abundance is higher in

topographically dissected areas than in areas with smooth slopes; this could then be illustrated on a graph showing degree of dissection vs. golden eagle abundance. These types of analyses will assist in planning future phases of the project to locate turbines away from potential high use areas. The null hypothesis of "no difference in turbine contribution to raptor mortality based on turbine placement" will be tested. Tests of association between topographic features and raptor mortality will also be conducted.

2.4 RAPTOR NESTING SURVEYS

Raptor nests are protected from taking and disturbance by the Migratory Bird Treaty Act (16 U.S.C. 703-711), and the BLM typically imposes seasonal use restrictions on buffer areas around active raptor nests. Information on the location of raptor nests in and adjacent to the project area will assist in locating turbines and facilities such that nests will not be destroyed at any time and birds will not be disturbed during the nesting season. Monitoring nests in the construction areas, both pre- and post-construction, will give information on the status of nests before and after construction. These data will provide a baseline for nesting pairs occupying territories within the area of potential influence of the project. This information, in conjunction with the use data, is used in the EIS to describe the existing environment and to evaluate potential impacts for each alternative.

2.4.1 Objectives

The objectives of the raptor nesting surveys are to:

- identify all raptor nests on and within 10 mi (16.1 km) of the ends of proposed turbine strings on Foote Creek Rim,
- determine nest status, and
- determine reproductive success.

The data will be used to locate project activities to avoid nests during the nesting season and will provide initial nesting productivity information for use in subsequent monitoring.

2.4.2 Methods

A combination of aerial and ground surveys was conducted from May through mid-August 1994 to obtain the raptor nesting information. An aerial survey of the entire project area (Foote Creek Rim plus a 10 mi [16.1 km] buffer and the Simpson Ridge area plus a 2 mi [3.2 km] buffer) was completed in May and June 1994 by helicopter. Literature indicates that 10 mi (16.1 km) is the mean maximum distance from the nest for many nesting raptor species, although individual golden eagles and prairie falcons have been reported as far as 17-22 mi (27.4-35.4 km) from the nest (Call 1978; data from Snake River Birds of Prey Study; personal communication, with Dale Strickland, WEST, Inc., Cheyenne, 1994). The 10 mi (16.1 km) buffer represents an area of potential influence on nesting populations within which most of the raptor activity would take place that may be influenced by the Windplant on Foote Creek Rim. Because the Simpson Ridge area would not be developed for several years, the initial nest inventory at Simpson Ridge included a 2 mi (3.2 km) buffer which is commonly used for permitting development projects in Wyoming. Assuming the golden eagles and prairie falcons of the Snake River studies represent the population in the Foote Creek Rim study area, the use of a 10 mi (16.1 km) buffer should be expected to study a minimum of 70% of the golden eagles and prairie falcons that would be affected by the project (personal communication, with Dale Strickland, WEST, Inc., Cheyenne, 1994). The eagles and falcons within the 10 mi (16.1 km) buffer should also be at greater risk than others that are beyond the 10 mi (16.1 km) because they should spend a significantly greater amount of time in the study area.

During the aerial survey, the pilot and one observer conducted a search for nests in suitable raptor nesting habitat. The location of each nest observed was documented with a GPS. Data on location, nest activity, and number of chicks were also recorded. Ground surveys were completed from June to mid-August to determine the status of nests that could not be viewed during helicopter surveys and to determine reproductive success. All active nests identified during the aerial survey were visited and the number of nestlings/fledglings recorded when possible.

2.4.3 Data Analysis

Number of nests by species, activity status, and productivity for 1994 has been summarized and described in the EIS. Nest locations have been mapped to assist in planning Windplant development. Due to the sensitive nature of this information, maps will not be included in the EIS but will be provided to appropriate agencies and to KENETECH, upon request.

3.0 PASSERINE AND RAPTOR SURVEYS - SIMPSON RIDGE

3.1 OBJECTIVE

The objective of the avifauna surveys on the Simpson Ridge area is to document the species present, relative abundance, and use of the area. These qualitative data gathered over several years will provide information on the existing environment in the Simpson Ridge area and, when supplemented with quantitative studies such as those being conducted on Foote Creek Rim, would serve as the basis for impact assessment for that area. More detailed quantitative surveys such as those conducted on the Foote Creek Rim area is not being conducted on the Simpson Ridge area at this time because the area will not be subject to development for approximately 2-4 years. Detailed surveys will be conducted in the turbine string areas 1-2 years prior to development.

3.2 METHODS

Surveys on the Simpson Ridge area use the Cooperative Breeding Bird Survey methods, which involve a point-count at 0.5 mi (0.8 km) intervals. At each point, all passerines heard or seen within 0.25 mi (0.4 km) of the point during a 3-minute period are recorded as to species, number of individuals, location, activity, flight height class, and direction of flight. Surveys begin within 0.25 hour of dawn and continue until all points are surveyed, generally 8 or 9 hours after sunrise. Surveys are conducted biweekly. Starting point and direction are varied such that early morning surveys (within 3 to 4 hours of sunrise) are completed along all portions of the route.

The survey route includes three segments: 1) 22 points along Wyoming Highway 72, 2) 9 points along Percy Creek on the western side of Simpson Ridge, and 3) 22 points along the Simpson Ridge/Carbon area in the eastern side of the project area. During winter and early spring, access to the Percy Creek and Simpson Ridge/Carbon areas is limited due to snow and mud, and the number of points surveyed is reduced accordingly.

3.3 DATA ANALYSIS

Qualitative assessments of species composition, relative abundance, and species diversity will be determined. These data are used in the EIS to describe the existing environment and evaluate potential impacts.

4.0 SAGE GROUSE LEK SURVEYS

4.1 OBJECTIVE

The objective of the sage grouse lek survey was to verify the location of sage grouse leks shown on Wyoming Game and Fish Department and Bureau of Land Management (BLM) maps and to locate additional leks not previously recorded. The lek is considered the center of the breeding/nesting complex, and most nesting activity occurs within approximately 2 mi (3.2 km) of the lek. Standard BLM stipulations prohibit construction activities and/or surface disturbance within 2 mi (3.2 km) of leks during the period from February 1 to July 1. The area of influence and study area for sage grouse, therefore, is the project area plus a 2 mi (3.2 km) buffer.

4.2 METHODS

Aerial surveys were used to locate sage grouse leks. Two separate aerial searches were conducted over the study area during April 1994. The surveys commenced at first suitable light and ceased approximately 3 hours after sunrise. A high-wing fixed-wing aircraft was flown along north-south transects spaced at 0.5 mi (0.8 km) intervals over the study areas. The plane was flown as low (100-300 ft [30.5-91.4 km] aboveground level) and slow (50-80 knots) as safety considerations allow. The pilot and one observer inspected the search area, which was approximately 0.25 mi (0.4 km) on either side of the transect, looking for sage grouse congregated on the lek. The location of leks observed was documented with a GPS on the aircraft and mapped on 7.5 minute topographic maps. The number of cocks, hens, and birds of unknown sex on the leks was recorded.

All historical leks were located, along with several leks not previously mapped. Therefore, no ground verification was necessary (personal communication, with Tom Rinkes, BLM, Rawlins, 1994).

4.3 DATA ANALYSIS

Locations of leks and the 0.25 mi (0.4 km) (potential breeding habitat) and 2.0 mi (3.2 km) (probable nesting habitat) zones will be displayed on a sage grouse breeding complex map. Proposed turbine string and transmission line locations will be overlaid on this map to determine location and amount of sage grouse habitat potentially impacted by development of the Foote Creek Rim phase of the project. Sage grouse information on the Simpson Ridge area will be used to identify sensitive resource areas to be included in EIS impact analysis and appropriate siting of future phases of development.

5.0 REFERENCES

Biosystems Analysis, Inc. 1992. Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County wind resource areas. Prepared for Alameda, Contra Costa, and Solano Counties and the California Energy Commission.

Buckland, S.T., D.R. Anderson, K.P. Burnham, and J.L. Laake. 1993. Distance sampling, estimating abundance of biological populations. Chapman and Hall, New York. 446 pp.

Call, M.W. 1978. Nesting habitats and surveying techniques for common western raptors. U.S. Department of Interior, Bureau of Land Management. Tech. Note 316. 115 pp.

Golden Software, Inc. 1990. SURFER reference manual and software, Golden, Colorado.

Hilden, O., P. Koskimies, R. Pakarinen, and R.A. Vaisanen. 1991. Point-count of breeding landbirds. *In* Monitoring bird populations, P. Koskimies and R.A. Vaisanen, editors, pp. 27-34. Finnish Museum of Natural History, University of Helsinki.

Laake, J.L., S.T. Buckland, D.R. Anderson, and K.P. Burnham. 1993. DISTANCE user's guide. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, Colorado.

Mariah Associates, Inc. 1979. Final baseline wildlife report, Seminoe II Mine. Prepared for Arch Mineral Corporation, Hanna, Wyoming. 57 pp. + append.

_____. 1994. Avifauna studies for the KENETECH Windpower, Inc. environmental impact statement. Prepared for KENETECH Windpower, Inc., April 1994. 13 pp.

Palmeirin, and Rubaca. 1994. A method to analyze and compensate for time-of-day effects on bird counts. J. Field Ornith. 65(1):17-26.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, California: Pacific Southwest Research Station, U.S. Department of Agriculture, Forest Service. 41 pp.

ADDENDUM A:

POWER CALCULATIONS

Table 1 Power of a Test for Various Sample Sizes, N, to Compare Two Proportions, with the Size of the Test, α = 0.10 (Two-Tailed), Assuming the Reference Value is pl = 0.8.

N	0.5	0.4	0.3	0.2	0.1
5	0.083	0.137	0.212	0.317	0.469
7	0.139	0.234	0.364	0.533	0.737
9	0.198	0.333	0.506	0.704	0.889
11	0.258	0.428	0.629	0.823	0.958
13	0.317	0.516	0.727	0.899	0.985
15	0.374	0.595	0.804	0.945	0.995
17	0.429	0.664	0.862	0.971	0.999
19	0.481	0.723	0.904	0.985	1.000
21	0.529	0.774	0.934	0.992	1.000
23	0.575	0.816	0.955	0.996	1.000
25	0.617	0.852	0.970	0.998	1.000
27	0.656	0.881	0.980	0.999	1.000
29	0.692	0.905	0.987	1.000	1.000

Table 2 Power of a Test for Various Sample Sizes, N, to Compare Two Proportions, with the Size of the Test, α = 0.10 (Two-Tailed), Assuming the Reference Value is pl = 0.7.

N	0.5	0.4	0.3	0.2	0.1
5	0.046	0.082	0.135	0.212	0.327
7	0.073	0.135	0.228	0.364	0.551
9	0.099	0.189	0.324	0.506	0.725
11	0.126	0.245	0.416	0.629	0.842
13	0.152	0.299	0.501	0.727	0.914
15	0.179	0.353	0.578	0.804	0.955
17	0.206	0.404	0.647	0.862	0.977
19	0.232	0.453	0.706	0.904	0.989
21	0.258	0.500	0.757	0.934	0.994
23	0.283	0.543	0.801	0.955	0.997
25	0.308	0.584	0.837	0.970	0.999
27	0.333	0.622	0.868	0.980	0.999
29	0.357	0.658	0.893	0.987	1.000

APPENDIX B:

GENERAL DESIGN
WYOMING WINDPOWER MONITORING PROPOSAL

DRAFT
GENERAL DESIGN
WYOMING WINDPOWER MONITORING PROPOSAL

Submitted to

KENETECH Windpower, Inc.
San Francisco, California

Submitted by

Western EcoSystems Technology, Inc.
2003 Central Avenue
Cheyenne, Wyoming 82001

January 1995

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	B-6
2.0 DESIGN CONCEPTS AND RISK EVALUATION	B-9
2.1 RAPTOR RESOURCE	B-10
2.2 NON-RAPTOR AVIAN RESOURCE	B-11
2.3 BIG GAME RESOURCE	B-11
2.4 SAGE GROUSE RESOURCE	B-13
3.0 GOAL	B-14
4.0 COMPONENTS OF MONITORING STUDY	B-15
4.1 RAPTOR RELATIVE DENSITY AND USE	B-15
4.1.1 Point Count Surveys for Raptors	B-15
4.1.1.1 Objective	B-15
4.1.1.2 Introduction	B-15
4.1.1.3 Field Methods	B-16
4.1.1.4 Data Analysis	B-20
4.1.2 Raptor Nest Census	B-22
4.1.2.1 Objective	B-22
4.1.2.2 Introduction	B-22
4.1.2.3 Field Methods	B-23
4.1.2.4 Data Analysis	B-24
4.2 NON-RAPTOR AVIAN SPECIES RELATIVE DENSITY AND USE	B-25
4.2.1 Point Count Surveys for Non-Raptor Avian Species	B-25
4.2.1.1 Objective	B-25
4.2.1.2 Introduction	B-25
4.2.1.3 Field Methods	B-25
4.2.1.4 Data Analysis	B-26
4.2.2 Additional Mountain Plover Surveys	B-28
4.2.2.1 Objective	B-28
4.2.2.2 Introduction	B-28
4.2.2.3 Field Methods	B-29
4.2.2.3.1 Habitat Suitability/Breeding Habitat	B-29
4.2.2.3.2 Mountain Plover Surveys	B-29
4.2.2.3.3 Nest Searches and Monitoring	B-29
4.2.2.3.4 Data Analysis	B-30

TABLE OF CONTENTS (Continued)

	Page
4.3 BIG GAME STUDIES	B-30
4.3.1 Objective	B-30
4.3.2 Introduction	B-31
4.3.3 Aerial Surveys	B-31
4.3.3.1 Field Methods	B-31
4.3.3.2 Data Analysis	B-32
4.3.4 Big Game Use Surveys Using Pellet Counts	B-33
4.3.4.1 Field Methods	B-33
4.3.4.2 Data Analysis	B-35
4.4 SAGE GROUSE LEK AND USE SURVEYS	B-35
4.4.1 Introduction	B-35
4.4.2 Sage Grouse Lek Surveys	B-36
4.4.2.1 Objective	B-36
4.4.2.2 Field Methods	B-36
4.4.2.3 Data Analysis	B-36
4.4.3 Sage Grouse Use Surveys	B-37
4.4.3.1 Objective	B-37
4.4.3.2 Field Methods	B-37
4.4.3.3 Data Analysis	B-37
4.5 PREY AVAILABILITY STUDY	B-37
4.5.1 Objective	B-37
4.5.2 Introduction	B-38
4.5.3 Field Methods	B-38
4.5.3.1 Lagomorphs	B-38
4.5.3.2 Prairie Dogs	B-39
4.5.3.3 Ground Squirrels	B-39
4.5.3.4 Data Analysis	B-40
4.6 CARCASS SEARCHES	B-40
4.6.1 Introduction	B-40
4.6.2 Estimation of Avian Mortality	B-40
4.6.2.1 Objective	B-40
4.6.2.2 Methods	B-41
4.6.2.3 Data Analysis	B-42
4.6.3 Estimation of Carcass Removal by Scavengers	B-42
4.6.3.1 Objective	B-42
4.6.3.2 Methods	B-42
4.6.3.3 Data Analysis	B-43
4.6.4 Estimation of Searcher Efficiency	B-43
4.6.4.1 Objective	B-43
4.6.4.2 Methods	B-43
4.6.4.3 Data Analysis	B-44

TABLE OF CONTENTS (Continued)

Page

5.0 DATA COMPILATION AND STORAGE B-45

6.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) B-46

7.0 DATA ANALYSIS B-47

8.0 DISPOSITION OF DATA B-49

9.0 SUMMARY B-50

10.0 LITERATURE CITED B-51

ADDENDUM A: DRAFT DATA SHEETS B-53

LIST OF MAPS

Page

Map 1.1 Locations of the Foote Creek Rim and Simpson Ridge Project Areas and the Permanent Reference Area. The KPPA Includes the Foote Creek Rim and Simpson Ridge Project Areas Plus the Three Alternate Transmission Line Routes Shown on This Map B-7

LIST OF FIGURES

Page

Figure 4.1 Approximate Locations of Raptor Observation Circles on Foote Creek Rim B-17

Figure 4.2 Approximate Locations of Raptor Observation Circles Within the Permanent Reference Area B-18

Figure 4.3 Approximate Avian Species Point Count Locations on Foote Creek Rim B-27

Figure 4.4 Approximate Locations for Big Game and Sage Grouse Pellet Count Transects near Foote Creek Rim B-34

LIST OF TABLES

Page

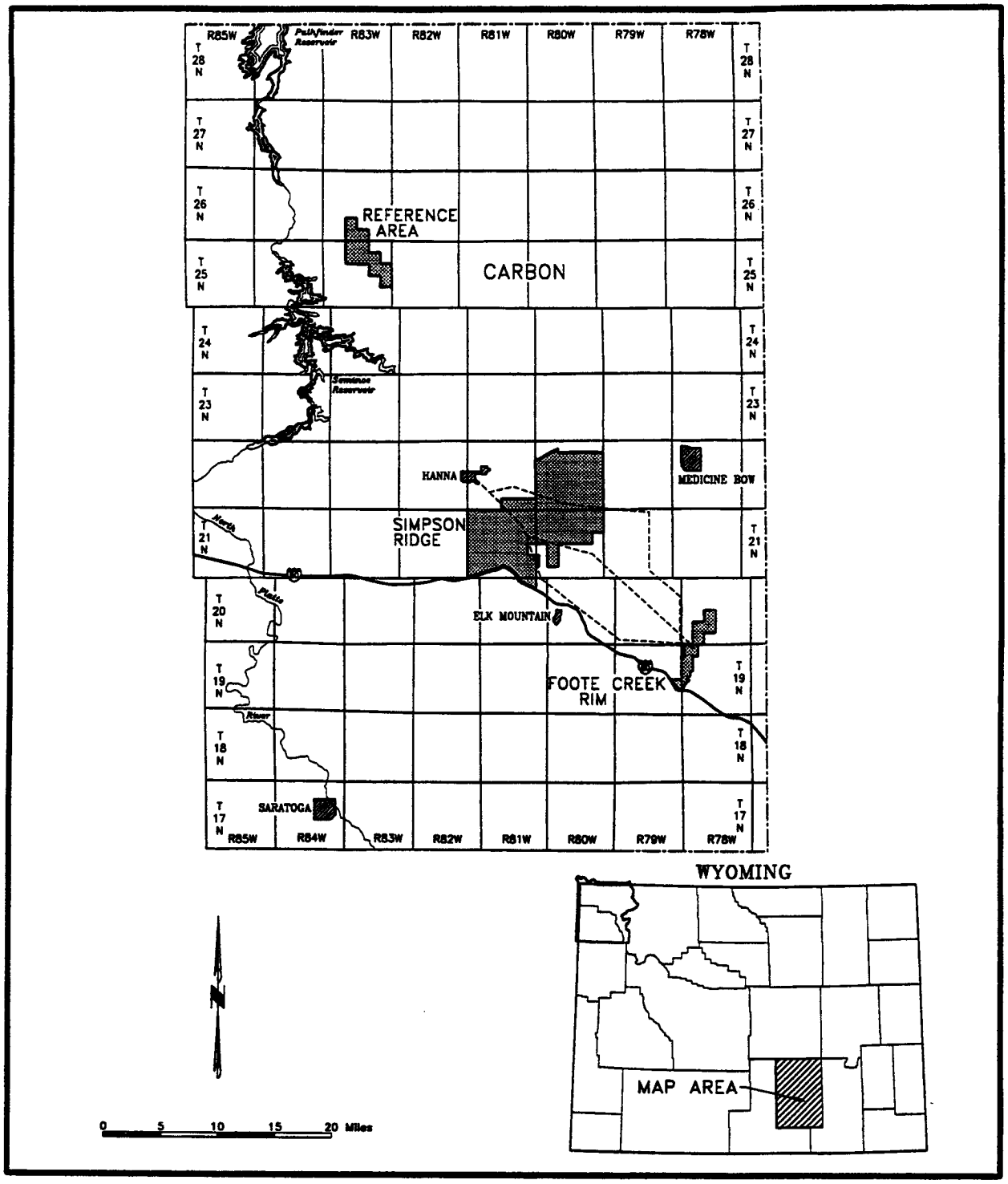
Table 4.1 Summary of Monitoring Protocol Components Showing the Timing, Location, and Frequency of Each Phase of the Study for 1995 ..... B-19

1.0 INTRODUCTION

The following describes the conceptual design and study methods of the monitoring study for the proposed 500-megawatt (MW) Windplant™ in the KENETECH Windpower, Inc. (KENETECH)/PacifiCorp, Inc. (PacifiCorp) Project Area (KPPA) between Arlington and Hanna in Carbon County, Wyoming. This Windplant will consist of approximately 1,390 wind turbine generators and related facilities, including transmission lines, communications systems, transformers, substations, roads, and operations and maintenance facilities. The studies are designed to collect baseline data prior to construction, as well as data to evaluate the potential effects of the Windplant during and after the construction period based on comparisons with reference areas.

For most surveys, three areas will initially be studied: Foote Creek Rim, Simpson Ridge, and a permanent reference area (Map 1.1). Foote Creek Rim provides the initial development area to be compared with a similar reference area. The Simpson Ridge area provides a second reference data set as well as pre-construction data for future expansion of the project. Future development in the Simpson Ridge area will be monitored at least three years prior to construction. However, if KENETECH decides not to proceed with further development at Foote Creek Rim, due to wildlife or other concerns, then KENETECH may apply for a BLM Notice to Proceed for the Simpson Ridge area. BLM will not approve any such application until one year of monitoring has been completed at Simpson Ridge. There will always be one permanent reference area (i.e., not proposed for development) to compare to the development areas. Any development area monitored prior to construction will serve as a second reference area for areas already under construction or with construction completed.

The permanent reference area and Foote Creek Rim are approximately the same size and the sampling intensity of raptor use studies covers both areas. Simpson Ridge is larger than the other two areas and the proposed sampling is less intensive. The sampling intensity for Simpson Ridge will be evaluated during the first field season to determine if additional



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Map 1.1 Locations of the Foote Creek Rim and Simpson Ridge Project Areas and the Permanent Reference Area. The KPPA Includes the Foote Creek Rim and Simpson Ridge Project Areas Plus the Three Alternate Transmission Line Routes Shown on This Map.

sampling stations are needed. In addition, the permanent reference area will be evaluated during the initial field season to determine its suitability as a long-term reference area. A new reference area will be selected if necessary. If the permanent reference area becomes unsuitable due to other development or disturbance, another permanent reference area will be located.

2.0 DESIGN CONCEPTS AND RISK EVALUATION

This protocol is a product of interaction among a large number of scientists, industry representatives, and agency professionals concerned with the potential effects of windpower development on wildlife in Wyoming. The design combines pre- and post-construction data from baseline studies and subsequent monitoring activities (before/after) with data from reference and development areas (control/treatment). By sampling both the reference area and the development areas before and after windpower development, both temporal and spatial controls are utilized, optimizing the impact design (Green 1979).

Monitoring activities combine relatively intensive surveys of species of primary concern (raptors, in general, and the golden eagle and ferruginous hawk, in particular; and the mountain plover), with relatively extensive surveys of species of reduced concern (e.g., other non-raptor avian species, big game, etc.). In addition, several resources are considered only insofar as they may affect the analysis of data on species of primary concern. For example, little concern exists regarding potential effects of windpower on small mammals (e.g., prairie dogs and ground squirrels). However, an index to the relative abundance of these species within the range of raptors potentially affected by the project will be used to assist the interpretation of fluctuating numbers or reproductive data for raptors.

The relative scarcity of the species of primary concern (e.g., raptors and mountain plover) or their broad distribution (e.g., big game) makes detection of statistically significant impacts of the magnitude anticipated with Phase I of the project difficult. Thus, the design and analysis uses a "weight of evidence" approach to determine the effects of the project on species of concern. A number of hypotheses, derived from the goal and objectives contained in the monitoring plan, will be tested with data accumulated over time. Estimates of direct mortality can be made in a given year through carcass searches, but tests of other parameters (e.g., nesting success) for any given year may have relatively little power to detect an effect of windpower development on the resources of concern. However, the trend of effects should be discernable and indicate if they are of a magnitude warranting

additional, more detailed, study. The monitoring plan does not estimate population parameters but only indices of population parameters. This monitoring plan, as designed, is a dynamic process that uses an accumulation of data to detect impacts and to direct further study.

The weight of evidence approach is illustrated by the following discussion. Depending on the resource of concern, the evaluation of effects from the wind energy development includes effects on individuals, such as use effects (e.g., reduction in use of the area occupied by the turbines), and population effects, such as mortality (e.g., death due to collision with a turbine) and reproduction (e.g., effect on reproduction in the area). The evaluation of effects is important in determining effective and adequate mitigative measures. For each resource monitored, potential effects and methods of evaluating these effects from the wind energy development are discussed below. The actual effects, if any, will not be known until monitoring begins and data have been evaluated.

2.1 RAPTOR RESOURCE

Several outcomes are possible from the raptor studies. For example, a decline in raptor use on the Foote Creek Rim area without a similar decline on the reference area(s) may be interpreted as evidence of an effect of windpower development. The presence of carcasses near turbines and/or a decline in nesting activity increases the weight of evidence that an effect can be attributed to windpower. A decline in use of both the reference and development area (i.e., an area with wind turbines) coupled with few to no carcasses may be interpreted as a population response unrelated to windpower. Other factors, such as differential prey availability between the reference areas and development areas, will aid in separating out effects of wind turbines from effects due to other factors.

The level at which mortalities are considered significant is subjective and will depend on the species involved. A significant number of carcasses associated with turbine strings may suggest a population effect, particularly during the breeding season. A significant number

of carcasses associated with a decline in use relative to the reference area and/or a decline in number of active nests may be interpreted as a probable population effect.

The above monitoring efforts would yield indices of population effects. If evidence suggests negative impacts on raptors, additional, more detailed studies of raptor population dynamics will be necessary to determine the significance of impacts (e.g., the effect of mortalities on the dynamics of the populations).

2.2 NON-RAPTOR AVIAN RESOURCE

As with the raptor resource, a decline in non-raptor avian use on development areas without a similar decline on the reference area(s) may be interpreted as evidence of an effect of windpower development. A decline in avian use coupled with mortalities associated with the turbines corroborates this interpretation. A decline in avian abundance on both the reference area(s) and development area(s) may be attributed to population responses to unknown factors.

2.3 BIG GAME RESOURCE

Big game issues related to the proposed Wyoming wind energy project are similar to the issues facing big game whenever land use changes. The KPPA is occupied seasonally by populations of pronghorn, mule deer, white-tailed deer, and elk. All of these species use the KPPA as winter habitat as well as during other seasons of the year. Thus, project features such as turbines, roads, buildings, and fences will result in direct habitat loss. The importance of this loss depends on the quality and quantity of habitat lost and the degree of dependence on that habitat by the species of concern.

Projects resulting in direct habitat loss also frequently result in the loss of use of habitat due to displacement. Each project feature and the construction of the project will have some zone of influence which will extend for some distance. Effects of construction activities,

roads, and power lines are somewhat predictable, based on other similar projects. However, the wind turbines are a new form of disturbance, and animals' responses to them are uncertain. Potential disturbances include maintenance activities, the visual appearance of the turbines and turbine strings, and the noise resulting from their operation.

Disturbances to daily movements and feeding activities are of interest. However, the effect of turbine strings on seasonal migrations, particularly for pronghorn, are of the highest concern. Pronghorn may habituate to the turbine strings and move around or across them as they often do barbed wire fences and unfenced roads. However, they may view the strings as an obstruction and refuse to pass under them, as they apparently refuse to make use of highway underpasses.

The use of the KPPA by big game animals will be evaluated before, during, and after construction of the turbines. Resource selection models will be developed, relating the probability of use to habitat, topography, and other environmental conditions. These features, as well as the use at varying distances to the turbines before and after construction, will be evaluated as a potential predictor of use of the KPPA development areas. The density of pellet groups and habitat selection by groups of animals recorded during aerial surveys will be considered an indicator of animal use. If the wind turbines have little effect on use of habitat by big game, then we would expect the distance from turbines to be a poor predictor of use. We would also expect the average amount of use of areas associated with turbines before and after construction to be approximately equal. Interactions between the other environmental factors and distances to turbines before and after construction will be used to separate out effects of these factors from possible wind turbine effects. These models will be evaluated seasonally. Multi-year estimates of use are important to accurately evaluate use effects.

Aerial surveys will also be used to estimate pronghorn and elk abundance and gross distribution before and after construction of the project. Observations will be made of all

other big game using the area surveyed. However, the survey technique provides a poor estimate of distribution for mule and white-tailed deer.

The above measures of effect are indirect and can be used to determine mitigation measures necessary to reduce or eliminate the effects of windpower development on big game. If turbines significantly influence habitat use, additional population studies may be necessary to determine if these effects influence the viability of the population (i.e., reproduction and mortality).

2.4 SAGE GROUSE RESOURCE

The sage grouse resource will be evaluated through population trends, use, and mortality. A decline in the population or use in a development area may be interpreted as an effect of windpower development if other factors such as snow patterns, vegetation, and water cannot fully explain these declines. There is the potential for direct mortality associated with the turbines for birds moving long distances. Although the majority of sage grouse activity is conducted on the ground or at very low altitudes, birds moving long distances may fly within the zone of the turbine rotors.

3.0 GOAL

The goal of the monitoring studies is to provide an evaluation of the effect of Windplant development on common raptor species and other wildlife resources potentially at risk from wind energy development and to aid in identifying future turbine locations and possible design modifications that minimize impacts to wildlife.

4.0 COMPONENTS OF MONITORING STUDY

The monitoring program is designed to study wildlife thought to be at risk from wind energy development. The monitoring plan proposes intensive studies on raptors, the mountain plover, and big game, and extensive studies (i.e., less intensive) of non-raptor avian species, raptor prey species, and sage grouse.

4.1 RAPTOR RELATIVE DENSITY AND USE

4.1.1 Point Count Surveys for Raptors

4.1.1.1 Objective

The objective of the raptor use surveys is to estimate the spatial and temporal use of the Foote Creek Rim and Simpson Ridge areas, and a permanent reference area by the raptor species of interest.

4.1.1.2 Introduction

Raptor use is considered an index to density for species using the study areas. Use will be measured by making repeated instantaneous and continuous counts of birds observed within sample plots. It is assumed use will be influenced by biological and physical characteristics of the site and/or the home range of the raptor. Each bird detected during instantaneous counts will be located in relation to existing or measured information regarding the physical and biological characteristics of the site.

4.1.1.3 Field Methods

Locations of stations (observation circles) on Foote Creek Rim will be the same as used by Mariah Associates, Inc. (Mariah) in 1994 (Figure 4.1). Six stations, three on the western edge of the rim and three on the eastern edge of the rim, will be visited. Six stations will be located on the portion of the Simpson Ridge area scheduled for development in the near future. If this initial area is much greater in size than Foote Creek Rim, additional stations will be established. As other areas come on-line for development, additional stations will be established and sampled. Six stations will also be established on the permanent reference area in a similar fashion (Figure 4.2).

Each station will be a 0.5 mi (0.8 km) radius circle centered on an observation point. Landmarks will be located to identify the 0.5 mi (0.8 km) boundary of each station. The boundary will be flagged if there are no landmarks. Incidental observations of birds beyond the 0.5 mi (0.8 km) radius will be recorded, but will be analyzed separately from the data collected within the plot.

Observations will be made every other week during the winter period and weekly during the rest of the year (Table 4.1). For the purpose of this protocol, the winter period is defined as November 1 through February 13. Visual observations will be made so as to cover all daylight hours. Each station will be visited twice on each sampling day, once during the morning (0600-1200) and once during the afternoon (1200-1800).

Data collected during each station visit will consist of instantaneous counts, as well as counts during a 40-minute interval to establish use of stations by species. Instantaneous counts will be taken at the beginning of the 40-minute interval, and every five minutes thereafter. A schedule will be developed by the study team leader prior to field work, to ensure each station is surveyed about the same number of times during each period of the day each season. The observation period per station visit (i.e., 40 minutes) will be evaluated based on the data collected during baseline studies and during the first breeding season.

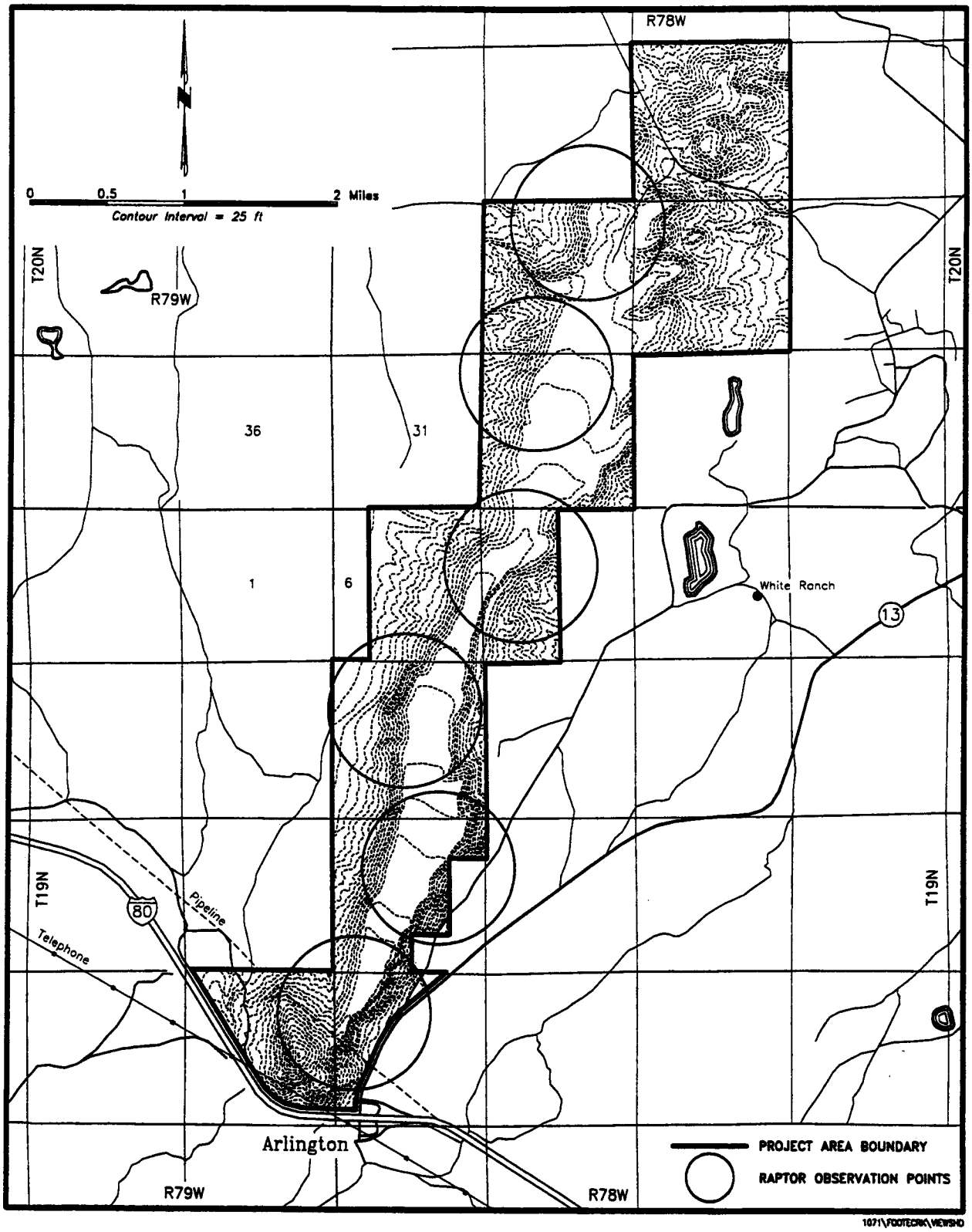


Figure 4.1 Approximate Locations of Raptor Observation Circles on Foote Creek Rim.

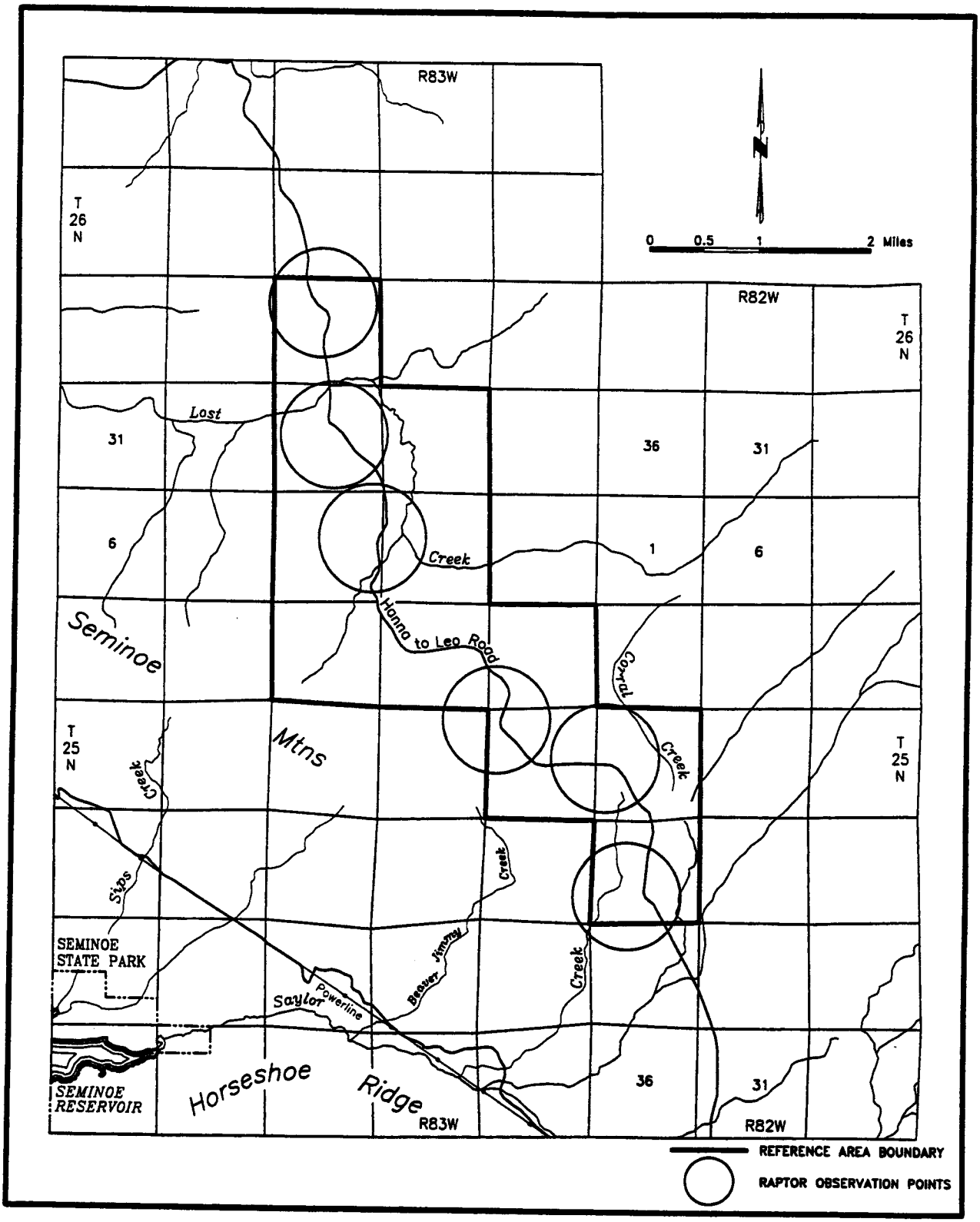


Figure 4.2 Approximate Locations of Raptor Observation Circles Within the Permanent Reference Area.

Table 4.1 Summary of Monitoring Protocol Components Showing the Timing, Location, and Frequency of Each Phase of the Study for 1995.

Survey/Study Description	Frequency	Timing	Location/Area
Raptor point count surveys	Biweekly winter, weekly otherwise	January - December	Foote Creek Rim and Simpson Ridge areas, reference area
Raptor nest surveys	One aerial survey, two ground surveys	April - August	Foote Creek Rim and Simpson Ridge areas, reference area and 10-mi (16-km) buffer
Avian species point count surveys	Three surveys	May - July	Foote Creek Rim and Simpson Ridge areas, reference area
Mountain plover surveys	Six surveys	May - July	Foote Creek Rim and Simpson Ridge areas, reference area
Big game aerial surveys	Bimonthly winter survey Parturition period survey	November - mid-April June	KPPA
Pellet county surveys	Twice a year	End of May, end of October	Foote Creek Rim and Simpson Ridge areas
Sage grouse lek surveys	Two aerial and three ground surveys	April	KPPA
Sage grouse use surveys	Once a year	July	Foote Creek Rim and Simpson Ridge areas
Lagomorph trend surveys	Once per year	July or August	Foote Creek Rim and Simpson Ridge areas, reference area, and 10-mi (16-km) buffer
Prairie dog surveys	Three transects per prairie dog town per year	July or August	Foote Creek Rim and Simpson Ridge areas, reference area and 10-mi (16-km) buffer
Ground squirrel surveys	One roadside survey per year	July or August	Foote Creek Rim and Simpson Ridge areas, reference area, and 10-mi (16-km) buffer
Carcass searches	Weekly	January - December	Where turbines become operational
Carcass removal trials	Once each season	January - December	Where turbines become operational
Carcass detectability trials	Once each season	January - December	Where turbines become operational

All raptor sightings will be recorded on the data sheets contained in Addendum A to this plan. A unique observation number will be assigned to each sighting. The date, time of observation, plot number, species, and distance from observer will be recorded. The type of survey (i.e., fixed point, traveling between points, other) will be identified. The observer will indicate whether the bird is within or outside the survey radius if seen during a fixed point survey. Weather information such as temperature, wind speed and direction, cloud cover, and precipitation will be recorded for each station visit. The field form will include codes to be used for identifying the bird to species, or to higher levels if the species is unidentifiable (e.g., unidentified buteo).

Location of first sighting, as well as direction of travel and distance from the observer, will be mapped in the field. Broad categories of flight behaviors (passing through the sampled area, courtship/pair bonding, foraging, aggressive interaction, etc.) will be recorded. Flight patterns (perched, soaring, flapping, gliding) will be recorded in the order identified. For example, if a raptor is first sighted while perched, and then leaves its perch and flies (flapping) out of the sampled area, then a "1" will be written in the box next to perching, and a "2" next to flapping. Estimates of flight height will be made. Classes of 0-26 ft (0-8 m), 26-184 ft (8-56 m), and >184 ft (56 m) will be used. These classes correspond to the height below, within, and above the space occupied by turbine rotors, respectively. Each height category flown by the raptor will be recorded, and the order in which flown will be identified. Observations will be related to the distance to unique habitat features (e.g., nesting sites, ridges, etc.). The habitat traversed by the raptor will be identified in a similar fashion. Any comments or unusual observations will be recorded in the comment section of the data form.

4.1.1.4 Data Analysis

Species lists will be generated by study period and study unit. The number of raptors seen during each point count survey will be standardized to a unit area and unit time searched. For example, if four raptors are seen during a 40-minute interval at a station with a viewing

area of 1.0 mi^2 (2.6 km^2), these data may be standardized to 4/1.0 mi^2 (2.6 km^2) = 4 raptors/mi^2 (1.5 raptors/km^2) during a 40-minute survey. For instantaneous counts, the number of raptors seen will be standardized by area searched and the number of instantaneous counts taken during the point count. For example, if at the same station, five instantaneous counts are taken during a 40-minute observation period, two raptors were present during the second instantaneous count, and one was present during the third instantaneous count, data may be standardized to [(2+1)/5]/1.0 mi^2 (2.6 km^2) = 0.6 raptors/mi^2 (0.2 raptors/km^2) per instantaneous count.

Data will be plotted to illustrate differences in raptor use between (1) seasons, (2) times of day, (3) stations, (4) study areas, and (5) pre- and post-construction periods. Randomization testing methods (Manly 1991) for repeated measures analysis of variance (Milliken and Johnson 1984) will be used to test for differences in raptor use and possible interactions between (1) seasons, (2) times of day, (3) study areas, and (4) pre- and post-construction time periods, using the statistical software packages SAS (SAS Institute 1988) and RT (Manly 1991).

Further information to guide placement of wind turbines will be obtained from analysis of the existing habitat and topographic data (e.g., habitat types, distance to canyons, distance to nests, etc.) collected from maps and related to the bird observations. Resource selection functions (Manly et al. 1993) will be derived from the information gathered for the location of each raptor observed and information on habitat available to the raptor within each study area. Habitats or other topographic variables positively or negatively related to raptor use will be identified.

4.1.2 Raptor Nest Census

4.1.2.1 Objective

The objective of the raptor nest census is to evaluate number and distribution of nesting raptors which may be potentially influenced by the project and to evaluate potential effects of the wind turbines on nesting parameters.

4.1.2.2 Introduction

It is assumed that the number and distribution of active nests within the area potentially impacted by the placement of wind turbines over time represents an index to the status of the breeding population of raptors. While all raptor species are of interest, nesting surveys will focus on the three species of most concern; the golden eagle, bald eagle, and ferruginous hawk. Since golden eagles are known to forage at least 10 mi (16 km) from a nest, it is also assumed that the zone influenced by the wind turbines extends approximately 10 mi (16 km) from the turbine strings. Thus, the study areas or nesting populations include the Foote Creek Rim and Simpson Ridge areas and the permanent reference area, and a 10-mi (16-km) buffer around each, excluding coniferous forests.

It is recognized that the number of occupied territories is more useful than occupied nests when evaluating breeding populations status. Inadequate data exist at present to allow an estimate of occupied territories. However, as data are accumulated over several years, estimates of nesting territory occupancy and other parameters that use the territory as the unit will be possible.

4.1.2.3 Field Methods

Study areas will be surveyed for raptor nests by helicopter during mid-April, when nesting activity of most raptors in the study areas will be well established. Helicopter surveys will be immediately followed by ground surveys to confirm the species and status of each observed nest. Surveys will be concentrated in likely raptor nesting habitat (e.g., rocky outcrops, cottonwood riparian zones, etc.). While all active raptor nests would be visited during the first ground survey, subsequent ground surveys will focus on the primary species of interest; golden eagle and ferruginous hawk [Bob Oakleaf, Rich Guenzel and Steve Tessmann, Wyoming Game and Fish Department (WGFD), personal communication]. Ground surveys will also be conducted in areas inaccessible by helicopter (e.g., Rock Creek Canyon) or where habitat features cause poor visibility from the air.

A 10-mi (16-km) buffer surrounding each study area will be surveyed. The buffer will include nests of pairs of birds most likely to use the area of interest (i.e., the site of turbine strings or a reference area). It is desirable to include an area containing at least 20 active golden eagle and 20 active ferruginous hawk nests; however, it is likely that 20 active nest for both these species will not be found within the combined survey area.

Regardless of species, all raptor nests located in each study area will be mapped on 7.5' topographic maps and located with a Geographic Positioning System (GPS). Data on habitat, nest status, and adult activity will also be recorded to the extent possible from the air. Nest data will be recorded on Bureau of Land Management (BLM) Nest History and Raptor Inventory data sheets (Addendum A).

All nests detected during the aerial survey will be visited once from the ground to verify location, species, and occupancy. For all golden eagle, bald eagle, and ferruginous hawk nests located, the approximate stage (e.g., nest building, incubating eggs, chicks, etc.) of the nest will be determined during the first visit to establish a date for a second visit. Two or

more additional ground visits will be made to all golden eagle, bald eagle, and ferruginous hawk nests to determine nest and territory parameters as described below.

4.1.2.4 Data Analysis

For all raptors, the number of occupied nests within the defined area will be used to estimate relative abundance of nesting species potentially affected by the wind turbines. For golden eagle, bald eagle, and ferruginous hawk, the following nest and territory parameters will be calculated:

- the total number of young fledged per active nest;
- the number of occupied nests/total number of nests checked;
- the number of reproductive pairs (with eggs)/number of total pairs (including those without eggs);
- the number of pairs that successfully fledge at least one young/number of reproductive pairs; and
- the number of young fledged/total number of pairs.

These parameters will be estimated to augment empirical data on nesting pairs. Statistical comparisons of these parameters (if sufficient data exist) will be made between study areas before and after construction (see Section 7.0 for description of statistical tests to be used). Statistical comparisons of these parameters will become more valuable as the territories become better defined.

4.2 NON-RAPTOR AVIAN SPECIES RELATIVE DENSITY AND USE

4.2.1 Point Count Surveys for Non-Raptor Avian Species

4.2.1.1 Objective

The objective of the point count surveys for non-raptor avian species is to estimate the species composition, relative abundance, and spatial use of the Foote Creek Rim and Simpson Ridge areas and a permanent reference area of the more common species and species of special interest (i.e., mountain plover) during the breeding season.

4.2.1.2 Introduction

Point count surveys will be used to estimate relative density and use for all non-raptor avian species during the breeding season on study areas. The intensity of the surveys insures sufficient data for some of the common species, but will provide only incidental data on less common and rare species, with the exception of the mountain plover. Thus, with the exception of the mountain plover and the most common species, impacts to non-raptor avian species will be based primarily on evidence of direct mortality. Point counts and productivity surveys will be intensified in historical mountain plover high use areas within the Foote Creek Rim area (see Section 4.3).

4.2.1.3 Field Methods

Three study areas will be used for point count surveys: the Foote Creek Rim area, the Simpson Ridge area, and a reference area. Point count surveys at each station will be replicated three times during the breeding season (mid-May to mid-July, weather dependent) a minimum of seven days apart. A grid of points will be established on each study area. The grid will consist of eight transects of five point count locations which run perpendicular to the long axis of each study area (Figure 4.3). Point count locations will be

established 1,312 ft (400 m) apart along the eight transects. The eight transects will be established equidistance apart along the long axis of the study area.

A variable circular plot method will be used for avian point count surveys (Reynolds et al. 1980; McDonald et al. 1993). Surveys will be conducted between the half hour before sunrise and four hours after sunrise. At each point, observers will count birds for eight minutes. Following the eight-minute count, the observer will move to the next point count location.

During the eight-minute count, observers will record all birds detected by sight or sound. Data recorded will include species of bird, number of birds in the group, estimated distance to the bird(s) out to a maximum of 328 ft (100 m), whether the bird(s) was seen within the first five minutes or last three minutes and the flight height class of the bird [0-26 ft (0-8 m), 26-184 ft (8-56 m), and > 184 ft (56 m) above ground]. Mountain plover, raptors, waterfowl, sage grouse, and shore birds will be recorded at any distance, but distance estimates will not be attempted.

Two observers will be used each survey day. One observer will start at a randomly chosen point and move in ascending order for 20 points. The second observer will start at the twenty-first point from the randomly chosen start point and continue for 20 points with Point 1 following Point 40. In this fashion, all points at one plot will be visited once during a survey day, and each observer will visit 20 points. On the Simpson Ridge area, additional observers or survey days may be needed to cover all survey points.

4.2.1.4 Data Analysis

Observed density of each bird species will be calculated for each plot from the variable circular plot data. Relative density corrected for visibility bias (Buckland et al. 1993) will be estimated by species (if data are sufficient) using the program DISTANCE (Laake et al. 1993). Pooling of data across some species will be required when low numbers preclude

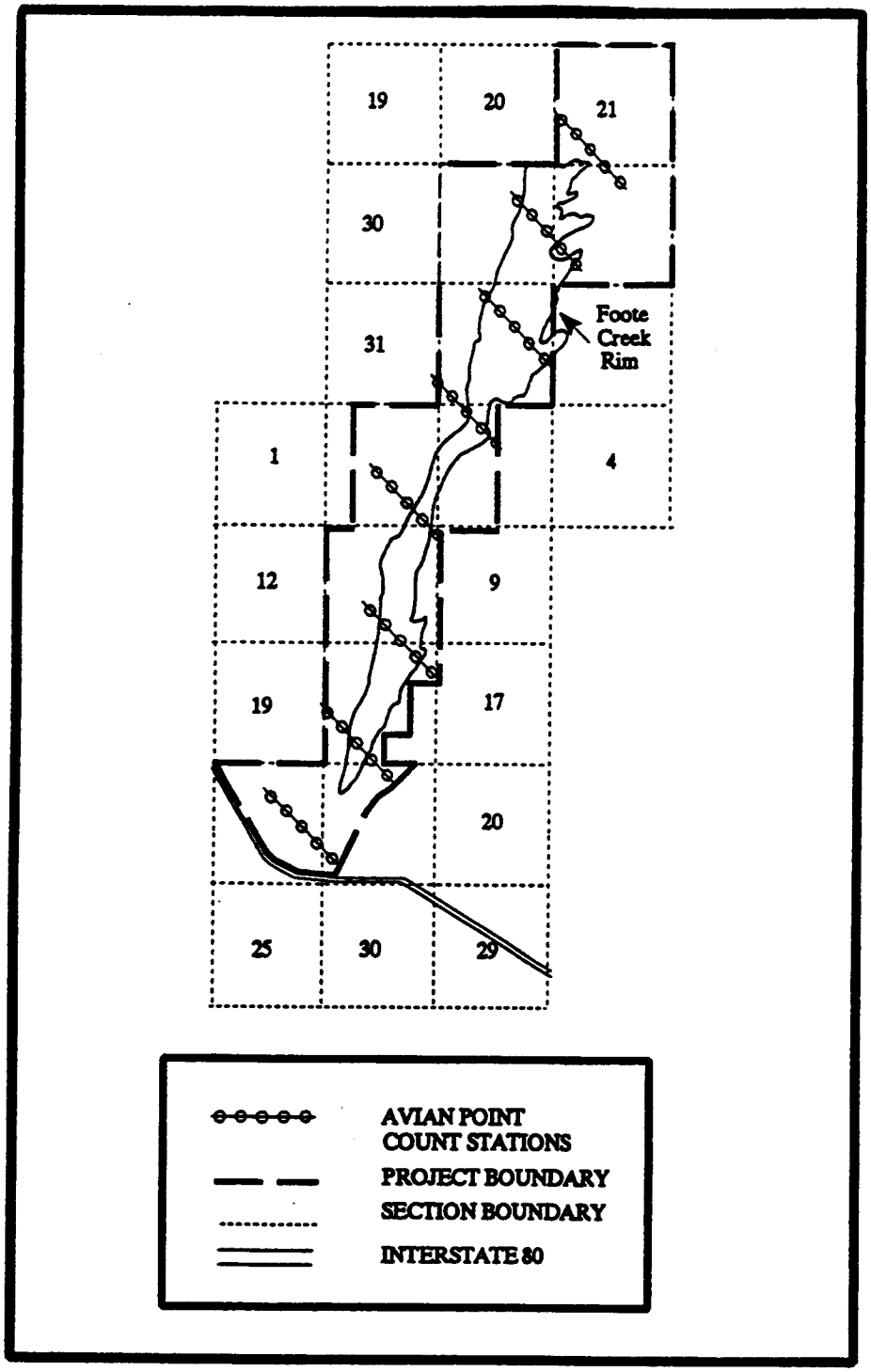


Figure 4.3 Approximate Avian Species Point Count Locations on Foote Creek Rim.

estimating visibility bias for the individual species. Species will be pooled into groups that exhibit similar detectability. Changes in relative density and use will be evaluated by comparing observed density and adjusted density between the Foote Creek Rim and Simpson Ridge study areas and the reference area (see Section 7.0 for description of statistical tests to be used).

4.2.2 Additional Mountain Plover Surveys

4.2.2.1 Objective

The objective of the mountain plover studies is to determine the number of birds, number of nesting pairs, clutch size, and number of young hatched on the KPPA and the permanent reference area.

4.2.2.2 Introduction

The U.S. Fish and Wildlife Service (USFWS) has been petitioned to list the mountain plover as endangered under the Endangered Species Act. Additional monitoring activities will provide data suitable for use in the consultation process that will be required should listing occur. The monitoring plan for the mountain plover addresses (1) detailed density estimates of mountain plovers using the study area, (2) the extent and use of breeding habitat on the study areas, and (3) the level of reproduction on the study areas. This protocol will provide data compatible with other monitoring efforts currently underway (e.g., U.S. Forest Service efforts in northeastern Colorado).

4.2.2.3 Field Methods

4.2.2.3.1 Habitat Suitability/Breeding Habitat

Mountain plovers show a strong affinity to flat or very slightly sloping areas, as well as areas with very short vegetation for nesting (Graul 1976, Parrish 1988). Topographic maps will be used to define areas within each study area where the slope would allow suitable habitat to exist. Site visits will be made to visually assess the potentially suitable habitat for key features such as slope, irregular topography, and vegetation height. These areas will be delineated on detailed maps.

4.2.2.3.2 Mountain Plover Surveys

A second smaller grid of bird survey points, within the avian species survey grid, will be established on the suitable breeding habitat for mountain plovers within the study areas. These points will be visited six times during the breeding season (May through July). The same methods as the avian surveys will be used; however, an emphasis will be placed on locating mountain plovers. All mountain plovers observed will be mapped, and additional data such as age (adult vs. hatch year), association with other mountain plovers, and behavior will be recorded.

4.2.2.3.3 Nest Searches and Monitoring

Graul (1975) found that 75% of the nests he monitored were initiated between April 25 and May 14. Nest initiation date is probably slightly later in Wyoming (Parrish 1988). Suitable habitat will be monitored on a frequent basis beginning in mid-April to determine when mountain plovers begin to arrive on-site.

Nest searches will begin in early May or when breeding behavior is observed. Efforts will be made to find all nests (including those for second clutches) on the study areas. The

location of each nest will be recorded on a detailed map of the study area. Each nest will be monitored on a three- to four-day rotation until the young have hatched and leave the nest. Surveyors will avoid disturbing the nest and pair as much as possible (e.g., observing from a vehicle and at long distances with a spotting scope).

4.2.2.3.4 Data Analysis

The proportion and amount of suitable breeding habitat for mountain plovers within each study area will be estimated. The habitat identified as suitable will be overlaid with the proposed development areas to determine the extent of habitat impacts.

The number of mountain plovers (and breeding pairs) using each study area will be calculated. Data from nest monitoring will be used to assess the reproductive effort of mountain plovers at the study sites. Mapped nest locations will be overlaid with other data (e.g., development area, turbine strings) to assess potential and extent of impacts. Hatching data, in conjunction with the bird surveys, will be used to estimate survivorship to fledgling, if feasible.

4.3 BIG GAME STUDIES

4.3.1 Objective

The primary objective of this study is to describe the temporal and spatial distribution, abundance, and habitat use of big game in and around the KPPA before and after construction of turbines, and using these data, to determine if the turbines have a displacement effect.

4.3.2 Introduction

It is assumed that the project may cause gross changes in distribution, and possibly, reduced habitat use and movements near areas where turbines are constructed. Aerial surveys will allow the determination of gross distribution and habitat use by big game during the winter and parturition periods. Pellet transects will allow a determination of seasonal use within areas of development. The design of pellet transects will allow the determination of use before and after construction as influenced by habitat features and distance to turbines. A fixed-wing aerial survey was selected because the pronghorn is the species of primary interest. Mule deer are most effectively counted using helicopter surveys, which would likely disturb pronghorn.

4.3.3 Aerial Surveys

4.3.3.1 Field Methods

Fixed-wing aerial surveys using a Piper Super Cub airplane (or similar aircraft) will be conducted to locate a sample of mule deer, pronghorn, and other big game groups in the study area. A single survey will be conducted during the parturition period (approximately the first of June) to estimate parturition period, number, and distribution. Surveys will be conducted every other week during the winter starting in November and continuing through April. The aerial surveys will be conducted within all of Hunt Area 46 plus the remainder of the Simpson Ridge area. North-south oriented line transects located systematically with a random starting point will be flown. Stratification of data post-construction will allow analysis of data at different distance classes from turbines.

The WGFD Pronghorn Survey Protocol will be followed with the possible exception that automated data entry/GPS equipment may be used. A GPS unit will be used to locate the starting and stopping points of each line. Once "on-line", the airplane will maintain a constant altitude. A laptop computer interfaced to the GPS will be used to record

continuous (every 10 seconds) latitudes and longitudes. When a group of animals is detected, latitude and longitude of the airplane will be captured when a line drawn from the airplane to the group is perpendicular to the transect. The observer (recorder) will record an observation number, species, number of animals, group composition, habitat type, and approximate perpendicular distance of the group from the transect. Comments and unusual observations will also be recorded.

Observer(s) will concentrate their efforts in a 0.6-mi (1.0-km) band on either side of the transect. Observations beyond the 0.6-mi (1.0-km) boundary may be recorded, but will be flagged to indicate they were outside this boundary.

Distance will be measured from the center of the sighting (e.g., individual pronghorn, groups of pronghorn) to the flight line along a perpendicular projection onto the flight line. To aid in estimating the perpendicular distance to groups of animals, clear window templates will be calibrated so that sightings viewed through them can be placed into discrete distance zones. The proper locations for the distance bands is dependent on altitude and will be determined using an inclinometer. Templates will be prepared with the observer's head in a fixed position relative to the window. Airspeed will depend on the habitat type. For example, airspeed in open prairie habitat will be greater than in other habitats where visibility of animals is lower.

4.3.3.2 Data Analysis

Relative density corrected for visibility bias (Buckland et al. 1993) will be estimated by each survey date for pronghorn and mule deer using the program DISTANCE (Laake et al. 1993). Locations of groups also will be mapped by month and by season. Habitat maps will be developed using existing data (e.g., information from available satellite imagery, WGFD habitat maps). These maps will be combined using a Geographic Information System (GIS) with group locations for determining habitat types by group. Animal visibility will likely be a function of group size and habitat, so the bias correction must be habitat-specific. Other

environmental variables (e.g., snow cover, distance to water) that may be related to selection will be obtained for each group.

Resource selection functions (Manly et al. 1993) will be derived from the information gathered for each group location and information for habitats available to the group throughout the KPPA. Information such as habitat types, snow depth, distance to roads, and distance to turbine locations will be determined from the available information. Logistic regression will be used to estimate relative probabilities of use as a function of habitat, topography, and other environmental variables (Pereira and Itami 1991).

4.3.4 Big Game Use Surveys Using Pellet Counts

4.3.4.1 Field Methods

Pellet counts will be conducted on the Foote Creek Rim and Simpson Ridge areas. Surveys will be conducted at the end of the summer/fall season (approximately the end of October) and the end of the winter/spring season (approximately at the end of April). A grid of points will be established on each study area. The grid will consist of 24 transects of ten 3.3-ft (1.0-m) radius circular plots which run perpendicular to the long axis of each study area (Figure 4.4). These permanent plot locations will be established approximately 820 ft (250 m) apart along the 24 transects. The 24 transects will be established equidistance apart along the long axis of the study area. Depending on the distribution of points relative to the turbine locations, additional plots may be established at varying distances from the turbines.

During field setup, all pellets will be removed from within each plot, guaranteeing only fresh pellets will be observed in subsequent surveys. During each survey, observers will count and remove the number of pellet-groups within the 3.3-ft (1.0-m) radius plot. For pellet-groups on the boundary of the 3.3-ft (1.0-m) radius circle, the following rule will be established for recording the group (Neff 1968): if over half of the pellet-group by horizontal surface area

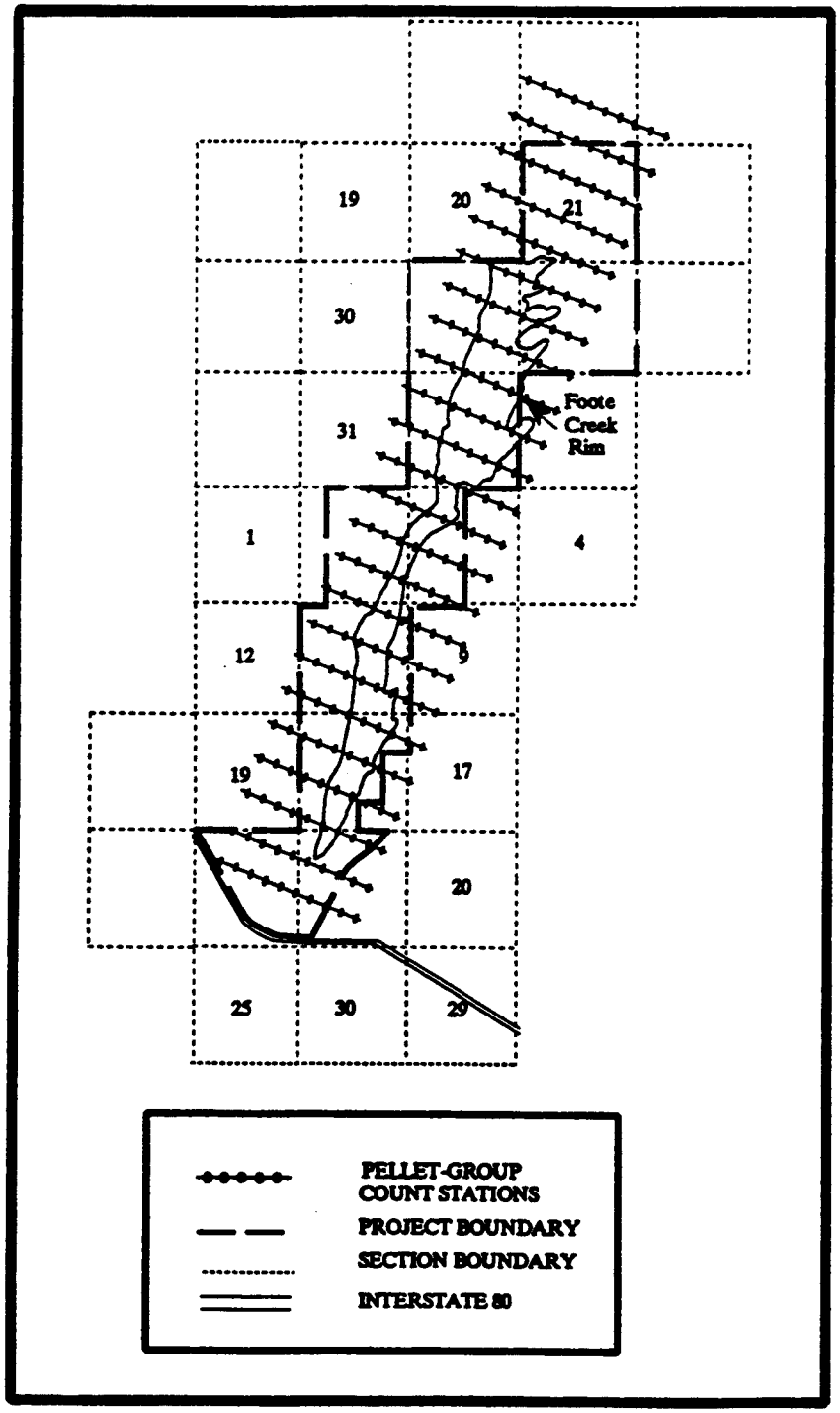


Figure 4.4 Approximate Locations for Big Game and Sage Grouse Pellet Count Transects near Foote Creek Rim.

is within the plot, the group is counted. If less than half of the pellet-group is within the plot, the group is not counted. For those pellet-groups that are half in and half out, every other group will be counted.

4.3.4.2 Data Analysis

Density of pellet groups by species will be calculated by season, study area, and habitat. Displacement effects will be evaluated by comparing the density of pellet groups as a function of distance from the turbines before and after construction. If there is a displacement effect, then the density of pellet groups within a certain distance from the turbines should decrease after construction relative to before construction (see Section 6.0 for description of statistical tests to be used).

4.4 SAGE GROUSE LEK AND USE SURVEYS

4.4.1 Introduction

The greatest concern for sage grouse is the potential effect of windpower on the breeding population within the KPPA. The size of breeding populations will be estimated pre- and post-construction by monitoring lek use on all historical and newly discovered leks. The use of seasonal habitats in areas where turbines are constructed is of secondary concern. Habitat use and distribution within areas where turbines are constructed will be determined from estimates of use as determined by avian point counts. In addition, some indication of use may be determined by noting sage grouse pellets within big game pellet plots discussed above.

4.4.2 Sage Grouse Lek Surveys

4.4.2.1 Objective

The objective of conducting sage grouse lek surveys is to monitor trends in sage grouse abundance and distribution over the KPPA prior to, during, and after construction of wind turbines.

4.4.2.2 Field Methods

A map of known historic and current sage grouse leks in the KPPA will be obtained from the WGFD. Two aerial surveys will be conducted in April 1995, approximately two weeks apart, to confirm existence and activity status of known leks and to search for additional leks. Once all active leks in the KPPA have been located and mapped, annual counts will be made to determine sage grouse abundance on leks. Sage grouse on leks, especially the cryptic hens, cannot accurately be counted from the air. Therefore, each lek will be visited three times during the month of April by foot or vehicle. During each visit, all grouse on the lek will be counted using binoculars and a spotting scope. Additional sage grouse lek trend data will be obtained from counts conducted by the WGFD in the KPPA in the 10-year period preceding construction.

4.4.2.3 Data Analysis

A map will be prepared each year showing location and mean number of birds attending each lek.

4.4.3 Sage Grouse Use Surveys

4.4.3.1 Objective

The objective of this survey is to determine relative sage grouse abundance and distribution by habitat in areas of planned development (the Foote Creek Rim and Simpson Ridge areas) within the KPPA.

4.4.3.2 Field Methods

Information on sage grouse use of the development sites within the KPPA outside of the breeding season will be collected by conducting sage grouse pellet counts. Counts will be conducted in July within the plots used for big game pellet-group counts. All sage grouse pellets or pellet groups left within the 3.3-ft (1.0-m) radius circular plot will be recorded and removed from the transect. Additional information on sage grouse use of the KPPA will be collected by obtaining results of annual sage grouse brood surveys conducted by the WGFD in July. These data will be collected for the 10-year period preceding construction.

4.4.3.3 Data Analysis

An index of relative density of sage grouse using the areas where turbines are constructed in the different habitats will be calculated from the density of pellet groups by season, study area, and habitat.

4.5 PREY AVAILABILITY STUDY

4.5.1 Objective

The objective of the prey availability studies is to determine an index of prey availability within a 10-mi (16-km) buffer of each of the three study areas (the Foote Creek Rim and

Simpson Ridge areas and the permanent reference area) and relate this index to differences in raptor use, breeding pair density, nest occupancy, and nest success between the study areas.

Three prey groups that are important to raptors will be studied: lagomorphs, prairie dogs, and ground squirrels.

4.5.2 Introduction

Little concern exists regarding potential effects of windpower on small mammals (e.g., prairie dogs and ground squirrels). However, an index to the relative abundance of these species within the range of raptors potentially affected by the project will be used to assist the interpretation of relative abundance and nesting parameter data for raptors. The index is based on an extensive measure of relative abundance of medium-sized mammals on and within 10 mi (16 km) of the Foote Creek Rim and Simpson Ridge areas, and the permanent reference area. The index is sensitive enough to demonstrate major changes in abundance (eruptions and crashes), but not minor changes in population density.

4.5.3 Field Methods

4.5.3.1 Lagomorphs

Trend counts as described in the Handbook of Biological Techniques (WGFD 1982) will be used to evaluate lagomorph abundance in the study areas. Five 20-mi (32-km) transects (one in the permanent reference area and four in the KPPA) along roads will be selected and sampled once in late July or early August. The transects will be distributed throughout the areas to provide adequate coverage of all habitat types. The transects will be driven at approximately 20 mph (32 kmph) beginning one half hour after sunset. All lagomorphs observed in the headlights of the vehicle will be counted, identified, and the mile point at

which they were observed recorded. Only one transect will be driven a night so that each transect is surveyed during peak activity hours for lagomorphs.

4.5.3.2 Prairie Dogs

All known prairie dog towns within a 10-mi (16-km) buffer of the Foote Creek Rim and Simpson Ridge areas, and the permanent reference area, based on WGFD maps, and any additional prairie dog towns detected during the big game and nest aerial surveys will be surveyed and mapped once during July or August of each year. To ensure that sample effort is approximately proportional to prairie dog town size, three transects 10 ft (3 m) wide, oriented north-south and equidistant apart will be located in each town. Observers will walk each transect measuring the distance as they go with a rolatape wheel and counting the number of active burrows within each transect. Active burrows will be defined by the presence of fresh scat within 1.6 ft (0.5 m) of the burrow entrance (Biggins et al. 1992). Burrows on the boundary of the transect will be counted if more than half of the burrow entrance is located within the transect (Biggins et al. 1992).

4.5.3.3 Ground Squirrels

An index to relative abundance of ground squirrels within a 10-mi (16-km) buffer of the Foote Creek Rim and Simpson Ridge areas, and the permanent reference area will be determined through roadside surveys once each year during July or August. All public roads within these areas will be mapped. A systematic sample of points along these roads will be selected. The observer will drive along predefined routes stopping at each systematically selected point. En route to each point, the observer will record the number of prairie dogs and ground squirrels (including road kills) seen within 164 ft (50 m) of the centerline on each side of the road in each mile segment of road. At each point the observer will randomly select the left or right side of the road, and search a 2.5 acre square plot on the selected side for the presence of active ground squirrel burrows. The observer will search the entire plot or until an active burrow is found. Active burrows will be defined by the

presence/absence of fresh scat or any other evidence of recent use within 1.6 ft (0.5 m) of the burrow entrance. Approximately 40 plots will be sampled in each study area.

Ground squirrel abundance and density will be evaluated in conjunction with the big game and sage grouse pellet count surveys to relate prey availability near turbines to raptor use. The number of active ground squirrel burrows within the plots used for big game and sage grouse pellet counts will be counted.

4.5.3.4 Data Analysis

Prey availability data will be evaluated to describe population trends in the three prey groups before and after construction of the wind turbines. The data will be evaluated in an effort to correlate raptor production and raptor use with prey availability.

4.6 CARCASS SEARCHES

4.6.1 Introduction

The primary indication of impact to individual birds is the estimation of mortality associated with turbines. All carcasses located within areas surveyed, regardless of species, will be recorded and a cause of death determined, if feasible. However, an estimate of total carcasses of avian species will be made by estimating scavenging and detectability bias.

4.6.2 Estimation of Avian Mortality

4.6.2.1 Objective

The objective of the carcass searches is to estimate extent of avian mortality associated with the wind turbines.

4.6.2.2 Methods

The Foote Creek Rim and Simpson Ridge areas will be used for carcass searches. Carcass searches will be initiated in each area when construction of wind turbines begins.

Two types of plots will be sampled: turbine strings and sections of electrical distribution lines. The size of the plots to be searched will be determined by the size of the area in which the operational turbines and distribution lines are located. That is, as turbine strings and distribution lines are constructed, they will be included in the area to be searched.

Once all turbine strings are operational, a systematic sample of the strings will be selected for searching on a given search day. Search plots will be rotated so that all turbine strings are searched on an equal basis. The area out to 197 ft (60 m) around each turbine string will be searched.

Once transmission lines are constructed, a systematic sample of 2,624-ft (800-m) sections will be selected for searching on a given search day. All electrical distribution lines within the boundary of the development area will be included. Search plots will be rotated so that each section of distribution line is searched on an equal basis. The area out to 98 ft (30 m) from the center line of distribution lines will be searched.

Biologists trained in search techniques will conduct the searches. Parallel transects will be established 33 ft (10 m) apart in the area to be searched [197 ft (60 m) in all directions of turbine strings and 98 ft (30 m) from the midline of each section of distribution lines]. A searcher will walk at a rate of approximately 197-295 ft (60-90 m) per minute along each transect searching both sides out to 16 ft (5 m) for casualties.

Searches of the selected turbine strings and electrical distribution lines will be conducted once a week to locate and collect any mortalities found under the turbines; however, casualties found at other times and places will also be collected and recorded. For all

casualties found, data recorded will include the species, sex if identifiable, age, date and time at which it was collected, the location of the casualty, condition of the casualty, and any comments which may indicate cause of death. All casualties located will be photographed as found and mapped on a detailed map of the study area which shows the location of the wind turbines and associated facilities such as power lines and towers.

All casualties found will be labelled with a unique number, bagged and frozen for future reference and possible necropsy. In absence of necropsy, sex and age will be determined, if feasible. A copy of the data sheet for each carcass will be maintained with the carcass at all times (i.e., bagged and frozen with the carcass).

4.6.2.3 Data Analysis

Casualties found will be used to document number and species of dead birds, to determine if birds were killed by the turbines, and to look for possible topographic or turbine characteristic effects.

4.6.3 Estimation of Carcass Removal by Scavengers

4.6.3.1 Objective

The objective of the scavenger carcass removal studies is to estimate the length of time avian mortalities remain in the search area.

4.6.3.2 Methods

Foote Creek Rim and the Simpson Ridge areas will be used for carcass removal studies. For each area, carcass removal trials will begin as soon as a string of wind turbines is complete. The size of the plot will be determined by the size of the area in which operational turbines are located.

Once each season, 20 carcasses of birds of two size classes [10 small passerines (e.g., house sparrow) and 10 medium-sized raptors (e.g., red-tailed hawk)] will be randomly placed within the study area. Maintenance personnel will be shown the location of the carcasses and instructed in the daily monitoring procedure. Each carcass will be checked once a day for seven days to determine scavenger removal rates. At the end of the seven-day trial, the carcasses that remain on the plot will be removed.

4.6.3.3 Data Analysis

Carcass removal rate will be expressed as the average length of time a carcass remains at the site before it is removed. The analyses will be used to evaluate effectiveness of the carcass searching effort and to estimate the number of carcasses missed because they are removed by scavengers before they can be located by search crews.

4.6.4 Estimation of Searcher Efficiency

4.6.4.1 Objective

The objective of the searcher efficiency trials is to estimate the percentage of avian mortalities found by searchers to evaluate searcher efficiency.

4.6.4.2 Methods

Foote Creek Rim and the Simpson Ridge areas will be used for searcher efficiency studies. For each area, searcher efficiency trials will begin when a string of wind turbines is complete. The size of the plot will be determined by the size of the area which is being searched for casualties.

Once each season, 20 carcasses of birds of two size classes [10 small passerines (e.g., house sparrow) and 10 medium-sized raptors (e.g., red-tailed hawk)] will be randomly placed

within the study area by personnel not involved in the carcass searches. In order to avoid increased scavenger rates and better mimic the likely number of carcasses expected at a given time, the trial will take place over a four-week period. Each week, five carcasses (alternating two and three per week from each size class) will be placed within the search area. Personnel conducting the searches will not know the location of the detectability carcasses. All carcasses will be placed at random locations within the areas being searched for avian mortality prior to the carcass search on the same day. Each carcass will be discreetly marked with tape around the leg so that it can be identified as a detectability carcass after it is found. The number and location of the detectability carcasses found during the carcass search will be recorded and the carcasses removed when they are found. Following the carcass search on the same day, the unrecovered carcasses will be picked up by personnel who are not involved in the carcass search and who know their location.

4.6.4.3 Data Analysis

Searcher effectiveness will be expressed as the average percentage of carcasses found by searchers. The analyses will be used to evaluate effectiveness of the carcass-searching effort.

5.0 DATA COMPILATION AND STORAGE

A database will be established to store, retrieve, and organize field observations. Data from field forms will be keyed into electronic data files using a pre-defined format that will make subsequent data analysis straightforward. All field data forms, field notebooks, and electronic data files will be retained for ready reference.

6.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

QA/QC measures will be implemented at all stages of the study, including field data collection, data entry, and data analysis and report preparation. At the end of each survey day, each observer will be responsible for inspecting his or her data forms for completeness, accuracy, and legibility. At least weekly, the study team leader will review data forms to insure completeness and legibility, and any problems detected will be corrected. Any changes made to the data forms will be initialed by the person making the change.

Data will be double-entered into electronic files by two different technicians. These two files will be compared and any errors detected will be corrected by referencing the raw data forms and/or consultation with the observer(s) who collected the data. Any irregular codes detected, or any unclear or ambiguous data will be discussed with the observer and study team leader. All changes made to the raw data must be documented for future reference.

After the data have been double-keyed and verified, the study team leader or QA/QC technician will check a 5% sample of data forms against the final computer file.

Any problem data identified in later stages of analysis will be traced back to the raw data forms, and appropriate changes in all steps will be made.

7.0 DATA ANALYSIS

Some analysis procedures specific to a given study have been presented within the section describing the study. The following is a general description of the statistical tests which will be used for exploratory analysis of many variables and for making statistical comparisons among study areas and between pre- and post-construction data within study areas.

For all parameters, data will be plotted by survey date for the Foote Creek Rim and Simpson Ridge areas and the permanent reference area. For many of the parameters estimated (e.g., avian species use, breeding pair density, etc.), statistical comparisons will be made (1) between the Foote Creek Rim and Simpson Ridge areas, and the permanent reference area (both pre- and post-construction) and (2) between data collected pre- and post-construction within the study areas, using randomization tests (Manly 1991) and the computer package RT (Manly 1991). Significance levels (i.e., p-values) will be reported, and those below $\alpha=0.10$ (one-tailed) will be judged as significant.

For all tests of hypotheses, the power (probability of concluding a difference between two study areas) will be calculated for various effect sizes based on baseline studies and initial data collected during monitoring, as soon as data allow for estimates of variance. The power of the test to detect an effect is a function of the sample size, the size of the test (α), estimates of variance, and the magnitude of the effect. For variables measured as proportions (e.g., reproductive success), power can be calculated using the large sample normal theory. For example, with 20 active nests on the reference and development area, $\alpha=0.05$ (one-tailed), and with a reference reproductive success rate of 90%, the power to detect a 40% decline relative to the reference is about 75%. Under these conditions the power to detect a 50% decline is 85%. With a reference reproductive success rate of 80%, the power to detect a 40% decline is 50%, and the power to detect a 50% decline is 75%. With a reference reproductive success rate of 70%, the power to detect a 40% decline is 45%, and the power to detect a 50% decline is 65%. With a reference reproductive success rate of 60%, the power to detect a 40% decline is 35%, and the power to detect a 50%

decline is 48%. By increasing the significance level α, or the Type I error rate (i.e., concluding an effect exists when, in fact, there is no effect), power increases. For example, with $\alpha = 0.10$, and with a reference reproductive success rate of 80%, the power to detect a 40% decline is 70%, and the power to detect a 50% decline is 86%.

8.0 DISPOSITION OF DATA

This monitoring program will provide data to the U.S. Department of the Interior BLM for their use in evaluating the initial phase of development and subsequent developments. Cooperating agencies will be provided copies of the annual reports by December 31 each year. Nest locations, nest status, and other raw data will be provided to cooperating agencies upon request. USFWS will also be notified immediately in the event that any individual of an endangered or threatened species is taken.

A technical committee made up of experts from the cooperating agencies and KENETECH representatives will be established to meet and discuss the results of the monitoring studies and evaluate methodology. The need for further study will be based on reasonable criteria proposed by the technical committee. The decision to conduct more detailed study will be based on reasonable criteria proposed by the technical committee and confirmed by the BLM in consultation with the cooperating agencies and KENETECH. The technical committee will meet annually during the month of January and at other times, based on need.

9.0 SUMMARY

Wildlife use of the Foote Creek Rim area will be monitored relative to the reference area(s) for the baseline year and several years after construction. Additional surveys of wildlife use will be conducted as new areas are brought on line with wind turbines. The nesting territories for raptor species of special interest within suitable habitat surrounding the turbine strings will be monitored for occupancy and success. Seasonal distribution and habitat use of big game will be monitored to evaluate the effects of wind turbines on these populations. Project effects on sage grouse populations will be evaluated through lek and use surveys. Raptor prey densities (lagomorph, prairie dogs, ground squirrels) will be monitored to aid in explaining variation in raptor use and nest parameters due to prey population fluctuations. Upon project start-up, the area surrounding each turbine string and associated power lines will be monitored for carcasses resulting from collisions with turbines and associated structures.

The need to monitor a specific development site beyond the initial period (e.g., three to five years post-construction) will be determined based on an evaluation of the results of the monitoring studies. Additional studies or adjustments in the protocols may be made within the baseline period.

10.0 LITERATURE CITED

Biggins, D., B. Miller, L. Hanebury, B. Oakleaf, A. Farmer, R. Crete, and A. Dood. 1992. A system for evaluating black-footed ferret habitat. U.S. Fish and Wildlife Service, National Ecology Research Center.

Buckland, S.T., D.R. Anderson, K.P. Burnham, and J.L. Laake. 1993. Distance Sampling: Estimating Abundance of Biological Populations. Chapman and Hall. New York. 446 pp.

Graul, W.D. 1975. Breeding biology of the mountain plover. Wilson Bulletin 87:6-31.

_____. 1976. Breeding status of the mountain plover. Condor 78:265-267.

Green, R. H. 1979. Sampling Design and Statistical Methods for Environmental Biologists. Wiley, New York.

Laake, J.L., S.T. Buckland, D.R. Anderson, and K.P. Burnham. 1993. DISTANCE User's Guide. Version 2.0. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins. 72 pp.

Manly, B.F.J. 1991. Randomization and Monte Carlo Methods in Biology. Chapman and Hall. New York. 281 pp.

_____, B.F., L.L. McDonald, and D.L. Thomas. 1993. Resource Selection by Animals: Statistical Design and Analysis for Field Studies. Chapman and Hall. New York, New York. 177 pp.

Milliken, G.A. and D. E. Johnson. 1984. Analysis of Messy Data. Volume I: Designed Experiments. Van Nostrand-Reinhold. New York. 472 pp.

McDonald, L.L., M.A. Mullen and D.P. Young. 1993. Analysis of data collected for an evaluation of the effects of timber-wildlife management on nongame birds at the Ashland Wildlife Research Area. Prepared for the Department of Conservation, Fish and Wildlife Research Center, Columbia, Missouri. 89 pp.

Neff, D.J. 1968. The pellet-group count technique for big game trend, census, and distribution: A review. Journal of Wildlife Management 32(3):597-614.

Parrish, T.L. 1988. Mountain plover habitat selection in the Powder River Basin, Wyoming. M.S. Thesis. University of Wyoming, Laramie.

Pereira, J.M.C and R.M. Itami. 1991. GIS-based habitat modeling using logistic multiple regression: A study of the Mt. Graham red squirrel. Photogrammetric Engineering and Remote Sensing 57(11): 1475-1486.

Reynolds, R.T., J.M. Scott, R.A. Nussbaum. 1980. A variable circular-plot method for estimating bird numbers. Condor 82(3):309-313.

SAS Institute Inc. 1988. SAS/STAT User's Guide, Release 6.03 Edition. SAS Institute Inc. Cary, North Carolina. 1,028 pp.

Wyoming Game and Fish Department. 1982. Handbook of Biological Techniques. WGFD, Cheyenne, Wyoming.

ADDENDUM A:

DRAFT DATA SHEETS

RAPTOR OBSERVATION DATA SHEET PAGE___OF_____

DATE: _____ LOCATION (circle one): FCR SR REF STATION NO.: _____ OBSERVER: _____
SURVEY TYPE (circle one) 1. fixed point (40 min) 2. instantaneous count 3. incidental START TIME: _____ END TIME:_____
WEATHER: PRECIP:_____ CLOUD COVER:_____ TEMP:_____ WIND DIRECTION:_____ WIND SPEED:_____
GENERAL COMMENTS:_____

Obs. #	Time	Species	# of Ind.	Distance from Observer	Activity[1]	Behavior[2]	Flight Height[3]	Direction of Flight	Habitat Traversed	Notes

[1] Activity: P=perched, S=soaring, F=flapping, G=gliding O=other (specify).
[2] Behavior: C=courtship H=hunt A=aggressive interaction O=other (specify).
[3] Flight height: 1 = 0-8 m, 2 = 8-56 m, 3 > 56 m.

AVIAN SPECIES SURVEY DATA SHEET PAGE ___ OF ___

DATE:_____ LOCATION (circle one): FCR SR REF STATION NO.: _____ OBSERVER:_____
SURVEY TYPE (circle one) 1. fixed point (40 min) 2. instantaneous count 3. incidental START TIME: _____ END TIME:_____
WEATHER: PRECIP:_____ CLOUD COVER:_____ TEMP:_____
WIND DIRECTION:_____ WIND SPEED:_____
GENERAL COMMENTS:_____

Station Number	1st 5 min.[1]	Last 3 min.[2]	Species	# of ind.	Distance from observer	Activity[3]	Flight Height[4]	Direction of flight	Notes

[1] Record a check (√) for observations taken during the first five minutes of the eight minute period
[2] Record a check (√) for observations taken during the last three minutes of the eight minute period
[3] Activity: P=perched, S=soaring, F=flapping, G=gliding O=other (specify)
[4] Flight height: 1 = 0-8 m, 2 = 8-56 m, 3 > 56 m.

PELLET COUNT DATA SHEET

DATE:________________ LOCATION(circle one): FCR SR PAGE ______ OF ______
OBSERVER:____________ START TIME:______________ END TIME:______________

WEATHER: PRECIP:__________ CLOUD COVER:__________ TEMP:______________
WIND DIRECTION:____________ WIND SPEED:______________
GENERAL COMMENTS:____
____

Transect Number	Plot Number	Species	Number of Pellet Groups	Notes

SAGE GROUSE LEK SURVEY DATA SHEET PAGE ___ OF ___

DATE:________________ LOCATION(circle one): FCR SR
OBSERVER:____________ START TIME:_________ END TIME:_________
SURVEY TYPE (circle one) Aerial Ground Incidental
WEATHER: PRECIP:__________ CLOUD COVER:___________ TEMP:___________
WIND DIRECTION:___________ WIND SPEED:_____________
GENERAL COMMENTS:____

Lek Identification	Time	Number of males	Number of females	Notes

LAGOMORPH TREND COUNT DATA SHEET

DATE:________________ LOCATION(circle one): FCR SR REF PAGE ___ OF ___
OBSERVER:________________ START TIME:______________ END TIME:______________
WEATHER: PRECIP:__________ CLOUD COVER:__________ TEMP:__________
WIND DIRECTION:__________ WIND SPEED:__________
GENERAL COMMENTS:____

Mile Point	Time	Species	Number of Individuals	Notes

PRAIRIE DOG TRANSECT COUNT DATA SHEET

DATE:_______________ LOCATION(circle one): FCR SR REF PAGE ___ OF ___
OBSERVER:_____________ START TIME:_________ END TIME:_________
WEATHER: PRECIP:__________ CLOUD COVER:__________ TEMP:_________
WIND DIRECTION:__________ WIND SPEED:__________
GENERAL COMMENTS:____

Prairie Dog Town Identification	Transect Number	Number of Active Burrows	Length of Transect	Notes

GROUND SQUIRREL BURROW COUNT DATA SHEET

DATE:________________ LOCATION(circle one): FCR SR REF PAGE ___ OF ___
OBSERVER:____________ START TIME:_________ END TIME:________
WEATHER: PRECIP:_________ CLOUD COVER:_________ TEMP:_________
WIND DIRECTION:_________ WIND SPEED:__________
GENERAL COMMENTS:____
____

Transect Number	Plot Number	Species	Number of Active Burrows	Notes

GROUND SQUIRREL TREND COUNT DATA SHEET

DATE:________________ LOCATION(circle one): FCR SR REF PAGE ___ OF ___
OBSERVER:____________ START TIME:_________ END TIME:_________
WEATHER: PRECIP:__________ CLOUD COVER:__________ TEMP:__________
WIND DIRECTION:__________ WIND SPEED:__________
GENERAL COMMENTS:____

Route Id.	Mile Segment	Species	Number of Live Ind.	Number of Road Kills	Selected Point	L or R Side	Presence of Active Burrows (Yes/No)	Notes

CARCASS SEARCH DATA SHEET

DATE:_____ PAGE ___ OF ___

LOCATION(circle one): FCR SR

OBSERVER:_____

WEATHER: PRECIP:_____ CLOUD COVER:_____ TEMP:_____
WIND DIRECTION:_____ WIND SPEED:_____

GENERAL COMMENTS:_____
_____
_____

Search Location: _____

Search Begin Time: _____

Search End Time: _____

Number of Casualties Found: _____

Number of Detectabilities Found: _____

CASUALTY INFORMATION DATA SHEET

DATE: _____ PAGE ___ OF ___

LOCATION(circle one): FCR SR REF

OBSERVER: _____

WEATHER: PRECIP:_____ CLOUD COVER:_____ TEMP:_____
WIND DIRECTION:_____ WIND SPEED:_____

GENERAL COMMENTS:_____

Species:_____

Sex (if known): _____ Age (if known): _____

Time Collected: _____

Location Collected (provide details of location): _____

Condition of Casualty (provide details): _____

Comments (cause of death, evidence of scavenging, etc.): _____

Photograph(s) number: _____

Freezer where stored: _____

Date Stored in Freezer: _____ Time Stored in Freezer: _____

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

RAPTOR INVENTORY DATA SHEET

Observer: _____ Nest Number: _____

Date of Observ.: _____ Species: _____

Land Ownership P S BLM T.____R.____Sec.____¼____¼____

Description of Nest Site: Latitude: _____

Nest Substrate: _____ Longitude: _____

Height of Substrate: _____ UTM_____/_____/_____

Nest Ht. Above Ground: _____ Remarks, Physical Relationship to Other Nests:

Exposure: _____ _____

Elevation: _____ _____

Vegetative Type: _____ _____

Condition of Nest: _____ _____

Location of slide/photo: _____ _____

_____ _____

Quad Name: _____

Record Nest Activity on Reverse Side:

MAP

NEST HISTORY

NEST NUMBER: _____

YEAR	DATE	STATUS	CONDITION	EGGS	YOUNG	REMARKS

APPENDIX C:

PLANT SPECIES LIST

Plant Species List

Common Name	Scientific Name
Trees	
Subalpine fir	*Abies lasiocarpa*
Rocky mountain maple	*Acer glabrum*
Englemann spruce	*Picea englemannii*
Ponderosa pine	*Pinus ponderosa*
Narrowleaf cottonwood	*P. angustifolia*
Eastern cottonwood	*P. deltoides*
Quaking aspen	*Populus tremuloides*
Douglas-fir	*Pseudotsuga menziesii* var. *glauca*
Shrubs	
Serviceberry	*Amelanchier* spp.
Silver sagebrush	*Artemisia cana*
Black sagebrush	*A. nova*
Birdfoot sagebrush	*A. pedatifida*
Bud sagebrush	*A. spinescens*
Big sagebrush	*A. tridentata*
Basin big sagebrush	*A. tridentata* var. *tridentata*
Wyoming big sagebrush	*A. tridentata* var. *wyomingensis*
Saltbush	*Atriplex* spp.
Gardner's saltbush	*A. gardneri*
Barberry	*Berberis thunbergii*
Mountain mahogany	*Cercocarpus montanus*
Rabbitbrush	*Chrysothamnus* spp.
Low rabbitbrush	*C. humilis*
Rubber rabbitbrush	*C. nauseosus*
Douglas rabbitbrush	*C. viscidiflorus*
Dogwood	*Cornus* sp.
Licorice	*Glycyrrhiza lepidota*

Plant Species List (Continued)

Common Name	Scientific Name
Common juniper	*Juniperus communis* var. *depressa*
Winterfat	*Krascheninnikovia lanata*
Oregon grape	*Mahonia repens*
Common chokecherry	*Prunus virginiana* var. *melanocarpa*
Antelope bitterbrush	*Purshia tridentata*
Ribes	*Ribes* spp.
Wood's rose	*Rosa woodsii*
Raspberry	*Rubus* sp.
Willow	*Salix* spp.
Elderberry	*Sambucus* sp.
Black greasewood	*Sarcobatus vermiculatus*
Snowberry	*Symphoriocarpus* spp.
Forbs	
Yarrow	*Achillea millefolium* var. *lanulosa*
Onion	*Allium* sp.
Pussy-toes	*Antennaria* sp.
Columbine	*Aquilegia* sp.
Arnica	*Arnica* sp.
Fringed sage	*Artemisia frigida*
Showy milkweed	*Asclepias speciosa*
Aster	*Aster* spp.
Milkvetch	*Astragalus* spp.
Bun milkvetch	*A. simplificifolius*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Indian paintbrush	*Castilleja* sp.
Canada thistle	*Cirsium arvense*
Hound's tongue	*Cynoglossum officinale*
Horsetail	*Equisetum* spp.

Plant Species List (Continued)

Common Name	Scientific Name
Buckwheat	*Eriogonum umbellatum*
Wintergreen	*Gaultheria humifusa*
Wild geranium	*Geranium* spp.
Curlycup gumweed	*Grindelia squarrosa*
Golden aster	*Heterotheca* sp.
Biscuitroot	*Lomatium* sp.
Lupine	*Lupinus* spp.
Stemmy goldenweed	*Oonopsis multicaulis*
Plains prickly pear	*Opuntia polyacantha* var. *polyacantha*
Beardtongue	*Penstemon* sp.
Phlox	*Phlox* spp.
Plantain	*Plantago* sp.
Bracken fern	*Pteridium aquilinum* var. *latiusculum*
Dock	*Rumex* spp.
Stonecrop	*Sedum* sp.
Ute lady's tresses	*Spiranthes diluvialis*
Sea blite	*Suaeda* sp.
Common dandelion	*Taraxicum officinale*
Mountain pea	*Thermopsis montana*
Red clover	*Trifolium pratense*
Cattail	*Typha* spp.
Vetch	*Vicia* spp.
Violet	*Viola* spp.
Woody aster	*Xylorhiza glabriuscula*
Grasses and graminoids	
Brome	*Bromus* spp.
Smooth brome	*B. inermis*
Sedges	*Carex* spp.

Plant Species List (Continued)

Common Name	Scientific Name
Spike rush	*Eleocharis* sp.
Wild rye	*Elymus* spp.
Bottlebrush squirreltail	*E. elymoides*
Thickspike wheatgrass	*E. lanceolatus*
Western wheatgrass	*E. smithii*
Bluebunch wheatgrass	*E. spicatus*
Idaho fescue	*Festuca idahoensis*
Foxtail barley	*Hordeum jubatum*
Rushes	*Juncus* spp.
Junegrass	*Koeleria* sp.
Contracted Indian ricegrass	*Oryzopsis contracta*
Indian ricegrass	*O. hymenoides*
Bluegrass	*Poa* spp.
Sandberg bluegrass	*P. secunda*
Timothy	*Phleum* sp.
Alkali sacaton	*Sporobolus airoides*
Needlegrass	*Stipa* spp.
Needle-and-thread grass	*S. comata*

APPENDIX D:

ANIMAL SPECIES LIST

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1]

Common Name	Scientific Name
Mammals[2]	
Masked shrew	*Sorex cinereus*
Dusky shrew	*S. monticolus*
Water shrew	*S. palustris*
Merriam's shrew	*S. merriami*
Little brown myotis	*Myotis lucifugus*
Long-legged myotis	*M. volans*
Silver-haired bat	*Lasionycteris noctivagans*
Big brown bat	*Eptesicus fuscus*
Hoary bat	*Lasiurus cinereus*
Mountain (Nuttall's) cottontail[3]	*Sylvilagus nuttallii*
Desert cottontail[3]	*S. audubonii*
White-tailed jackrabbit[3]	*Lepus townsendii*
Least chipmunk[3]	*Tamias minimus*
Yellow-bellied marmot	*Marmota flaviventris*
Wyoming ground squirrel[3]	*Spermophilus elegans*
Thirteen-lined ground squirrel[3]	*S. tridecemlineatus*
Golden-mantled ground squirrel	*S. lateralis*
White-tailed prairie dog[3]	*Cynomys leucurus*
Red squirrel	*Tamiasciurus hudsonicus*
Northern pocket gopher	*Thomomys talpoides*
Olive-backed pocket mouse	*Perognathus fasciatus*
Ord's kangaroo rat	*Dipodomys ordii*
Beaver[3]	*Castor canadensis*
Western harvest mouse	*Reithrodontomys megalotis*
Deer mouse	*Peromyscus maniculatus*
White-footed mouse	*P. leucopus*
Northern grasshopper mouse	*Onychomys leucogaster*
Bushy-tailed woodrat	*Neotoma cinerea*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Heather vole	*Phenacomys intermedius*
Montane vole	*Microtus montanus*
Long-tailed vole	*M. longicaudus*
Prairie vole	*M. ochrogaster*
Sagebrush vole	*Lemmiscus curtatus*
Muskrat[3]	*Ondatra zibethicus*
Western jumping mouse	*Zapus princeps*
Porcupine[3]	*Erethizon dorsatum*
Coyote[3]	*Canis latrans*
Red fox[3]	*Vulpes vulpes*
Swift fox	*V. velox*
Black bear	*Ursus americanus*
Raccoon	*Procyon lotor*
Ermine	*Mustela erminea*
Long-tailed weasel	*M. frenata*
Black-footed ferret	*M. nigripes*
Mink	*M. vison*
Badger[3]	*Taxidea taxus*
Western spotted skunk	*Spilogale gracilis*
Striped skunk[3]	*Mephitis mephitis*
Mountain lion	*Felis concolor*
Bobcat	*F. rufus*
Elk[3]	*Cervus elaphus*
Mule deer[3]	*Odocoileus hemionus*
White-tailed deer[3]	*O. virginianus*
Moose	*Alces alces*
Pronghorn[3]	*Antilocapra americana*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Birds[4]	
Common loon[3]	*Gavia immer*
Pied-billed grebe[3]	*Podilymbus podiceps*
Horned grebe	*Podiceps auritus*
Eared grebe	*P. nigricollis*
Western grebe	*Aechmophorus occidentalis*
Clark's grebe	*A. clarkii*
American white pelican[3]	*Pelecanus erythrorhynchos*
Double-crested cormorant[3]	*Phalacrocorax auritus*
American bittern	*Botaurus lentiginosus*
Great blue heron[3]	*Ardea herodias*
Snowy egret	*Egretta thula*
Cattle egret	*Bubulcus ibis*
Green-backed heron	*Butorides striatus*
Black-crowned night-heron	*Nycticorax nycticorax*
White-faced ibis[3]	*Plegadis chihi*
Tundra swan	*Cygnus columbianus*
Trumpeter swan	*C. buccinator*
Snow goose[3]	*Chen caerulescens*
Canada goose[3]	*Branta canadensis*
Wood duck	*Aix sponsa*
Green-winged teal[3]	*Anas crecca*
Mallard[3]	*A. platyrhynchos*
Northern pintail[3]	*A. acuta*
Blue-winged teal[3]	*A. discors*
Cinnamon teal[3]	*A. cyanoptera*
Northern shoveler[3]	*A. clypeata*
Gadwall[3]	*A. strepera*
American wigeon[3]	*A. americana*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Canvasback[3]	*Aythya valisineria*
Redhead[3]	*A. americana*
Ring-necked duck[3]	*A. collaris*
Lesser scaup[3]	*A. affinis*
Common goldeneye	*Bucephala clangula*
Bufflehead[3]	*B. albeola*
Hooded merganser	*Lophodytes cucullatus*
Common merganser[3]	*Mergus merganser*
Red-breasted merganser	*M. serrator*
Ruddy duck	*Oxyura jamaicensis*
Turkey vulture[3]	*Cathartes aura*
Osprey[3]	*Pandion haliaetus*
Bald eagle[3]	*Haliaeetus leucocephalus*
Northern harrier[3]	*Circus cyaneus*
Sharp-shinned hawk[3]	*Accipiter striatus*
Cooper's hawk	*A. cooperii*
Northern goshawk[3]	*A. gentilis*
Broad-winged hawk[3]	*Buteo platypterus*
Swainson's hawk[3]	*B. swainsoni*
Red-tailed hawk[3]	*B. jamaicensis*
Ferruginous hawk[3]	*B. regalis*
Rough-legged hawk[3]	*B. lagopus*
Golden eagle[3]	*Aquila chrysaetos*
American kestrel[3]	*Falco sparverius*
Merlin[3]	*F. columbarius*
Peregrine falcon[3]	*F. peregrinus*
Prairie falcon[3]	*F. mexicanus*
Blue grouse[3]	*Dendragapus obscurus*
Sage grouse[3]	*Centrocercus urophasianus*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Wild turkey	*Meleagris gallopavo*
Virginia rail[3]	*Rallus limicola*
Sora	*Porzana carolina*
American coot[3]	*Fulica americana*
Sandhill crane[3]	*Grus canadensis*
Whooping crane	*G. americana*
Black-bellied plover	*Pluvialis squatarola*
Lesser golden plover	*P. dominica*
Western snowy plover	*Charadrius alexandrinus nivosus*
Semipalmated plover[3]	*C. semipalmatus*
Killdeer[3]	*C. vociferus*
Mountain plover[3]	*C. montanus*
Black-necked stilt	*Himantopus mexicanus*
American avocet[3]	*Recurvirostra americana*
Greater yellowlegs[3]	*Tringa melanoleuca*
Lesser yellowlegs	*T. flavipes*
Solitary sandpiper	*T. solitaria*
Willet	*Catoptrophorus semipalmatus*
Spotted sandpiper[3]	*Actitus macularia*
Upland sandpiper[3]	*Bartramia longicauda*
Long-billed curlew	*Numenius americanus*
Marbled godwit	*Limosa fedoa*
Sanderling	*Calidris alba*
Semipalmated sandpiper	*C. pusilla*
Western sandpiper	*C. mauri*
Least sandpiper	*C. minutilla*
Baird's sandpiper	*C. bairdii*
Pectoral sandpiper	*C. melanotos*
Stilt sandpiper	*C. himantopus*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Long-billed dowitcher[3]	*Limnodromus scolopaceus*
Common snipe[3]	*Gallinago gallinago*
Wilson's phalarope[3]	*Phalaropus tricolor*
Red-necked phalarope	*P. lobatus*
Franklin's gull[3]	*Larus pipixcan*
Bonaparte's gull	*L. philadelphia*
Ring-billed gull	*L. delawarensis*
California gull[3]	*L. californicus*
Herring gull	*L. argentatus*
Caspian tern[3]	*Sterna caspia*
Forster's tern	*S. forsteri*
Black tern	*Chlidonias niger*
Rock dove[3]	*Columba livia*
Mourning dove[3]	*Zenaida macroura*
Black-billed cuckoo	*Coccyzus erythropthalmus*
Barn owl	*Tyto alba*
Eastern screech owl	*Otus asio*
Great horned owl[3]	*Bubo virginianus*
Western burrowing owl	*Athene cunicularia hypugea*
Long-eared owl	*Asio otus*
Short-eared owl[3]	*A. flammeus*
Northern saw-whet owl[3]	*Aegolius acadicus*
Common nighthawk[3]	*Chordeiles minor*
Common poorwill	*Phalaenoptilus nuttallii*
White-throated swift	*Aeronautes saxatalis*
Broad-tailed hummingbird[3]	*Selasphorus platycercus*
Rufous hummingbird	*S. rufus*
Belted kingfisher[3]	*Ceryle alcyon*
Lewis' woodpecker	*Melanerpes lewis*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Red-headed woodpecker[3]	*Melanerpes erythrocephalus*
Red-naped sapsucker	*Sphyrapicus nuchalis*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker[3]	*P. villosus*
Northern flicker[3]	*Colaptes auratus*
Olive-sided flycatcher[3]	*Contopus borealis*
Western wood-pewee[3]	*C. sordidulus*
Willow flycatcher[3]	*Empidonax traillii*
Least flycatcher[3]	*E. minimus*
Hammond's flycatcher[3]	*E. hammondii*
Dusky flycatcher[3]	*E. oberholseri*
Cordilleran flycatcher	*E. occidentalis*
Say's phoebe[3]	*Sayornis saya*
Ash-throated flycatcher	*Myiarchus cinerascens*
Western kingbird[3]	*Tyrannus verticalis*
Eastern kingbird[3]	*T. tyrannus*
Horned lark[3]	*Eremophila alpestris*
Purple martin[3]	*Progne subis*
Tree swallow[3]	*Tachycineta bicolor*
Violet-green swallow[3]	*T. thalassina*
Northern rough-winged swallow[3]	*Stelgidopteryx serripennis*
Bank swallow	*Riparia riparia*
Cliff swallow[3]	*Hirundo pyrrhonota*
Barn swallow[3]	*H. rustica*
Gray jay[3]	*Perisoreus canadensis*
Steller's jay	*Cyanocitta stelleri*
Blue jay	*C. cristata*
Scrub jay	*Aphelocoma coerulescens*
Pinyon jay[3]	*Gymnorhinus cyanocephalus*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Clark's nutcracker[3]	*Nucifraga columbiana*
Black-billed magpie[3]	*Pica pica*
American crow[3]	*Corvus brachyrhynchos*
Common raven[3]	*C. corax*
Black-capped chickadee[3]	*Parus atricapillus*
Mountain chickadee[3]	*P. gambeli*
Chestnut-backed chickadee[3]	*P. rufescens*
Plain titmouse[3]	*P. inornatus*
Bushtit	*Psaltriparus minimus*
Red-breasted nuthatch[3]	*Sitta canadensis*
White-breasted nuthatch[3]	*S. carolinensis*
Pygmy nuthatch	*S. pygmaea*
Brown creeper	*Certhia americana*
Rock wren[3]	*Salpinctes obsoletus*
Canyon wren	*Catherpes mexicanus*
Bewick's wren	*Thryomanes bewickii*
House wren[3]	*Troglodytes aedon*
Marsh wren	*Cistothorus palustris*
American dipper	*Cinclus mexicanus*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet[3]	*R. calendula*
Blue-gray gnatcatcher[3]	*Polioptila caerulea*
Eastern bluebird[3]	*Sialia sialis*
Western bluebird	*S. mexicana*
Mountain bluebird[3]	*S. currucoides*
Townsend's solitaire[3]	*Myadestes townsendi*
Veery[3]	*Catharus fuscescens*
Swainson's thrush	*C. ustulatus*
Hermit thrush[3]	*C. guttatus*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
American robin[3]	*Turdus migratorius*
Gray catbird	*Dumetella carolinensis*
Northern mockingbird	*Mimus polyglottos*
Sage thrasher[3]	*Oreoscoptes montanus*
Brown thrasher	*Toxostoma rufum*
American pipit[3]	*Anthus rubescens*
Bohemian waxwing	*Bombycilla garrulus*
Cedar waxwing[3]	*B. cedrorum*
Northern shrike[3]	*Lanius excubitor*
Loggerhead shrike[3]	*L. ludovicianus*
European starling[3]	*Sturnus vulgaris*
Solitary vireo	*Vireo solitarius*
Warbling vireo	*V. gilvus*
Red-eyed vireo[3]	*V. olivaceus*
Tennessee warbler	*Vermivora peregrina*
Orange-crowned warbler[3]	*V. celata*
Virginia's warbler[3]	*V. virginiae*
Yellow warbler[3]	*Dendroica petechia*
Yellow-rumped warbler[3]	*D. coronata*
Black-throated gray warbler	*D. nigrescens*
Townsend's warbler[3]	*D. townsendi*
Blackpoll warbler	*D. striata*
Black-and-white warbler	*Mniotilta varia*
American redstart	*Setophaga ruticilla*
Ovenbird	*Seiurus aurocapillus*
Northern waterthrush	*S. noveboracensis*
MacGillivray's warbler[3]	*Oporornis tolmiei*
Common yellowthroat	*Geothlypis trichas*
Wilson's warbler[3]	*Wilsonia pusilla*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Yellow-breasted chat	*Icteria virens*
Western tanager[3]	*Piranga ludoviciana*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Black-headed grosbeak[3]	*P. melanocephalus*
Blue grosbeak[3]	*Guiraca caerulea*
Lazuli bunting[3]	*Passerina amoena*
Indigo bunting	*P. cyanea*
Dickcissel	*Spiza americana*
Green-tailed towhee[3]	*Pipilo chlorurus*
Rufous-sided towhee[3]	*P. erythrophthalmus*
Cassin's sparrow[3]	*Aimophila cassinii*
American tree sparrow[3]	*Spizella arborea*
Chipping sparrow[3]	*S. passerina*
Clay-colored sparrow[3]	*S. pallida*
Brewer's sparrow[3]	*S. breweri*
Vesper sparrow[3]	*Pooecetes gramineus*
Lark sparrow[3]	*Chondestes grammacus*
Black-throated sparrow	*Amphispiza bilineata*
Sage sparrow[3]	*A. belli*
Lark bunting[3]	*Calamospiza melanocorys*
Savannah sparrow[3]	*Passerculus sandwichensis*
Baird's sparrow	*Ammodramus bairdii*
Grasshopper sparrow	*A. savannarum*
Fox sparrow	*Passerella iliaca*
Song sparrow[3]	*Melospiza melodia*
Lincoln's sparrow	*M. lincolnii*
White-throated sparrow[3]	*Zonotrichia albicollis*
White-crowned sparrow[3]	*Z. leucophrys*
Dark-eyed junco[3]	*Junco hyemalis*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
McCown's longspur[3]	*Calcarius mccownii*
Lapland longspur	*C. lapponicus*
Chestnut-collared longspur	*C. ornatus*
Snow bunting	*Plectrophenax nivalis*
Bobolink[3]	*Dolichonyx oryzivorus*
Red-winged blackbird[3]	*Agelaius phoeniceus*
Western meadowlark[3]	*Sturnella neglecta*
Yellow-headed blackbird[3]	*Xanthocephalus xanthocephalus*
Rusty blackbird	*Euphagus carolinus*
Brewer's blackbird[3]	*E. cyanocephalus*
Common grackle[3]	*Quiscalus quiscula*
Brown-headed cowbird[3]	*Molothrus ater*
Orchard oriole[3]	*Icterus spurius*
Northern oriole[3]	*I. galbula*
Rosy finch[3]	*Leucosticte arctoa*
Pine grosbeak	*Pinicola enucleator*
Purple finch[3]	*Carpodacus purpureus*
Cassin's finch[3]	*C. cassinii*
House finch[3]	*C. mexicanus*
Red crossbill	*Loxia curvirostra*
Common redpoll	*Carduelis flammea*
Pine siskin[3]	*C. pinus*
Lesser goldfinch	*C. psaltria*
American goldfinch[3]	*C. tristis*
Evening grosbeak	*Coccothraustes vespertinus*
House sparrow[3]	*Passer domesticus*

Animal Species Known to Occur or Potentially Occurring Within the KPPA[1] (Continued)

Common Name	Scientific Name
Amphibians and Reptiles[5]	
Tiger salamander	*Ambystoma tigrinum*
Wyoming toad	*Bufo hemiophrys baxteri*
Leopard frog	*Rana pipiens*
Chorus frog	*Pseudacris triseriata*
Sagebrush lizard	*Sceloporus graciosus*
Easten short-horned lizard[3]	*Phrynosoma douglassi brevirostre*
Western terrestrial garter snake	*Thamnophis elegans*
Fish[6]	
Common carp	*Cyprinus carpio*
Emerald shiner	*Notropis atherinoides*
Sand shiner	*N. stramineus*
Longnose dace	*Rhinichthys cataractae*
Creek chub	*Semotilus atromaculatus*
Longnose sucker	*Catostomus catostomus*
White sucker	*C. commersoni*
Cutthroat trout (Yellowstone subspecies)	*Oncorhynchus clarki*
Rainbow trout	*O. mykiss*
Brown trout[3]	*Salmo trutta*
Brook trout[3]	*Salvelinus fontinalis*
Johnny darter	*Etheostoma nigrum*
Walleye	*Stizostedion vitreum*

1 Based on range, habitat characteristics, and actual field observations.
2 Adapted from Clark and Stromberg (1987), WGFD (1992), and Mariah (1994a).
3 Species observed within or immediately adjacent to the KPPA during field surveys in 1994.
4 Adapted from Scott (1987), Russell (1990), WGFD (1992), and Mariah (1994a).
5 Adapted from Stebbins (1966), Baxter and Stone (1985), and Smith and Brodie (1982).
6 Adapted from Baxter and Simon (1970), Oberholtzer (1985), and American Fisheries Society (1991).

APPENDIX E:
SOCIOECONOMIC DATA

Table E1 Trades Utilized in Construction and Operation of the Windplant, 1995-2034.

Job Classification	Number of Employees 1995 Quarters				Number of Employees 1996 Quarters				Number of Employees 1997 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	7	7	0	0	5	5	0	0	5	5	0
Cement finisher	0	2	2	0	0	1	1	0	0	1	1	0
Cement, rebar	0	3	3	0	0	2	2	0	0	2	2	0
Electrician, helper	0	18	18	0	0	12	12	0	0	12	12	0
Electrician, industrial	0	12	12	0	0	8	8	0	0	8	8	0
Electrician, master	0	2	2	0	0	1	1	0	0	1	1	0
Laborer	0	42	42	0	0	30	30	0	0	30	30	0
Structural steel worker	0	18	18	0	0	12	12	0	0	12	12	0
Backhoe operator	0	3	3	0	0	2	2	0	0	2	2	0
Cherry picker operator	0	8	8	0	0	6	6	0	0	6	6	0
Cable crane operator	0	5	5	0	0	4	4	0	0	4	4	0
Dozer operator	0	2	2	0	0	1	1	0	0	1	1	0
Power shovel operator	0	2	2	0	0	1	1	0	0	1	1	0
Road roller operator	0	2	2	0	0	1	1	0	0	1	1	0
Transmission line												
Foreman	0	7	7	0	–	–	–	–	–	–	–	–
Lineman	0	8	8	0	–	–	–	–	–	–	–	–
Equipment operator	0	7	7	1	–	–	–	–	–	–	–	–
Laborer	0	4	4	0	–	–	–	–	–	–	–	–
Wireman	0	9	9	0	–	–	–	–	–	–	–	–
Total Construction Workers	0	161	161	1	0	86	86	0	0	86	86	0
O&M												
Windsmith	9	9	9	9	11	11	11	11	13	13	13	13
Grand Total	9	170	170	10	11	97	97	11	13	99	99	13

Table E1 (Continued)

Job Classification	Number of Employees 1998 Quarters				Number of Employees 1999 Quarters				Number of Employees 2000 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	5	5	0	0	5	5	0	0	5	5	0
Cement finisher	0	1	1	0	0	1	1	0	0	1	1	0
Cement, rebar	0	2	2	0	0	2	2	0	0	2	2	0
Electrician, helper	0	12	12	0	0	12	12	0	0	12	12	0
Electrician, industrial	0	8	8	0	0	8	8	0	0	8	8	0
Electrician, master	0	1	1	0	0	1	1	0	0	1	1	0
Laborer	0	30	30	0	0	30	30	0	0	30	30	0
Structural steel worker	0	12	12	0	0	12	12	0	0	12	12	0
Backhoe operator	0	2	2	0	0	2	2	0	0	2	2	0
Cherry picker operator	0	6	6	0	0	6	6	0	0	6	6	0
Cable crane operator	0	4	4	0	0	4	4	0	0	4	4	0
Dozer operator	0	1	1	0	0	1	1	0	0	1	1	0
Power shovel operator	0	1	1	0	0	1	1	0	0	1	1	0
Road roller operator	0	1	1	0	0	1	1	0	0	1	1	0
Transmission line												
Foreman	–	–	–	–	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–	–	–	–	–
Total Construction Workers	0	86	86	0	0	86	86	0	0	86	86	0
O&M												
Windsmith	15	15	15	15	17	17	17	17	20	20	20	20
Grand Total	15	101	101	15	17	103	103	17	20	106	106	20

Table E1 (Continued)

Job Classification	Number of Employees 2001 Quarters				Number of Employees 2002 Quarters				Number of Employees 2003 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	5	5	0	0	5	5	0	0	5	5	0
Cement finisher	0	1	1	0	0	1	1	0	0	1	1	0
Cement, rebar	0	2	2	0	0	2	2	0	0	2	2	0
Electrician, helper	0	12	12	0	0	12	12	0	0	12	12	0
Electrician, industrial	0	8	8	0	0	8	8	0	0	8	8	0
Electrician, master	0	1	1	0	0	1	1	0	0	1	1	0
Laborer	0	30	30	0	0	30	30	0	0	30	30	0
Structural steel worker	0	12	12	0	0	12	12	0	0	12	12	0
Backhoe operator	0	2	2	0	0	2	2	0	0	2	2	0
Cherry picker operator	0	6	6	0	0	6	6	0	0	6	6	0
Cable crane operator	0	4	4	0	0	4	4	0	0	4	4	0
Dozer operator	0	1	1	0	0	1	1	0	0	1	1	0
Power shovel operator	0	1	1	0	0	1	1	0	0	1	1	0
Road roller operator	0	1	1	0	0	1	1	0	0	1	1	0
Transmission line												
Foreman	–	–	–	–	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–	–	–	–	–
Total Construction Workers	0	86	86	0	0	86	86	0	0	86	86	0
O&M												
Windsmith	22	22	22	22	25	25	25	25	27	27	27	27
Grand Total	22	108	108	22	25	111	111	25	27	113	113	27

Table E1 (Continued)

Job Classification	Number of Employees 2004 Quarters				Number of Employees 2005-2034 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION								
Windplant								
Carpenter/form setter	0	5	5	0	–	–	–	–
Cement finisher	0	1	1	0	–	–	–	–
Cement, rebar	0	2	2	0	–	–	–	–
Electrician, helper	0	12	12	0	–	–	–	–
Electrician, industrial	0	8	8	0	–	–	–	–
Electrician, master	0	1	1	0	–	–	–	–
Laborer	0	30	30	0	–	–	–	–
Structural steel worker	0	12	12	0	–	–	–	–
Backhoe operator	0	2	2	0	–	–	–	–
Cherry picker operator	0	6	6	0	–	–	–	–
Cable crane operator	0	4	4	0	–	–	–	–
Dozer operator	0	1	1	0	–	–	–	–
Power shovel operator	0	1	1	0	–	–	–	–
Road roller operator	0	1	1	0	–	–	–	–
Transmission line								
Foreman	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–
Total Construction Workers	0	86	86	0	–	–	–	–
O&M								
Windsmith	29	29	29	29	29	29	29	29
Grand Total	29	115	115	29	29	29	29	29

Table E2 Locally Hired Windplant Employees, Projections 1995-2034.[1]

Job Classification	Number of Employees 1995 Quarters				Number of Employees 1996 Quarters				Number of Employees 1997 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	6	6	0	0	4	4	0	0	4	4	0
Cement finisher	0	2	2	0	0	1	1	0	0	1	1	0
Cement, rebar	0	3	3	0	0	2	2	0	0	2	2	0
Electrician, helper	0	16	16	0	0	11	11	0	0	11	11	0
Electrician, industrial	0	6	6	0	0	6	6	0	0	6	6	0
Electrician, master	0	2	2	0	0	1	1	0	0	1	1	0
Laborer	0	38	38	0	0	27	27	0	0	27	27	0
Structural steel worker	0	14	14	0	0	11	11	0	0	11	11	0
Backhoe operator	0	3	3	0	0	2	2	0	0	2	2	0
Cherry picker operator	0	2	2	0	0	2	2	0	0	2	2	0
Cable crane operator	0	4	4	0	0	4	4	0	0	4	4	0
Dozer operator	0	2	2	0	0	1	1	0	0	1	1	0
Power shovel operator	0	2	2	0	0	1	1	0	0	1	1	0
Road roller operator	0	2	2	0	0	1	1	0	0	1	1	0
Transmission line												
Foreman	0	1	1	0	–	–	–	–	–	–	–	–
Lineman	0	1	1	0	–	–	–	–	–	–	–	–
Equipment operator	0	6	6	1	–	–	–	–	–	–	–	–
Laborer	0	4	4	0	–	–	–	–	–	–	–	–
Wireman	0	1	1	0	–	–	–	–	–	–	–	–
Total Construction Workers	0	115	115	1	0	74	74	0	0	74	74	0
O&M												
Windsmith	8	8	8	9	10	10	10	10	12	12	12	12
Grand Total	8	123	123	10	10	84	84	10	12	86	86	12

[1] Locally hired Windplant employees are those employees who were residents of Carbon or Albany County during the previous year. Projections based on assumed 90% use of available local labor force.

Table E2 (Continued)

Job Classification	Number of Employees 1998 Quarters				Number of Employees 1999 Quarters				Number of Employees 2000 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	4	4	0	0	4	4	0	0	4	4	0
Cement finisher	0	1	1	0	0	1	1	0	0	1	1	0
Cement, rebar	0	2	2	0	0	2	2	0	0	2	2	0
Electrician, helper	0	11	11	0	0	11	11	0	0	11	11	0
Electrician, industrial	0	6	6	0	0	6	6	0	0	6	6	0
Electrician, master	0	1	1	0	0	1	1	0	0	1	1	0
Laborer	0	27	27	0	0	27	27	0	0	27	27	0
Structural steel worker	0	11	11	0	0	11	11	0	0	11	11	0
Backhoe operator	0	2	2	0	0	2	2	0	0	2	2	0
Cherry picker operator	0	2	2	0	0	2	2	0	0	2	2	0
Cable crane operator	0	4	4	0	0	4	4	0	0	4	4	0
Dozer operator	0	1	1	0	0	1	1	0	0	1	1	0
Power shovel operator	0	1	1	0	0	1	1	0	0	1	1	0
Road roller operator	0	1	1	0	0	1	1	0	0	1	1	0
Transmission line												
Foreman	–	–	–	–	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–	–	–	–	–
Total Construction Workers	0	74	74	0	0	74	74	0	0	74	74	0
O&M												
Windsmith	14	14	14	14	15	15	15	15	18	18	18	18
Grand Total	14	88	88	14	15	89	89	15	18	92	92	18

Table E2 (Continued)

Job Classification	Number of Employees 2001 Quarters				Number of Employees 2002 Quarters				Number of Employees 2003 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	4	4	0	0	4	4	0	0	4	4	0
Cement finisher	0	1	1	0	0	1	1	0	0	1	1	0
Cement, rebar	0	2	2	0	0	2	2	0	0	2	2	0
Electrician, helper	0	11	11	0	0	11	11	0	0	11	11	0
Electrician, industrial	0	6	6	0	0	6	6	0	0	6	6	0
Electrician, master	0	1	1	0	0	1	1	0	0	1	1	0
Laborer	0	27	27	0	0	27	27	0	0	27	27	0
Structural steel worker	0	11	11	0	0	11	11	0	0	11	11	0
Backhoe operator	0	2	2	0	0	2	2	0	0	2	2	0
Cherry picker operator	0	2	2	0	0	2	2	0	0	2	2	0
Cable crane operator	0	4	4	0	0	4	4	0	0	4	4	0
Dozer operator	0	1	1	0	0	1	1	0	0	1	1	0
Power shovel operator	0	1	1	0	0	1	1	0	0	1	1	0
Road roller operator	0	1	1	0	0	1	1	0	0	1	1	0
Transmission line												
Foreman	–	–	–	–	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–	–	–	–	–
Total Construction Workers	0	74	74	0	0	74	74	0	0	74	74	0
O&M												
Windsmith	20	20	20	20	23	23	23	23	24	24	24	24
Grand Total	20	94	94	20	23	97	97	23	24	98	98	24

Table E2 (Continued)

Job Classification	Number of Employees 2004 Quarters				Number of Employees 2005-2034 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION								
Windplant								
Carpenter/form setter	0	4	4	0	–	–	–	–
Cement finisher	0	1	1	0	–	–	–	–
Cement, rebar	0	2	2	0	–	–	–	–
Electrician, helper	0	11	11	0	–	–	–	–
Electrician, industrial	0	6	6	0	–	–	–	–
Electrician, master	0	1	1	0	–	–	–	–
Laborer	0	27	27	0	–	–	–	–
Structural steel worker	0	11	11	0	–	–	–	–
Backhoe operator	0	2	2	0	–	–	–	–
Cherry picker operator	0	2	2	0	–	–	–	–
Cable crane operator	0	4	4	0	–	–	–	–
Dozer operator	0	1	1	0	–	–	–	–
Power shovel operator	0	1	1	0	–	–	–	–
Road roller operator	0	1	1	0	–	–	–	–
Transmission line								
Foreman	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–
Total Construction Workers	0	74	74	0	–	–	–	–
O&M								
Windsmith	26	26	26	26	26	26	26	26
Grand Total	26	100	100	26	26	26	26	26

Table E3 In-migrant Windplant Employees, Projections 1995-2034.[1]

Job Classification	Number of Employees 1995 Quarters				Number of Employees 1996 Quarters				Number of Employees 1997 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	1	1	0	0	1	1	0	0	1	1	0
Cement finisher	0	0	0	0	0	0	0	0	0	0	0	0
Cement, rebar	0	0	0	0	0	0	0	0	0	0	0	0
Electrician, helper	0	2	2	0	0	1	1	0	0	1	1	0
Electrician, industrial	0	6	6	0	0	2	2	0	0	2	2	0
Electrician, master	0	0	0	0	0	0	0	0	0	0	0	0
Laborer	0	4	4	0	0	3	3	0	0	3	3	0
Structural steel worker	0	4	4	0	0	1	1	0	0	1	1	0
Backhoe operator	0	0	0	0	0	0	0	0	0	0	0	0
Cherry picker operator	0	6	6	0	0	4	4	0	0	4	4	0
Cable crane operator	0	1	1	0	0	0	0	0	0	0	0	0
Dozer operator	0	0	0	0	0	0	0	0	0	0	0	0
Power shovel operator	0	0	0	0	0	0	0	0	0	0	0	0
Road roller operator	0	0	0	0	0	0	0	0	0	0	0	0
Transmission line												
Foreman	0	6	6	0	–	–	–	–	–	–	–	–
Lineman	0	7	7	0	–	–	–	–	–	–	–	–
Equipment operator	0	1	1	0	–	–	–	–	–	–	–	–
Laborer	0	0	0	0	–	–	–	–	–	–	–	–
Wireman	0	8	8	0	–	–	–	–	–	–	–	–
Total Construction Workers	0	46	46	1	0	12	12	0	0	12	12	0
O&M												
Windsmith	1	1	1	1	1	1	1	1	1	1	1	1
Grand Total	1	47	47	2	1	13	13	1	1	13	13	1

[1] In-migrant Windplant employees are those employees who were not residents of Albany or Carbon County during the previous year. Projections based on assumed 90% use of available local labor force.

Table E3 (Continued)

Job Classification	Number of Employees 1998 Quarters				Number of Employees 1999 Quarters				Number of Employees 2000 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	1	1	0	0	1	1	0	0	1	1	0
Cement finisher	0	0	0	0	0	0	0	0	0	0	0	0
Cement, rebar	0	0	0	0	0	0	0	0	0	0	0	0
Electrician, helper	0	1	1	0	0	1	1	0	0	1	1	0
Electrician, industrial	0	2	2	0	0	2	2	0	0	2	2	0
Electrician, master	0	0	0	0	0	0	0	0	0	0	0	0
Laborer	0	3	3	0	0	3	3	0	0	3	3	0
Structural steel worker	0	1	1	0	0	1	1	0	0	1	1	0
Backhoe operator	0	0	0	0	0	0	0	0	0	0	0	0
Cherry picker operator	0	4	4	0	0	4	4	0	0	4	4	0
Cable crane operator	0	0	0	0	0	0	0	0	0	0	0	0
Dozer operator	0	0	0	0	0	0	0	0	0	0	0	0
Power shovel operator	0	0	0	0	0	0	0	0	0	0	0	0
Road roller operator	0	0	0	0	0	0	0	0	0	0	0	0
Transmission line												
Foreman	–	–	–	–	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–	–	–	–	–
Total Construction Workers	0	12	12	0	0	12	12	0	0	12	12	0
O&M												
Windsmith	1	1	1	1	2	2	2	2	2	2	2	2
Grand Total	1	13	13	1	2	14	14	2	2	14	14	2

Table E3 (Continued)

Job Classification	Number of Employees 2001 Quarters				Number of Employees 2002 Quarters				Number of Employees 2003 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION												
Windplant												
Carpenter/form setter	0	1	1	0	0	1	1	0	0	1	1	0
Cement finisher	0	0	0	0	0	0	0	0	0	0	0	0
Cement, rebar	0	0	0	0	0	0	0	0	0	0	0	0
Electrician, helper	0	1	1	0	0	1	1	0	0	1	1	0
Electrician, industrial	0	2	2	0	0	2	2	0	0	2	2	0
Electrician, master	0	0	0	0	0	0	0	0	0	0	0	0
Laborer	0	3	3	0	0	3	3	0	0	3	3	0
Structural steel worker	0	1	1	0	0	1	1	0	0	1	1	0
Backhoe operator	0	0	0	0	0	0	0	0	0	0	0	0
Cherry picker operator	0	4	4	0	0	4	4	0	0	4	4	0
Cable crane operator	0	0	0	0	0	0	0	0	0	0	0	0
Dozer operator	0	0	0	0	0	0	0	0	0	0	0	0
Power shovel operator	0	0	0	0	0	0	0	0	0	0	0	0
Road roller operator	0	0	0	0	0	0	0	0	0	0	0	0
Transmission line												
Foreman	–	–	–	–	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–	–	–	–	–
Total Construction Workers	0	12	12	0	0	12	12	0	0	12	12	0
O&M												
Windsmith	2	2	2	2	2	2	2	2	3	3	3	3
Grand Total	2	14	14	2	2	14	14	2	3	15	15	3

Table E3 (Continued)

Job Classification	Number of Employees 2004 Quarters				Number of Employees 2005-2034 Quarters			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
CONSTRUCTION								
Windplant								
Carpenter/form setter	0	1	1	0	–	–	–	–
Cement finisher	0	0	0	0	–	–	–	–
Cement, rebar	0	0	0	0	–	–	–	–
Electrician, helper	0	1	1	0	–	–	–	–
Electrician, industrial	0	2	2	0	–	–	–	–
Electrician, master	0	0	0	0	–	–	–	–
Laborer	0	3	3	0	–	–	–	–
Structural steel worker	0	1	1	0	–	–	–	–
Backhoe operator	0	0	0	0	–	–	–	–
Cherry picker operator	0	4	4	0	–	–	–	–
Cable crane operator	0	0	0	0	–	–	–	–
Dozer operator	0	0	0	0	–	–	–	–
Power shovel operator	0	0	0	0	–	–	–	–
Road roller operator	0	0	0	0	–	–	–	–
Transmission line								
Foreman	–	–	–	–	–	–	–	–
Lineman	–	–	–	–	–	–	–	–
Equipment operator	–	–	–	–	–	–	–	–
Laborer	–	–	–	–	–	–	–	–
Wireman	–	–	–	–	–	–	–	–
Total Construction Workers	0	12	12	0	–	–	–	–
O&M								
Windsmith	3	3	3	3	3	3	3	3
Grand Total	3	15	15	3	3	3	3	3

Table E4 Total and Average Payroll, 1995-2034.

Year	Construction Jobs		O&M Jobs		Total Annual Payroll for All Employment
	Average Salary for 6 Month Work Period	Total Annual Payroll	Average Annual Salary	Total Annual Payroll	
1995	$19,685	$3,169,285	$28,122	$253,094	$3,422,379
1996	$20,473	$1,750,635	$29,246	$321,711	$2,082,346
1997	$21,292	$1,831,069	$30,416	$395,412	$2,226,481
1998	$22,143	$1,904,298	$31,633	$474,495	$2,378,793
1999	$23,029	$1,980,494	$32,898	$559,271	$2,539,765
2000	$23,950	$2,059,700	$34,214	$684,285	$2,743,985
2001	$24,908	$2,142,088	$35,583	$782,821	$2,924,909
2002	$25,905	$2,227,787	$37,006	$925,153	$3,152,940
2003	$26,941	$2,316,883	$38,486	$1,039,131	$3,356,014
2004	$28,018	$2,409,548	$40,026	$1,160,748	$3,570,296
2005	–	–	$41,627	$1,207,178	$1,207,178
2006	–	–	$43,292	$1,255,465	$1,255,465
2007	–	–	$45,024	$1,305,684	$1,305,684
2008	–	–	$46,825	$1,357,911	$1,357,911
2009	–	–	$48,698	$1,412,228	$1,412,228
2010	–	–	$50,645	$1,468,717	$1,468,717
2011	–	–	$52,671	$1,527,466	$1,527,466
2012	–	–	$54,778	$1,588,564	$1,588,564
2013	–	–	$56,969	$1,652,107	$1,652,107
2014	–	–	$59,248	$1,718,191	$1,718,191
2015	–	–	$61,618	$1,786,919	$1,786,919
2016	–	–	$64,083	$1,858,396	$1,858,396
2017	–	–	$66,646	$1,932,731	$1,932,731
2018	–	–	$69,312	$2,010,041	$2,010,041
2019	–	–	$72,084	$2,090,442	$2,090,442
2020	–	–	$74,968	$2,174,060	$2,174,060
2021	–	–	$77,966	$2,261,022	$2,261,022
2022	–	–	$81,085	$2,351,463	$2,351,463
2023	–	–	$84,328	$2,445,522	$2,445,522
2024	–	–	$87,701	$2,543,343	$2,543,343
2025	–	–	$91,210	$2,645,076	$2,645,076

Table E4 (Continued)

Year	Construction Jobs		O&M Jobs		Total Annual Payroll for All Employment
	Average Salary for 6 Month Work Period	Total Annual Payroll	Average Annual Salary	Total Annual Payroll	
2026	–	–	$94,858	$2,750,879	$2,750,879
2027	–	–	$98,652	$2,860,915	$2,860,915
2028	–	–	$102,598	$2,975,351	$2,975,351
2029	–	–	$106,702	$3,094,365	$3,094,365
2030	–	–	$110,970	$3,218,140	$3,218,140
2031	–	–	$115,409	$3,346,865	$3,346,865
2032	–	–	$120,026	$3,480,740	$3,480,740
2033	–	–	$124,827	$3,619,970	$3,619,970
2034	–	–	$129,820	$3,764,768	$3,764,768
Total payroll 1995 through 2034					$96,102,427

Table E5 Sales and Property Taxes Paid by the Windplant, 1995-2034.

Year	Sales Tax	Property Tax	Portion of Property Tax Going to Schools (80.8% of Property Tax)
1995	–	–	–
1996	$1,760,604	$ 790,014	$ 638,331
1997	$1,831,028	$1,350,549	$1,091,244
1998	$1,904,269	$1,914,995	$1,547,316
1999	$1,980,440	$2,483,511	$2,006,677
2000	$2,059,657	$3,056,258	$2,469,456
2001	$2,142,044	$3,633,406	$2,935,792
2002	$2,227,725	$4,215,131	$3,405,826
2003	$2,316,834	$4,801,616	$3,879,706
2004	$1,445,705	$5,393,052	$4,357,586
2005	–	$5,668,369	$4,580,042
2006	–	$5,445,721	$4,400,143
2007	–	$5,223,072	$4,220,242
2008	–	$5,000,424	$4,040,343
2009	–	$4,777,776	$3,860,443
2010	–	$4,555,127	$3,680,543
2011	–	$4,332,479	$3,500,643
2012	–	$4,109,831	$3,320,743
2013	–	$3,887,182	$3,140,843
2014	–	$3,664,534	$2,960,943
2015	–	$3,441,886	$2,781,044
2016	–	$3,219,237	$2,601,143
2017	–	$2,996,589	$2,421,244
2018	–	$2,773,941	$2,241,344
2019	–	$2,551,292	$2,061,444
2020	–	$2,328,644	$1,881,544
2021	–	$2,105,996	$1,701,645
2022	–	$1,883,347	$1,521,744
2023	–	$1,660,699	$1,341,845
2024	–	$1,438,051	$1,161,945
2025	–	$1,215,402	$ 982,045
2026	–	$ 992,754	$ 802,145

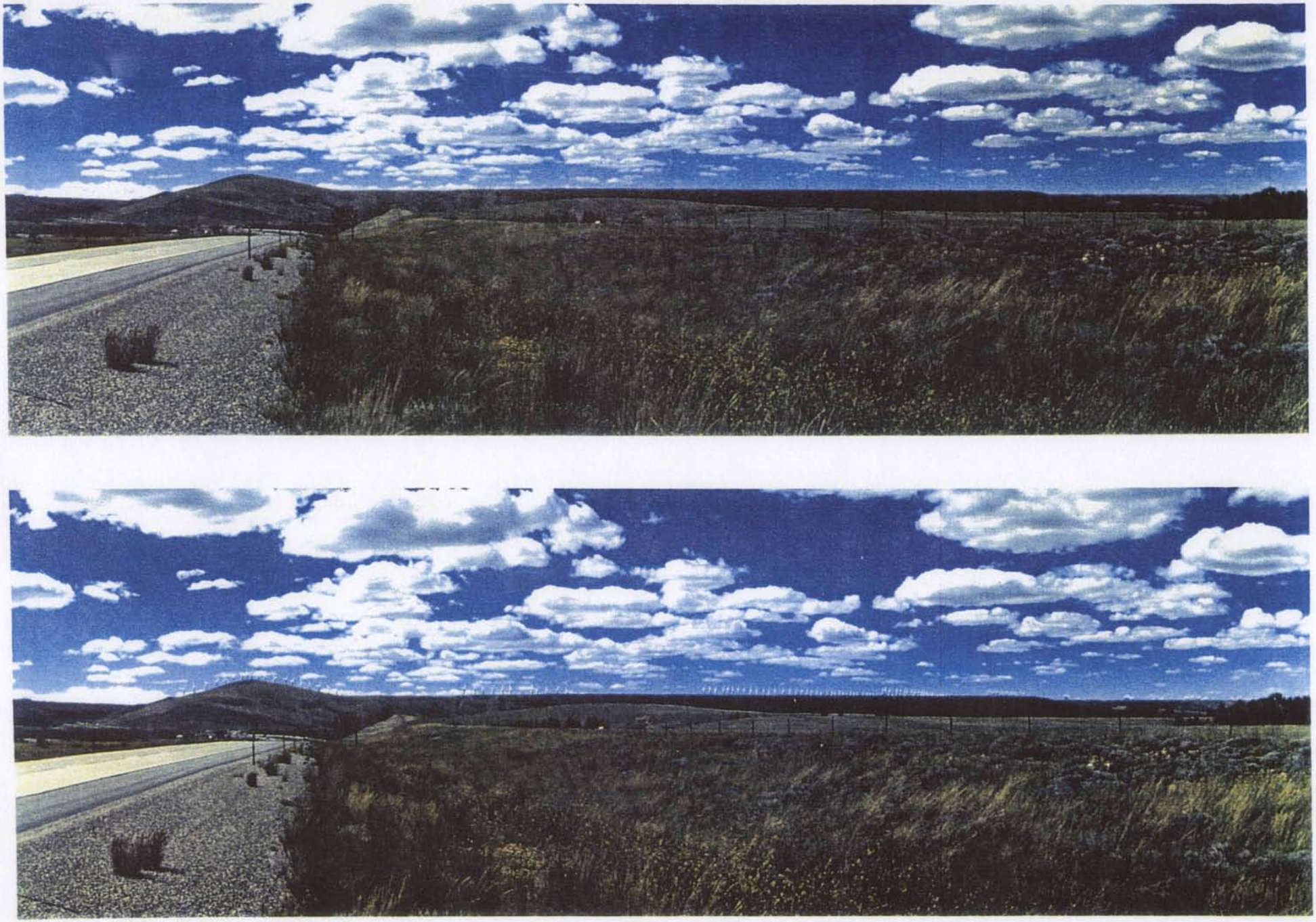
Table E5 (Continued)

Year	Sales Tax	Property Tax	Portion of Property Tax Going to Schools (80.8% of Property Tax)
2027	–	$ 796,440	$ 643,524
2028	–	$ 619,687	$ 500,707
2029	–	$ 463,280	$ 374,330
2030	–	$ 328,031	$ 265,049
2031	–	$ 214,787	$ 173,548
2032	–	$ 124,428	$ 100,538
2033	–	$ 57,869	$ 46,758
2034	–	$ 16,063	$ 12,979

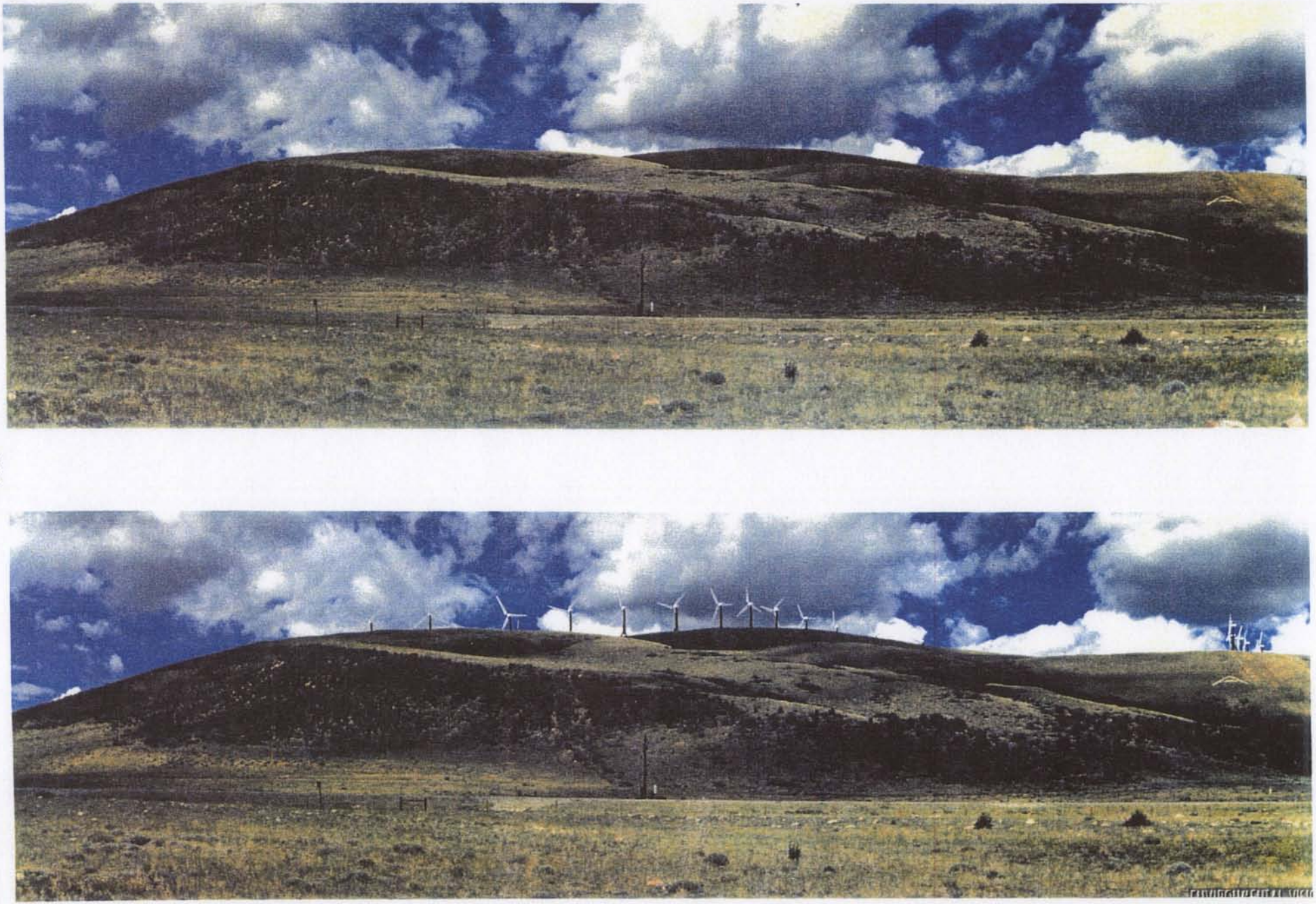
APPENDIX F:

VISUAL SIMULATIONS OF THE WINDPLANT

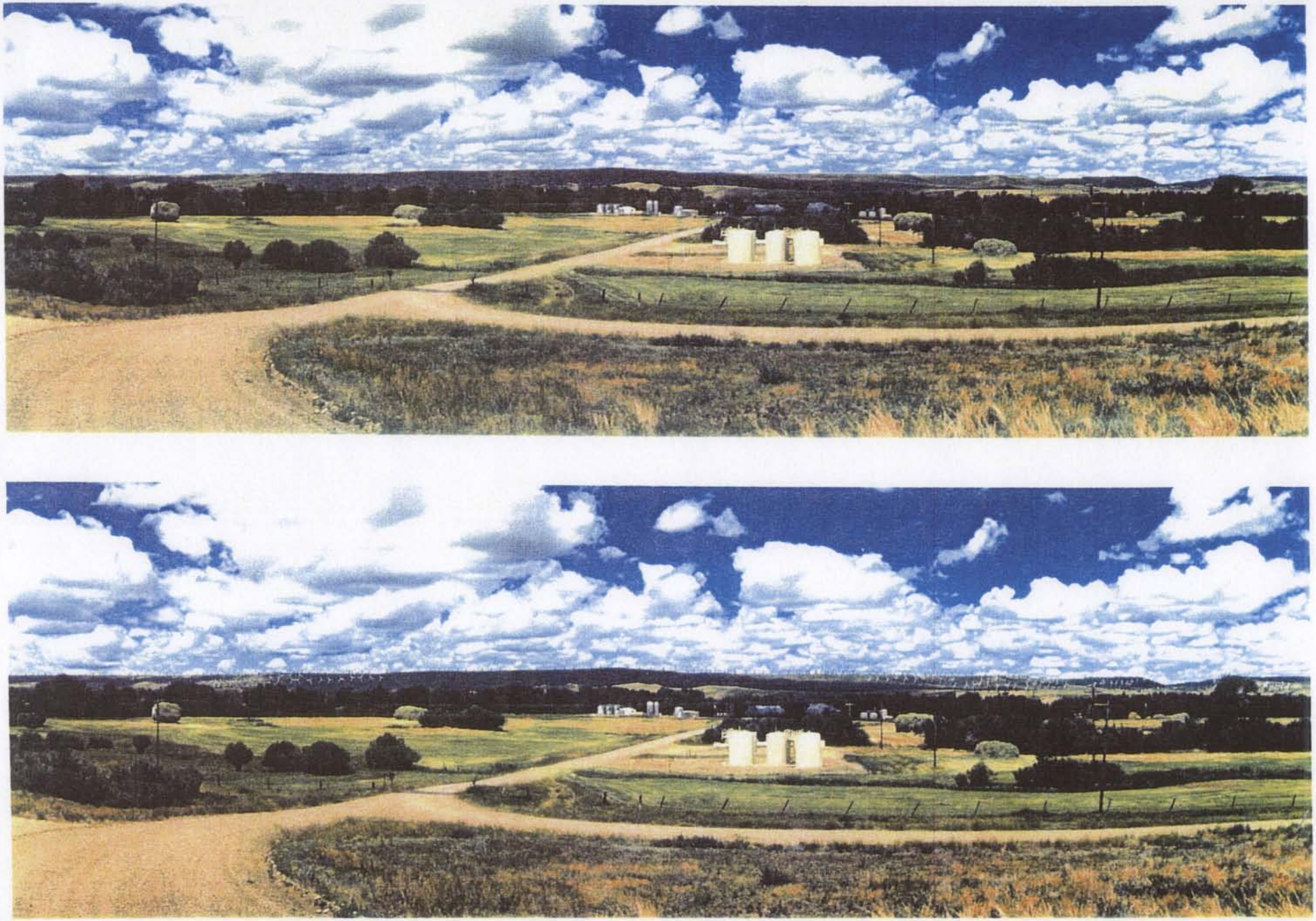
(The simulations in this appendix do not show other Windplant facilities or roads.)



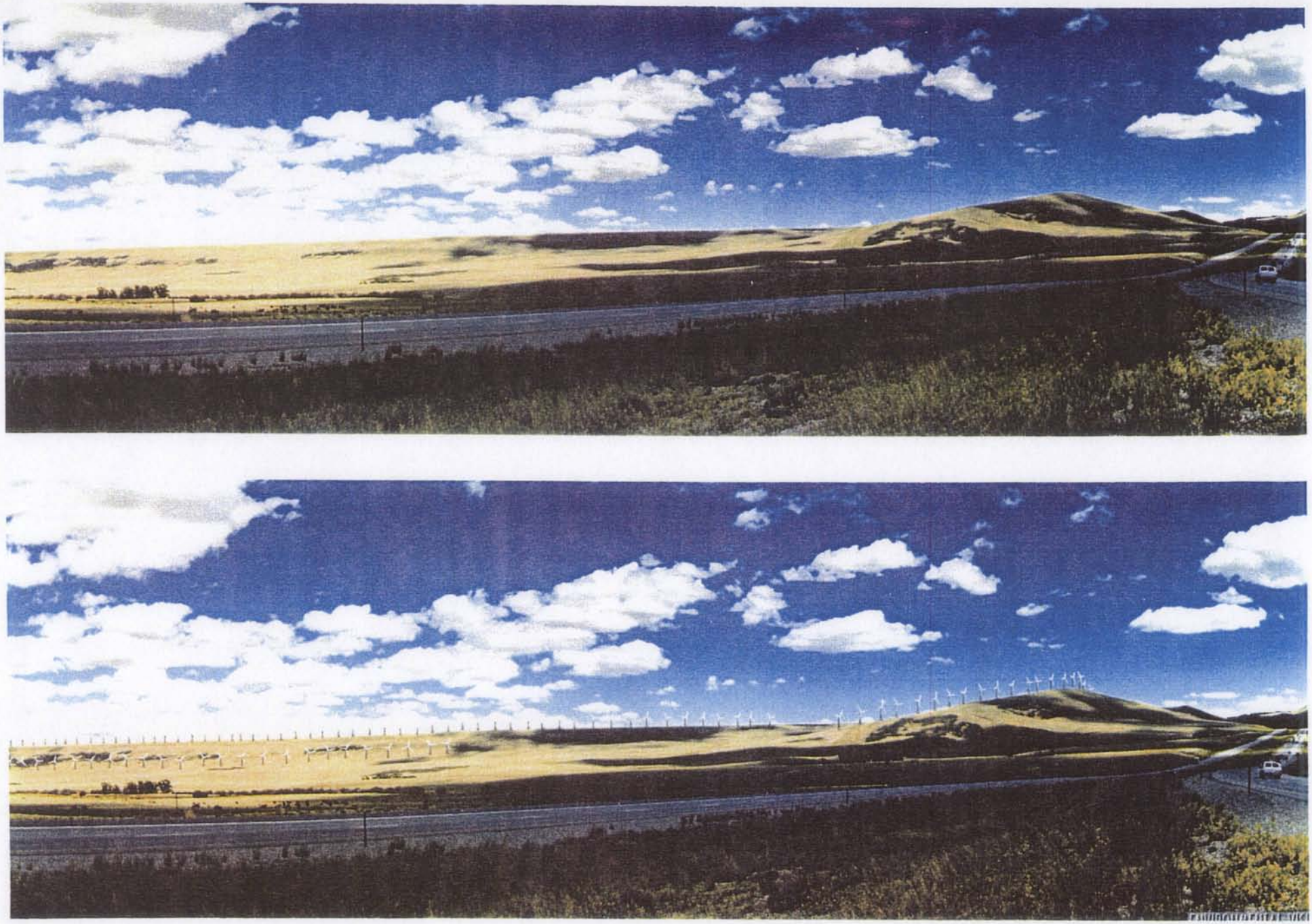
Photograph F.1 KOP 1 - 1.5 mi (2.4 km) East of the Arlington Exit on I-80 Looking Northwest Towards Foote Creek Rim. Top is the Existing View; Bottom is a Simulation of the 200-MW Foote Creek Rim Portion of the Windplant as Seen from this Point.



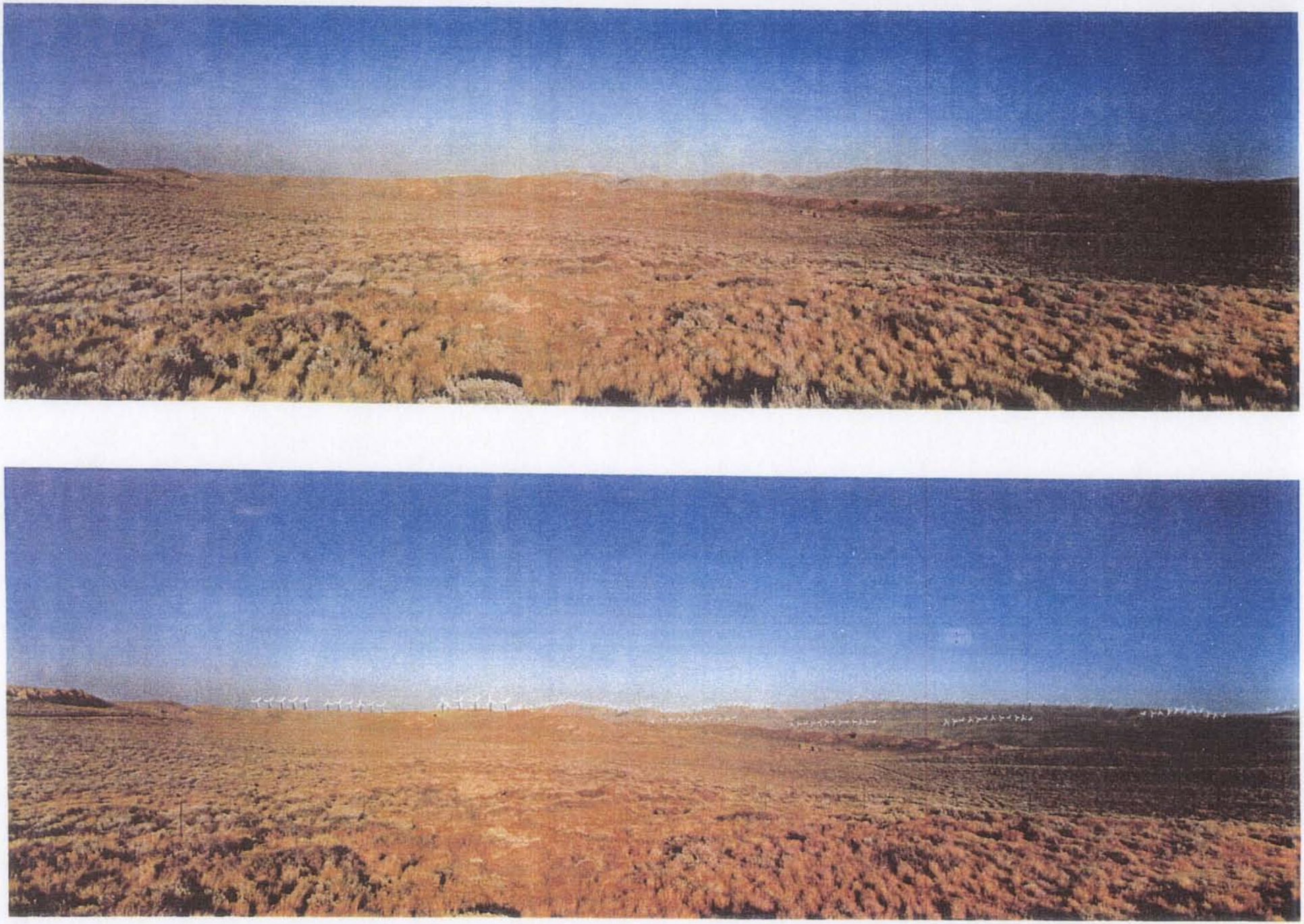
Photograph F.2 KOP 2 - At the Arlington KOA Looking Northwest Towards Foote Creek Rim. Top is the Existing View; Bottom is a Simulation of the 200-MW Foote Creek Rim Portion of the Windplant as Seen from this Point.



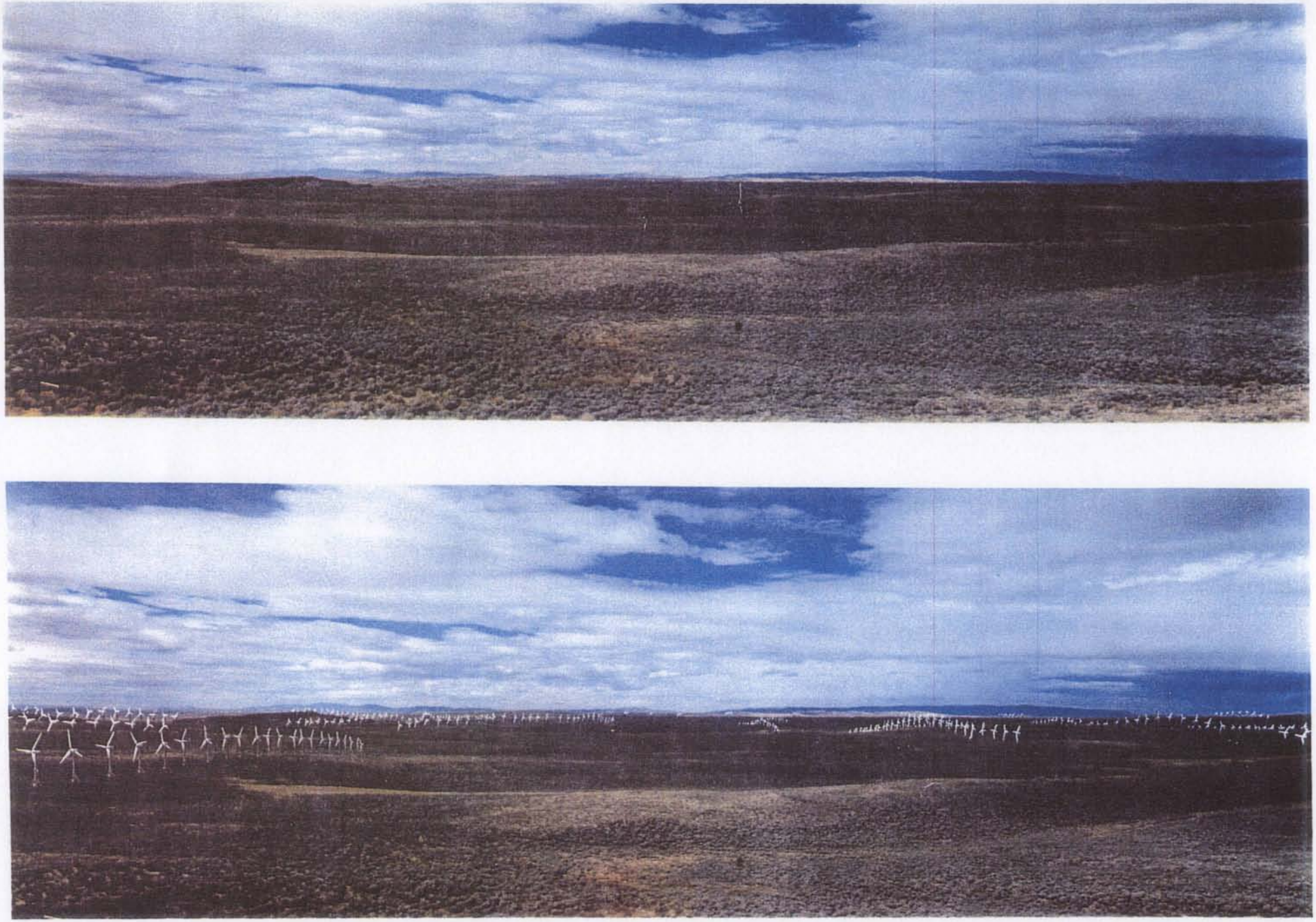
Photograph F.3 KOP 3 - McFadden School Looking Northwest Towards Foote Creek Rim. Top is Existing View; Bottom is a Simulation of the 200-MW Foote Creek Rim Portion of the Windplant as Seen from this Point.



Photograph F.4 KOP 5 - 2.0 mi (3.2 km) West of Arlington on I-80 Looking East Towards Foote Creek Rim. Top is Existing View; Bottom is a Simulation of the 200-MW Foote Creek Rim Portion of the Windplant as Seen from this Point.



Photograph F.5 KOP 6 - In the Simpson Ridge Area 4.0 mi (6.4 km) Southeast of Hanna Junction on Highway 72 Looking East. Top is Existing View; Bottom is a Simulation of the 300-MW Simpson Ridge Portion of the Windplant as Seen from this Point.



Photograph F.6 KOP 7 - 5.0 mi (8.0 km) West of the Elk Mountain Exit on I-80, Looking North. Top is Existing View; Bottom is a Simulation of the 300-MW Simpson Ridge Portion of the Windplant as Seen from this Point.