

APPENDIX H

Biological Resources: *Humboldt Wind Energy Project Eagle Use Survey
Report, Humboldt County, California, October 2017–October 2018*



Humboldt Wind Energy Project
Eagle Use Count Survey Report

November 19, 2018

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Table of Contents

ACRONYMS AND ABBREVIATIONS	I
EXECUTIVE SUMMARY	V
1.0 INTRODUCTION.....	1
2.0 ENVIRONMENTAL SETTING	2
3.0 EAGLE USE COUNT SURVEY METHODS	3
4.0 EAGLE USE COUNT SURVEY RESULTS	4
4.1 WEATHER RESULTS.....	4
4.2 SURVEY EFFORT	4
4.3 PERCENT VISIBILITY BY PLOT	5
4.4 EAGLE USE.....	5
4.5 AGE CLASS AND BEHAVIORS	8
5.0 DISCUSSION.....	9
6.0 REFERENCES.....	10

LIST OF TABLES

Table 1. Survey effort by plot number for eagle use surveys conducted at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018	4
Table 2. Percent visibility by plot for eagle use surveys conducted at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.	5
Table 3. Eagle minutes documented at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.	6
Table 4. Number of flying eagle observations and eagle minutes by month at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.	6
Table 5. Eagle use minutes by plot at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.	7
Table 6. Age classes of eagles observed at the Humboldt Wind Energy Project, Humboldt, California, October 24, 2017–October 26, 2018	8
Table 7. Eagle behaviors displayed by minute at the Humboldt Wind Energy Project, Humboldt, California, October 24, 2017–October 26, 2018.	9

LIST OF GRAPHS

Graph 1. Eagle use minutes and survey effort by month at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.	7
Graph 2. Eagle use minutes and survey effort by plot at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.	8

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

LIST OF FIGURES

Figure 1. General Overview Map

Figure 2. Project Area Map

Figure 3. Eagle Use Count Survey Plot Locations

Figure 4. Eagle Use Minutes by Survey Plot

LIST OF APPENDICES

APPENDIX A WEATHER SUMMARY

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

Acronyms and Abbreviations

BUC	bird use count
C	Celsius
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
ECPG	Eagle Conservation Plan Guidance
EUC	eagle use count
F	Fahrenheit
ft	foot/feet
gen-tie	generation transmission line
m	meter
mi	mile
USFWS	U.S. Fish and Wildlife Service

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Note:

Often, agency suggestions and guidelines are provided in US units of measure (e.g., acres [ac] feet [ft], or miles [mi]), and in other instances, agency guidance is provided in metric (aka SI, or System International) units (e.g., meters [m] or kilometers [km]). To convert an otherwise readily recognized agency standard (e.g., 10 mi or 1 km) to the other system may result in confusion. Accordingly, measures are provided in either system, using the original agency suggestion unchanged, and provide conversion to the other standard only when it makes sense to do so.

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

Executive Summary

Humboldt Wind, LLC plans to permit, build, and operate a wind energy project on land in Humboldt County, California. As one part of the studies to support review of the project pursuant to the California Environmental Quality Act (CEQA), Stantec Consulting Services Inc. (Stantec) conducted eagle use count (EUC) surveys between October 2017 and October 2018. This report includes all data collected from October 2017 through the end of October 2018.

EUC surveys were conducted for a total of 129.75 hours (7,785 minutes). Four bald eagles and seven golden eagles were observed during surveys. In addition, biologists observed one incidental golden eagle while traveling between plots. Duration of total eagle observations was 32 minutes, and duration of eagle observations within the 800-meter (m) plot radius and below 223.3 m¹ (eagle use minutes) was 27 minutes. Therefore, duration of eagle observations per minute of survey was 0.0041 and eagle use minutes per minute of survey was 0.0035.

Eagle observation minutes and eagle use minutes per minute of survey were greatest during spring, followed by summer, and fall. Biologists observed eagles at 7 of the 13 survey plots and total effort at individual plots varied between 5.75 to 13 hours.

¹ The 2016 Eagle Rule (USFWS 2016) indicated that the maximum height of the vertical survey plot should be 200 m or 25 m above the maximum rotor swept height, whichever is greater. The tallest turbine model under consideration would have a maximum rotor-swept height of 198.3 m; therefore, we used 223.3 m for the maximum height of the vertical survey plot.

1.0 INTRODUCTION

Humboldt Wind, LLC (Humboldt Wind) is planning to construct and operate the Humboldt Wind Energy Project (project) in south-central Humboldt County, California (Figure 1). The project would consist of up to 60 wind turbines and associated facilities including meteorological towers, electrical collection system, access roads, construction staging areas, a substation, an operations and maintenance facility, up to a 25-mile (mi) generation transmission line (gen-tie) and its point of interconnection at the existing Pacific Gas & Electric Bridgeville Substation. The project would have a nameplate generating capacity of up to 155 megawatts (MW). Proposed turbine locations are situated on two prominent ridgelines, Bear River Ridge and Monument Ridge, 4.7 mi south and southwest of Scotia, California (Figure 1).

The project area includes a 1,000-foot-(ft-) wide corridor centered on proposed turbine locations; a 200-ft-wide corridor centered on project roads, the electrical collection line, and the gen-tie; and a 500-ft-wide buffer around proposed staging and temporary impact areas and project substations, encompassing 2,241 acres (Figure 2). The project area is divided into the following segments for description purposes:

- Bear River Ridge
- Western Monument Ridge
- Eastern Monument Ridge
- Monument Ridge – Highway 101
- Highway 101 – Shively Ridge
- Shively Ridge
- Bridgeville

Stantec Consulting Services Inc. (Stantec) prepared a Draft Biological Resources Work Plan (Draft Work Plan) detailing biological resource surveys designed to support project planning and review (Stantec 2018a). Starting in October 2017 through October 2018, eagle use counts (EUC) were conducted as outlined in the Draft Work Plan. This report includes all data collected from October 2017 through the end of October 2018.

On January 8, 2018, the project team met with the United States Fish and Wildlife Service (USFWS) to discuss studies related to bald and golden eagles. Bald and golden eagles both occur in Humboldt County, including the study area and vicinity. Bald eagles are considered a rare to uncommon resident and local breeder in the county, with greater numbers during winter (Harris 2005, Hunter et al. 2005). Golden eagles are also rare to uncommon residents and breeders, particularly in southern Humboldt County (Harris 2005, Hunter et al. 2005, McAllister and Fix 2008).

The purpose of the EUC survey was to summarize the seasonal and spatial variation in eagle use across the project area, and to provide the number of eagle use minutes within the study area, which includes an 800-m-radius area centered on the EUC plot locations (referred to as 'plots' hereafter) (Figure 3). The USFWS developed a predictive model which uses EUC data for a collision fatality risk estimate. Eagle use minutes is one of the primary model inputs for their model. If warranted, the USFWS's model will be run based on eagle use minutes collected during two years of EUC data collected at the project site.

2.0 ENVIRONMENTAL SETTING

Humboldt County is within the Klamath/North Coast bioregion, and features a rocky coastline, montane forests, and small and sparsely populated settlements. The county is among those with the wettest and foggiest weather in California. Cool, moist climate is typical on the coast but becomes progressively drier, warmer, and more variable but remaining mild inland. Humboldt County features several biological communities; the most abundant is coniferous forest comprising Douglas fir, redwood, and pine forests, followed by oak woodlands, and grasslands. Less abundant habitats include coastal beach dune vegetation, northern coastal scrub, chaparral, salt marsh, riparian, and freshwater marsh. Humboldt Bay, located about 16 mi north of the project, is the second largest estuary in California. As such, the Bay and coast of Humboldt County coast have high biodiversity and support many species of resident and migratory wildlife with high seasonal and year-round abundance. Six rivers run through the county, providing habitats for fish and wildlife as well as important water resources. Nearly 400,000 acres of the county's undeveloped forests and coastlines are designated as parks or forests.

Humboldt County spans two geologic provinces. The Coast Ranges Province in the county's center and southwest comprises mainly the Franciscan Complex, with schists, sand, and other alluvial deposits associated with the coast. The Klamath Mountains Province in the northeast features older sedimentary rock including sandstone, chert, slate, and schist.

The average July temperature in Humboldt County is typically in the 60s (Fahrenheit). While rain can occur throughout the year, about 90% of the annual rain results from Pacific Ocean storms and falls between October and April. Seasonal totals average more than 40 inches in the driest areas and exceed 100 inches in the wettest zones. Moisture and moderate temperature combined create high average relative humidity.

The project is on privately owned and managed lands in rural, unincorporated south-central Humboldt County, 10 mi southeast of Ferndale, 20 mi south of Eureka, and 22 mi north of Garberville, California. Most of the project would be located on two prominent ridgelines that are located south and east of the town of Scotia. Monument Ridge is located south and west of Highway 101 and the Eel River, and Shively ridge is located north and east of Highway 101 and the Eel River.

The project area consists primarily of managed timberlands that are dominated by redwood and Douglas-fir forests, with annual grassland, hardwood, and chaparral inclusions. In addition to timber production, some areas of the project site are managed for cattle grazing. The topography is diverse and steep in places, and elevation ranges from nearly sea level in river bottoms to just over 3,000 feet.

The general plan designation for the majority of this area is Timber, with a smaller amount of Agricultural Grazing. About 100 acres of the project area has a designation of Residential Agriculture. Most of the area is zoned Timber Production Zone (TPZ) and Agriculture Exclusive with a combining zone specifying a minimum building site of 160 acres (AE-B-5(160)).

3.0 EAGLE USE COUNT SURVEY METHODS

Survey methods were consistent with the USFWS's Eagle Conservation Plan Guidance (ECPG; USFWS 2013) and Draft Work Plan (Stantec 2018a), which was reviewed by the USFWS. EUCs were conducted monthly (1 survey event = 1 monthly round of surveys at all plots) at the same 13 locations used for bird use count (BUC) surveys (Figure 3). Plots were sampled for one hour each month. Biologists alternated the starting points between north to south or south to north on successive surveys to stratify effort among plots across the daylight interval.

EUC locations were selected to achieve views out to a distance of at least 800 m in all cardinal directions (however, in order to sample throughout the project area, plots also included forested locations where the view was more limited in one or more directions). Consistent with the 2016 Eagle Rule, the proportion of the airspace within an 800-m radius and 223.3 m¹ vertical height from each plot center was recorded.

The following data were recorded at the beginning of each survey:

- Plot number
- Date
- Start time
- Temperature
- Wind speed and direction
- Visibility
- Cloud cover
- Precipitation

For each eagle observation, biologists recorded the start time of observation, species, number of individuals, sex and age (as possible), flight height, distance from observer, and behavior for each 1-minute interval during which the eagle was observed.

Data Summary

Duration of eagle observations were calculated as the total number of minutes an eagle was observed regardless of its location or flight height. Eagle use minutes were calculated as the sum of the number of minutes each eagle was observed in flight within 800-m-radius plots and below heights of 223.3 m. The duration of eagle observations was summed with eagle use minutes, then divided by the number of survey minutes to standardize the sum by the level of effort. Temporal variation was evaluated by calculating eagle minutes per month over the study period and comparing results graphically. Spatial variation was evaluated by mapping eagle minutes at each plot across the study period and comparing results graphically. The number of eagle observations by age class, and the number of observations and number of minutes of observation by behavior were summarized.

¹ The 2016 Eagle Rule indicated that the maximum height of the vertical survey plot should be 200 m or 25 m above the maximum rotor swept height, whichever is greater. The tallest turbine model under consideration would have a maximum rotor-swept height of 198.3 m; therefore, we used 223.3 m for the maximum height of the vertical survey plot.

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

4.0 EAGLE USE COUNT SURVEY RESULTS

4.1 WEATHER RESULTS

Weather was suitable during EUCs, with minimal precipitation. Brief periods of precipitation occurred on 3 out of 47 survey-days, but these events did not result in restricted visibility within the 800-m-radius plots (Appendix A Table 1).

4.2 SURVEY EFFORT

Biologists sampled 13 plots comprising 53% of the project area²: 11, 12, 13, 14, 15, 16, 17, 18, 19, 28, 29, 30, and 31 (Figure 3). Biologists conducted between 10 and 13 survey events at plots 11–19. Biologists conducted 6 survey events at plots 28–31, which were added later when land access was granted. Data was not available for plots 12 and 19 in August; and due to project layout changes, surveys were not conducted at plots 15–16 and 18–19 between March 1 and April 31 (Table 1).

Table 1. Survey effort by plot number for eagle use surveys conducted at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018

Plot No.	Month/Dates													Total Visits
	Oct 24–26	Nov 1, 19, 29	Dec 13, 19–20	Jan 3–4, 9–10	Feb 7, 14–15	Mar 7–8, 14	Apr 3	May 1, 23, 29	Jun 6–7, 15, 26	Jul 3–5, 11–12, 19, 25	Aug 8–9, 15, 27	Sep 13–14, 22, 24, 27–28	Oct 4, 15, 26	
11	1	1	1	1	1	1	1	1	1	1	1	1	1	13
12	1	1	1	1	1	1	1	1	1	1	0	1	1	12
13	1	1	1	1	1	1	1	1	1	1	1	1	1	13
14	1	1	1	1	1	1	1	1	1	1	1	1	1	13
15	1	1	1	1	1	0	0	1	1	1	1	1	1	11
16	0	2	1	1	1	0	0	1	1	1	1	1	1	11
17	0	2	1	1	1	1	1	1	1	1	1	1	1	13
18	0	2	1	1	1	0	0	1	1	1	1	1	1	11
19	0	2	1	1	1	0	0	1	1	1	0	1	1	10
28	0	0	0	0	0	0	0	1	1	1	1	1	1	6
29	0	0	0	0	0	0	0	1	1	1	1	1	1	6
30	0	0	0	0	0	0	0	1	1	1	1	1	1	6
31	0	0	0	0	0	0	0	1	1	1	1	1	1	6
Total	5	13	9	9	9	5	5	13	13	13	11	13	13	131

² For this calculation, we considered a 1-km buffer surrounding the proposed turbine locations and measured how much of that area was covered by the cumulative area of the 13, 800-m radius survey plots.

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

4.3 PERCENT VISIBILITY BY PLOT

Percent visibility by plot ranged from 10% at plots 15 and 18, to 99% at plots 28 and 31 due to tree and hillside obstructions (Table 2).

Table 2. Percent visibility by plot for eagle use surveys conducted at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.

Plot Number	Percent Visibility
11	95%
12	90%
13	95%
14	90%
15	10%
16	80%
17	90%
18	10%
19	25%
28	99%
29	95%
30	95%
31	99%

4.4 EAGLE USE

Four bald eagles and seven golden eagles were observed during the survey period and observed one golden eagle incidentally while traveling between plots.

During 7,785 survey minutes (129.75 survey hours), duration of eagle observations both inside and outside of the 800-m plot radius and either above or below 223.3 m was 32 minutes. Biologists recorded 27 eagle use minutes (within 800-m plot radius and below 223.3 m) (Table 3).

Duration of total eagle observations per minute of survey was greatest during spring (0.0130) followed by summer (0.0060) and fall (0.0004). Eagle use minutes per minute of survey were greatest in spring (0.0094) followed by summer (0.0060) and fall (0.0004) (Table 3).

Biologists recorded most eagle observation minutes in May (18 minutes), followed by August (11 minutes). Eagle use minutes were greatest in May (13 minutes), followed by August (11 minutes) (Table 4; Graph 1).

Biologists observed eagles at 7 of the 13 survey plots and total effort at individual plots varied between 5.75 to 13 hours. Plot 12 had the greatest duration of eagle observation minutes (12 minutes), followed by plot 31 (8 minutes),

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

and plot 11 (5 minutes). Plot 12 had the greatest number of eagle use minutes (9 minutes), followed by plot 31 (6 minutes), and plot 11 (5 minutes) (Table 5; Graph 2).

Table 3. Eagle minutes documented at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.

Season	Number of Observations	Duration of Eagle Observations (Minutes) ¹	Eagle Use Minutes ²	Survey Effort (Hours)	Survey Effort (Minutes)	Duration of Eagle Observations per Minute Survey	Eagle Use Minutes per Minute Survey
Fall 9/1/2017–11/30/2017, 9/1/2018–10/26/2018	1	1	1	43.50	2,610	0.0004	0.0004
Winter 12/1/2017–2/28/2018	0	0	0	27.00	1,620	0.0000	0.0000
Spring 3/1/2018–6/1/2018	5	18	13	23.00	1,380	0.0130	0.0094
Summer 6/2/2018–8/31/2018	5	13	13	36.25	2,175	0.0060	0.0060
Total	11	32	27	129.75	7,785	0.0041	0.0035

¹ Total minutes eagles observed regardless of distance from observer or flight height

² Minutes eagles were observed within 800-m plot radius and below 223.3 m

Table 4. Number of flying eagle observations and eagle minutes by month at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.

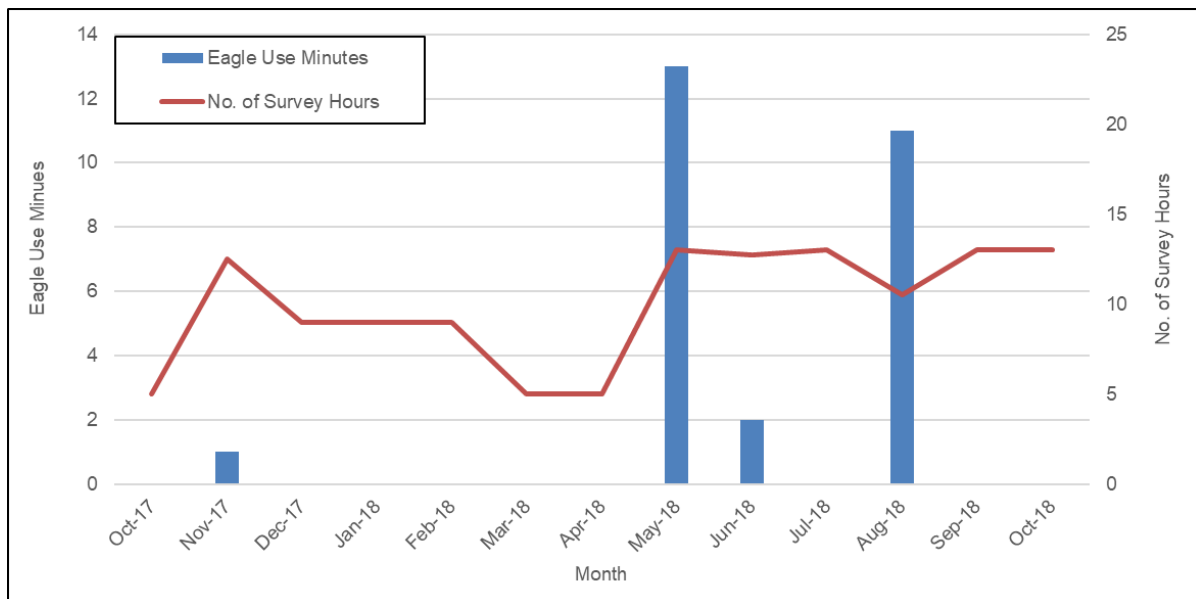
Month	Number of Survey Hours	Total Eagle Observations ¹	Eagle Observations Within 800 m and Below 223.3 m	Duration of Eagle Observation Minutes	Eagle Use Minutes
October 2017	5.00				
November 2017	12.50	1	1	1	1
December 2017	9.00				
January 2018	9.00				
February 2018	9.00				
March 2018	5.00				
April 2018	5.00				
May 2018	13.00	5	5	18	13
June 2018	12.75	1	1	2	2
July 2018	13.00				
August 2018	10.50	4	4	11	11
September 2018	13.00				
October 2018	13.00				
Total	129.75	11	11	32	27

¹ Total does not include one golden eagle incidentally observed while traveling between plots 15 and 17 in February

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

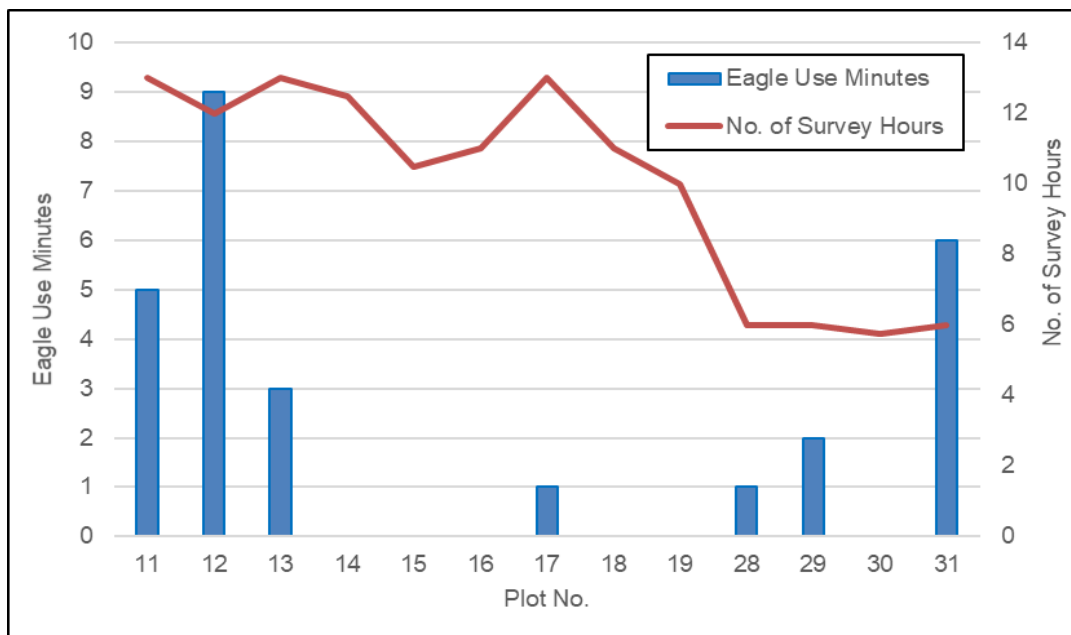
Table 5. Eagle use minutes by plot at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.

Plot Number	Number of survey hours	Number of observations	Duration of Eagle Observation Minutes	Eagle Use Minutes
11	13.00	2	5	5
12	12.00	3	12	9
13	13.00	1	3	3
14	12.50	0		
15	10.50	0		
16	11.00	0		
17	13.00	1	1	1
18	11.00	0		
19	10.00	0		
28	6.00	1	1	1
29	6.00	1	2	2
30	5.75	0		
31	6.00	2	8	6



Graph 1. Eagle use minutes and survey effort by month at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT



Graph 2. Eagle use minutes and survey effort by plot at the Humboldt Wind Energy Project, Humboldt County, California, October 24, 2017–October 26, 2018.

4.5 AGE CLASS AND BEHAVIORS

Six adult eagles, three sub-adult eagles, one juvenile eagle, and one eagle of unknown age were observed during surveys (Table 6).

Table 6. Age classes of eagles observed at the Humboldt Wind Energy Project, Humboldt, California, October 24, 2017–October 26, 2018

Age	Species		
	Bald Eagle	Golden Eagle	All Eagles
Adult	3	3	6
Sub-Adult	1	2	3
Juvenile		1	1
Unknown		1	1
Total	4	7	11

Four different behavior categories were observed during eagle surveys: flapping or gliding, soaring, being mobbed, and stooping or diving in response to another bird. Flapping or gliding behavior was displayed by the most individuals (n=8) and represented the greatest number of behavior minutes (22 minutes) and the greatest number of behavior use minutes (17 minutes) (Table 7).

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Table 7. Eagle behaviors displayed by minute at the Humboldt Wind Energy Project, Humboldt, California, October 24, 2017–October 26, 2018.

Behavior	No. Individuals¹	Total Behavior Minutes²	Behavior Use Minutes³
flapping or gliding	8	22	17
soaring	4	7	7
being mobbed	2	2	2
stooping or diving in response to another bird	1	1	1
Total	15	32	27

¹ Some eagles displayed multiple behaviors, therefore the total number of behavioral observations is greater than the number of eagles observed.

² Minutes each behavior was observed regardless of flight height.

³ Minutes observed within the 800-m plot radius and below 223.3 m.

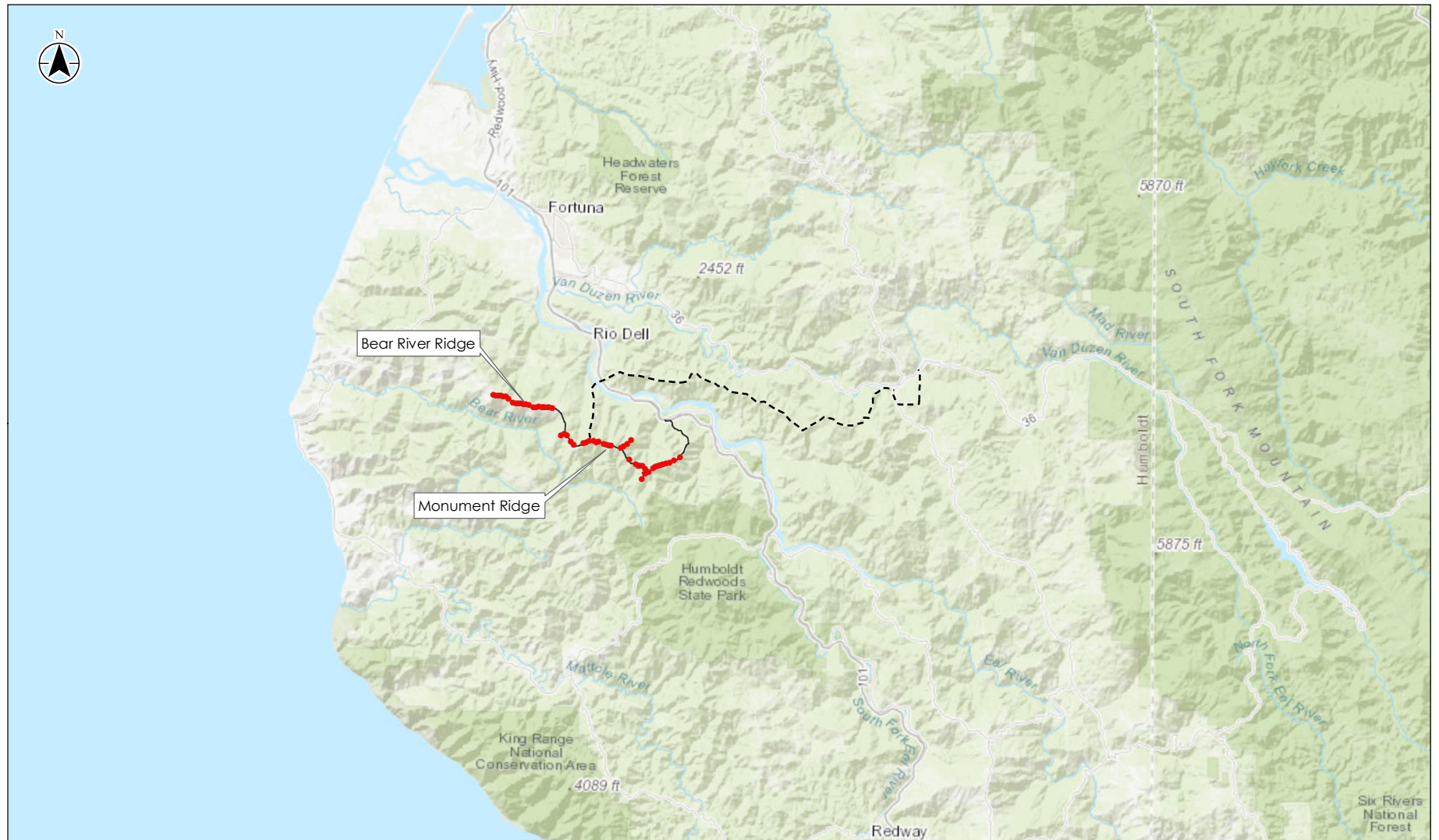
5.0 DISCUSSION

Survey data was collected in accordance with the ECPG and 2016 Eagle Rule. Eagle use minutes collected at the project can be used to inform the USFWS's collision risk model. These survey results will serve as a basis for understanding possible project-related impacts.

6.0 REFERENCES

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FIGURES



- Proposed Representative Wind Turbine Locations
- Generation Transmission line (gen-tie)
- Proposed Access Roads



Notes
 1. Coordinate System: NAD 1983 UTM Zone 10N
 2. Base map: ESRI World Topographic Map web mapping service.



Project Location 185703758
 Humboldt County, California
 Prepared by PG on 2018-08-06
 Technical Reviewed by YA on 2018-08-07
 Independent Review by JD on 2018-08-07

Client/Project
 Humboldt Wind, LLC
 Humboldt Wind Energy Project

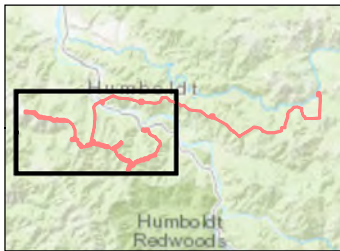
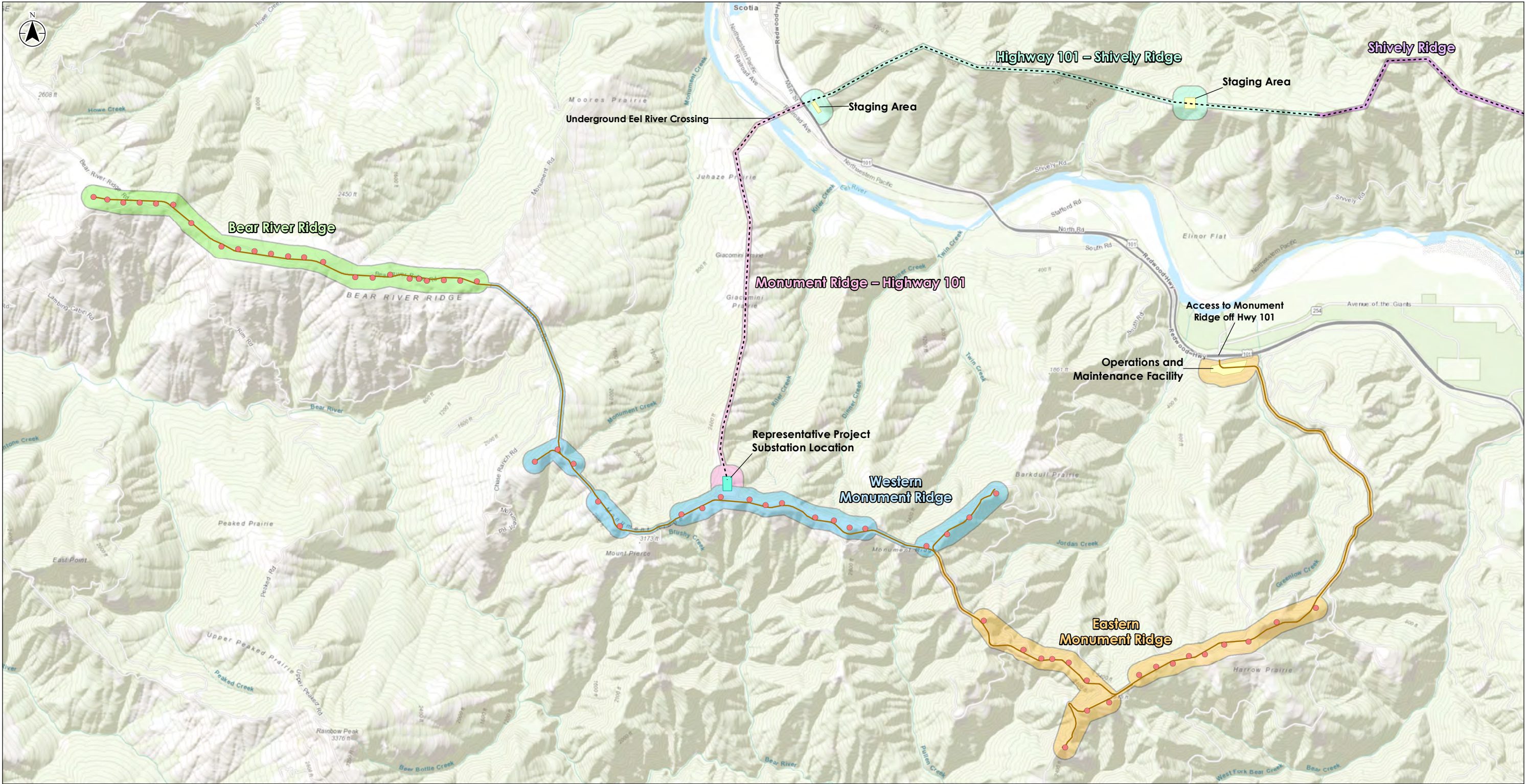
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1

Title

General Overview






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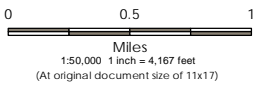


Project Area Segments

- | | |
|--|---|
|  Bear River Ridge |  Highway 101 - Shively Ridge |
|  Western Monument Ridge |  Shively Ridge |
|  Monument Ridge - Highway 101 |  Bridgeville |
|  Eastern Monument Ridge | |

Project Components

-  Proposed Representative Wind Turbine Locations
-  Generation Transmission Line (Gen-Tie)
-  Proposed Access Roads
-  Substation
-  Staging Area



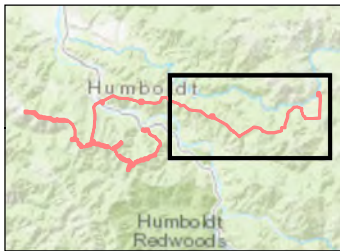
- Notes**
- Coordinate System: NAD 1983 UTM Zone 10N
 - Base map: Esri World Topographic Map



Project Location
Humboldt County, California
185703758
Prepared by PC on 2018-09-13
Technical Review by SC on 2018-09-13

Client/Project
Humboldt Wind, LLC
Humboldt Wind Energy Project

Figure No.
2
Title
Project Area

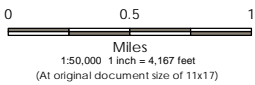


Project Area Segments

- | | |
|------------------------------|-----------------------------|
| Bear River Ridge | Highway 101 - Shively Ridge |
| Western Monument Ridge | Shively Ridge |
| Monument Ridge - Highway 101 | Bridgeville |
| Eastern Monument Ridge | |

Project Components

- Proposed Representative Wind Turbine Locations
- Generation Transmission Line (Gen-Tie)
- Proposed Access Roads
- Substation
- Staging Area



Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Base map: Esri World Topographic Map



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Technical Review by SC on 2018-09-13

Client/Project
Humboldt Wind, LLC
Humboldt Wind Energy Project

Figure No.
2
Title
Project Area



APPENDICES

Appendix A WEATHER SUMMARY

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

Appendix A Table 1. Eagle Use Count Survey Weather Data by Plot and By Survey Event Conducted in the Humboldt Project area, Humboldt County, CA, October 24, 2017–October 26, 2018

Plot No.	Survey Event/Date	Temperature	Precipitation	Wind Speed	Cloud cover (%)	Wind direction	Visibility distance
11	1/Oct 24	28.8° C (84° F)	none	1.8–5.4 m/s (4–12 mph)	0	E	>800 m
12	1/Oct 25	19.0° C (66° F)	none	4.0–13.4 m/s (9–30 mph)	0	N	>800 m
13	1/Oct 25	24.0–29.0° C (75–84° F)	none	4.0–13.4 m/s (9–30 mph)	0	N	>800 m
14	1/Oct 25	24.0° C (75° F)	none	4.0–13.4 m/s (9–30 mph)	0	N	>800 m
15	1/Oct 26	22.2° C (72° F)	none	0 m/s (0 mph)	0	N/A	>800 m
16	2/Nov 1	13.3° C (56° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
17	2/Nov 1	14.1° C (57° F)	none	0.4–1.3 m/s (1–3 mph)	0	NE	>6 mi
18	2/Nov 1	8.8–11.6° C (48–53° F)	none	0 m/s (0 mph)	10	N/A	3–6 mi
19	2/Nov 1	5.5–8.3° C (42–47° F)	none	0 m/s (0 mph)	0	N/A	3–6 mi
15	2/Nov 19	8.0° C (46° F)	none	4.0–5.4 m/s (9–12 mph)	100	S	1–3 mi
16	2/Nov 19	9.0° C (48° F)	none	0.4–1.3 m/s (1–3 mph)	100	S	3–6 mi
17	2/Nov 19	8.5° C (47° F)	none	4.0–5.4 m/s (9–12 mph)	90–95	SE	>6 mi
18	2/Nov 19	10.5° C (51° F)	none	1.8–3.6 m/s (4–8 mph)	100	SE	1–3 mi
19	2/Nov 19	15.0° C (59° F)	showers	4.0–17.0 m/s (9–38 mph)	100	SW	300–400 m
11	2/Nov 29	3.7–7.0° C (39–45° F)	none	1.8–5.4 m/s (4–12 mph)	50–100	NW	3–6 mi
12	2/Nov 29	5.0° C (41° F)	none	4.0–5.4 m/s (9–12 mph)	50–100	N	>6 mi
13	2/Nov 29	5.5° C (42° F)	none	0.4–1.3 m/s (1–3 mph)	95–100	NE	>6 mi
14	2/Nov 29	5.0–7.5° C (41–46° F)	none	4.0–5.4 m/s (9–12 mph)	75	NW	>6 mi
11	3/Dec 13	16.0° C (61° F)	none	1.8–5.4 m/s (4–12 mph)	5	NE	1–3 mi
12	3/Dec 13	16.0° C (61° F)	none	4.0–5.4 m/s (9–12 mph)	10	N	1–3 mi
13	3/Dec 13	16.0–17.5° C (61–64° F)	none	1.8–5.4 m/s (4–12 mph)	50	NE	1–3 mi
14	3/Dec 13	12.0–16.0° C (54–61° F)	none	1.8–5.4 m/s (4–12 mph)	10	NW	3–6 mi
15	3/Dec 19	5.5° C (42° F)	drizzle	1.8–5.4 m/s (4–12 mph)	100	S	150 m–3 mi
16	3/Dec 19	6.0° C (43° F)	fog, drizzle	0–1.3 m/s (0–3 mph)	100	S	100 m
17	3/Dec 19	8.0–8.5° C (46–47° F)	none	0–1.3 m/s (0–3 mph)	95–100	S	3–6 mi
18	3/Dec 20	2.0° C (36° F)	none	0 m/s (0 mph)	50–100	N/A	1–3 mi
19	3/Dec 20	3.0° C (37° F)	drizzle	0 m/s (0 mph)	50–100	N/A	100 m–3 mi
15	4/Jan 3	14.3–15.5° C (58–60° F)	none	1.8–3.6 m/s (4–8 mph)	95–100	SW	>6 mi
16	4/Jan 3	13.0–14.0° C (55–57° F)	none	0.4–1.3 m/s (1–3 mph)	100	S	3–6 mi
17	4/Jan 3	18.0° C (64° F)	none	0.4–3.6 m/s (1–8 mph)	80–100	SE	>6 mi
18	4/Jan 4	12.5–13.0° C (55° F)	none	1.8–3.6 m/s (4–8 mph)	90–100	SW	1,000 m
19	4/Jan 4	12.5–13.0° C (55° F)	none	0.4–1.3 m/s (1–3 mph)	100	S	>6 mi
14	4/Jan 9	8.0° C (46° F)	none	4.0–8.0 m/s (9–18 mph)	100	S	75 m
11	4/Jan 10	8.0° C (46° F)	none	0–3.6 m/s (0–8 mph)	100	SW	50–100 m
12	4/Jan 10	7.5–8.5° C (46–47° F)	none	0.4–5.4 m/s (1–12 mph)	100	SW	150 m
13	4/Jan 10	5.0–6.5° C (41–44° F)	none	0.4–5.4 m/s (1–12 mph)	75–95	SW	200–100m
11	5/Feb 7	19.0° C (66° F)	none	0 m/s (0 mph)	5–10	N/A	>6 mi
12	5/Feb 7	19.0° C (66° F)	none	0.4–1.3 m/s (1–3 mph)	0	S	>6 mi
13	5/Feb 7	18.0–19.0° C (64–66° F)	none	0.4–3.6 m/s (1–8 mph)	0–5	S	>6 mi
14	5/Feb 7	15.5–17.0° C (60–63° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
15	5/Feb 14	6.5–7.5° C (44–46° F)	none	0 m/s (0 mph)	90–95	N/A	3–6 mi
16	5/Feb 14	7.5–13.0° C (46–55° F)	none	0–3.6 m/s (0–8 mph)	5–75	N	>6 mi
17	5/Feb 14	7.5–9.0° C (46–48° F)	none	0 m/s (0 mph)	60–95	N/A	3–6 mi
18	5/Feb 15	1.5–4.3° C (35–40° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
19	5/Feb 15	5.0° C (41° F)	none	1.8–3.6 m/s (4–8 mph)	0	NW	>6 mi
12	6/Mar 7	12.0–13.0° C (54–55° F)	none	5.8–10.7 m/s (13–24 mph)	40–50	S	3 mi
13	6/Mar 7	no data	none	4.0–13.4 m/s (9–30 mph)	25–100	SE	3–6 mi
14	6/Mar 7	no data	none	1.8–5.4 m/s (4–12 mph)	5–95	SE	>6 mi
11	6/Mar 8	6.1° C (43° F)	none	4.0–8.0 m/s (9–18 mph)	100	S	400 m
17	6/Mar 14	4.5–6.0° C (40–43° F)	none	0 m/s (0 mph)	25–95	N/A	1–6 mi
11	7/Apr 3	12.7–14.4° C (55–58° F)	none	1.8–3.6 m/s (4–8 mph)	10–50	NW	>6 mi
12	7/Apr 3	12.7° C (55° F)	none	0–3.6 m/s (0–8 mph)	10–25	NW	>6 mi
13	7/Apr 3	16.6° C (62° F)	none	0 m/s (0 mph)	0–10	N/A	>6 mi
14	7/Apr 3	15.5° C (60° F)	none	0–1.3 m/s (0–3 mph)	5	SW	>6 mi
17	7/Apr 3	12.2° C (54° F)	none	0 m/s (0 mph)	10	N/A	>6 mi
11	8/May 1	9.1–9.5° C (48–49° F)	none	4.0–5.4 m/s (9–12 mph)	0–50	N	3–6 mi
12	8/May 1	6.3–6.5° C (43–44° F)	none	1.8–8.0 m/s (4–18 mph)	5–25	NW	3–6 mi
13	8/May 1	9.5–11.0° C (49–52° F)	none	4.0–8.0 m/s (9–18 mph)	50–75	NW	3–6 mi
14	8/May 1	9.3° C (49° F)	fog	0.4–5.4 m/s (1–12 mph)	50	N	1 mi
17	8/May 1	12.0° C (54° F)	none	1.8–8.0 m/s (4–18 mph)	50	N	1 mi
15	8/May 23	12.0–13.0° C (54–55° F)	fog	0 m/s (0 mph)	100	N/A	50–100 m
16	8/May 23	12.0° C (54° F)	fog	0 m/s (0 mph)	100	N/A	150 m

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

Plot No.	Survey Event/Date	Temperature	Precipitation	Wind Speed	Cloud cover (%)	Wind direction	Visibility distance
18	8/May 23	14.3° C (58° F)	fog	0 m/s (0 mph)	100	N/A	1 mi
19	8/May 23	13.4–16.0° C (56–61° F)	fog	0–1.3 m/s (0–3 mph)	100	N	3–6 mi
28	8/May 29	9.1–11.9° C (48–53° F)	none	4.0–8.0 m/s (9–18 mph)	100	NW	800 m
29	8/May 29	12.9–16.1° C (55–61° F)	none	4.0–5.4 m/s (9–12 mph)	100	NW	1–6 mi
30	8/May 29	11.5° C (53° F)	none	1.8–5.4 m/s (4–12 mph)	50	N	3 mi
31	8/May 29	13.1° C (56° F)	none	0.4–3.6 m/s (1–8 mph)	50	N	3 mi
11	9/Jun 6	13.9° C (57° F)	none	1.8–3.6 m/s (4–8 mph)	100	N	25 m
12	9/Jun 6	13.6° C (56° F)	none	0.4–1.3 m/s (1–3 mph)	100	N	400–600 m
13	9/Jun 7	15.1° C (59° F)	none	0.4–1.3 m/s (1–3 mph)	100	N	25–200 m
14	9/Jun 7	11.0° C (52° F)	none	0–1.3 m/s (0–3 mph)	50–100	N	50 m–1 mi
15	9/Jun 15	14.8–16.5° C (59–62° F)	none	0 m/s (0 mph)	0	N/A	3–6 mi
16	9/Jun 15	9.3–10.0° C (49–50° F)	none	4.0–5.4 m/s (9–12 mph)	0	N	1–3 mi
17	9/Jun 15	12.3–13.9° C (54–57° F)	none	0.4–1.3 m/s (1–3 mph)	0–25	N	1–3 mi
18	9/Jun 15	15.2° C (59° F)	none	0 m/s (0 mph)	10	N/A	>6 mi
19	9/Jun 15	13.9° C (57° F)	none	0.4–1.3 m/s (1–3 mph)	100	N	50 m
28	9/Jun 26	23.9° C (75° F)	none	4.0–10.7 m/s (9–24 mph)	0	NW	unlimited
29	9/Jun 26	21.1° C (70° F)	none	4.0–8.0 m/s (9–18 mph)	0	NW	unlimited
30	9/Jun 26	23.2° C (74° F)	none	4.0–5.4 m/s (9–12 mph)	0	N	>6 mi
31	9/Jun 26	22.7° C (73° F)	none	0.4–1.3 m/s (1–3 mph)	0	N	>6 mi
11	10/Jul 3	15.8–16.3° C (60–61° F)	none	1.8–8.0 m/s (4–18 mph)	0	N	>6 mi
12	10/Jul 4	22.7–23.8° C (73–75° F)	none	0–1.3 m/s (0–3 mph)	10	N	3–6 mi
13	10/Jul 4	20.8–21.1° C (69–70° F)	none	0–1.3 m/s (0–3 mph)	20	N	3–6 mi
14	10/Jul 5	23.0–24.3° C (73–76° F)	none	0–1.3 m/s (0–3 mph)	10–20	N	3 mi
15	10/Jul 11	28.7° C (84° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
16	10/Jul 11	19.5° C (67° F)	none	0 m/s (0 mph)	0	N/A	6 mi
18	10/Jul 11	18.6° C (65° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
19	10/Jul 11	18.9° C (66° F)	none	0 m/s (0 mph)	0	N/A	6 mi
17	10/Jul 12	27.2–31.3° C (81–88° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
28	10/Jul 19	21.0° C (70° F)	none	4.0–5.4 m/s (9–12 mph)	5	N	>6 mi
29	10/Jul 19	21.1° C (70° F)	none	0.4–3.6 m/s (1–8 mph)	20	NW	>6 mi
30	10/Jul 19	21.7° C (71° F)	none	1.8–5.4 m/s (4–12 mph)	20	NW	>6 mi
31	10/Jul 25	29.2° C (85° F)	none	0.4–1.3 m/s (1–3 mph)	0	N	3–6 mi
12	11/Aug 8	not available					
13	11/Aug 8	30.5° C (86.9° F)	none	0.4–1.3 m/s (1–3 mph)	60	S	3–6 mi
14	11/Aug 8	28.8° C (84° F)	none	0 m/s (0 mph)	0	N/A	3–6 mi
15	11/Aug 8	19.8° C (68° F)	none	0 m/s (0 mph)	0	N/A	3–6 mi
11	11/Aug 9	33.0–37.4° C (91–99° F)	none	0 m/s (0 mph)	25	N/A	1–3 mi
16	11/Aug 15	25.5° C (78° F)	none	0 m/s (0 mph)	0	N/A	800 m–3 mi
17	11/Aug 15	16.1° C (61° F)	fog	0.4–1.3 m/s (1–3 mph)	100	W	0-1 mi
18	11/Aug 15	20.0° C (68° F)	fog	0.4–1.3 m/s (1–3 mph)	100	N	1–6 mi
19	11/Aug 15	not available					
28	11/Aug 27	15.3–15.7° C (60° F)	none	4.0–5.4 m/s (9–12 mph)	10	N	3–6 mi
29	11/Aug 27	23.3° C (74° F)	none	4.0–5.4 m/s (9–12 mph)	0	N	3–6 mi
30	11/Aug 27	17.6° C (64° F)	none	1.8–3.6 m/s (4–8 mph)	10	N	1–3 mi
31	11/Aug 27	24.0° C (75° F)	none	1.8–3.6 m/s (4–8 mph)	0	NW	1–6 mi
11	12/Sep 13	13.7–14.1°C (57° F)	none	0.4–1.3 m/s (1–3 mph)	0	N	>6 mi
12	12/Sep 13	12.4–13.5°C (54–56° F)	none	0.4–1.3 m/s (1–3 mph)	0	N	>6 mi
13	12/Sep 14	16.0–18.2°C (61–65° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
14	12/Sep 14	17°C (63° F)	none	0.4–1.3 m/s (1–3 mph)	0	N	>6 mi
15	12/Sep 22	24.9–28.0°C (77–82° F)	none	0–1.3 m/s (0–3 mph)	25–75	N	>6 mi
16	12/Sep 22	19.9–22.5°C (68–73° F)	none	0–1.3 m/s (0–3 mph)	25–50	NW	>6 mi
18	12/Sep 22	20.7–25.0°C (69–77° F)	none	0 m/s (0 mph)	10–25	N/A	>6 mi
19	12/Sep 22	15.6–15.8°C (60° F)	none	0–5.4 m/s (0–12 mph)	10–50	N	>6 mi
17	12/Sep 24	20.4–21.6°C (69–71° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
28	12/Sep 27	31.0–33.5°C (88–92° F)	none	0–1.3 m/s (0–3 mph)	10–50	N	>6 mi
29	12/Sep 28	17.4–17.9°C (63–64° F)	none	0–1.3 m/s (0–3 mph)	10–75	SW	>6 mi
30	12/Sep 28	19.7°C (67° F)	none	0.4–1.3 m/s (1–3 mph)	75	SW	>6 mi
31	12/Sep 28	20.5–24.1°C (69–75° F)	none	0 m/s (0 mph)	75	N/A	>6 mi
15	13/Oct 4	17.3°C (63° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
16	13/Oct 4	16.0–18.3°C (61–65° F)	none	0–1.3 m/s (0–3 mph)	0	N	>6 mi
18	13/Oct 4	16.9–20.0° C (62–68° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
19	13/Oct 4	10.8–12.4° C (51–54° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
11	13/Oct 15	18.7–22.5° C (66–73° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
12	13/Oct 15	20.4–21.6°C (69–71° F)	none	0 m/s (0 mph)	0	N/A	>6 mi

HUMBOLDT WIND ENERGY PROJECT EAGLE USE SURVEY REPORT

Appendix A Weather Summary

Plot No.	Survey Event/Date	Temperature	Precipitation	Wind Speed	Cloud cover (%)	Wind direction	Visibility distance
13	13/Oct 15	27.0–28.0°C (81–82° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
14	13/Oct 15	20.5–21.0°C (69–70° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
17	13/Oct 15	21.6–28.5°C (71–83° F)	none	0 m/s (0 mph)	0	N/A	>6 mi
28	13/Oct 26	18.5–20.0° C (65–68° F)	none	0–1.3 m/s (0–3 mph)	10–25	NE	>6 mi
29	13/Oct 26	22.3–25.8°C (72–79° F)	none	0.4–1.3 m/s (1–3 mph)	5	NE	>6 mi
30	13/Oct 26	20.3–20.4°C (69° F)	none	0.4–1.3 m/s (1–3 mph)	5	NE	>6 mi
31	13/Oct 26	17.8–21.9°C (64–71° F)	none	0.4–1.3 m/s (1–3 mph)	5	NE	>6 mi

Acronyms: C = Celsius; F = Fahrenheit; mi = miles; m = meters; m/s = meters per second; mph = mph.