Montague Wind Power Facility: Wildlife Monitoring and Mitigation Plan

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This plan describes wildlife monitoring that the certificate holder shall conduct during operation of the Montague Wind Power Facility (MWPF).[1] The monitoring objectives are to determine whether the facility causes significant fatalities of birds and bats and to determine whether the facility results in a loss of habitat quality.

The certificate holder shall use experienced and properly trained personnel (the "investigators") to conduct the monitoring required under this plan. ~~The professional qualifications of the investigators are subject to approval by the Oregon Department of Energy (Department).~~ For all components of this plan except the Wildlife Reporting and Handling System, the certificate holder shall hire independent third party investigators (not employees of the certificate holder) to perform monitoring tasks.

The *Wildlife Monitoring and Mitigation Plan* for the MWPF has the following components:

1) Fatality monitoring program including:
    a) Removal trials
    b) Searcher efficiency trials
    c) Fatality search protocol
    d) Statistical analysis
2) Raptor nesting surveys
3) Washington ground squirrel surveys
4) Wildlife Reporting and Handling System

Based on the results of the monitoring programs, mitigation of significant impacts may be required. The selection of the mitigation actions should allow for flexibility in creating appropriate responses to monitoring results that cannot be known in advance. If the Department determines that mitigation is needed, the certificate holder shall propose appropriate mitigation actions to the Department and shall carry out mitigation actions approved by the Department, subject to review by the Oregon Energy Facility Council (Council).

1. Fatality Monitoring

(a) Definitions and Methods

Seasons

This plan uses the following dates for defining seasons:

[1] This plan is incorporated by reference in the site certificate for the MWPF and must be understood in that context. It is not a "stand-alone" document. This plan does not contain all mitigation required of the certificate holder.

Season	Dates
Spring Migration	March 16 to May 15
Summer/Breeding	May 16 to August 15
Fall Migration	August 16 to October 31
Winter	November 1 to March 15

Search Plots

The investigators shall conduct fatality monitoring within circular search plots, centered on each sampled turbine, and having a radius of 150 meters (m) which is equal to the maximum blade tip height of all turbines at the MWPF. ~~The certificate holder, in consultation with the Oregon Department of Fish and Wildlife (ODFW), shall select search plots based on a systematic sampling design with a random starting point that ensures that the selected search plots are representative of the habitat conditions in different parts of the site. Each search plot will contain one turbine. Search plots will be square or circular. Circular search plots will be centered on the turbine location and will have a radius equal to the maximum blade tip height of the turbine contained within the plot. "Maximum blade tip height" is the turbine hub height plus one-half the rotor diameter. Square search plots will be of sufficient size to contain a circular search plot as described above. The certificate holder shall provide maps of the search plots to the Department before beginning fatality monitoring at the facility.~~ The certificate holder shall use the same search plots for each search conducted during a monitoring year, unless a switch to a road and pad search methodology is deemed warranted for a portion of the monitoring year (see Road and Pad Search Methodology section below).

Scheduling

Fatality monitoring will begin one month after commencement of commercial operation of the facility. Subsequent monitoring years will follow the same schedule (beginning in the same calendar month in the subsequent monitoring year).

The Certificate Holder will survey each search plot twice per month for the duration of the one year monitoring period. This is a more frequent search schedule during the summer and winter seasons than recommended by the previous (August 2017) version of the WMMP, which prescribed a monthly search interval for summer and winter, and is expected to provide for more accurate fatality estimation. Given the sensitivity of fatality rates to carcass persistence, the Certificate Holder may increase or decrease search frequency based on carcass persistence bias trials over the monitoring period but will do no fewer searches than the twice monthly searches described in the WMMP. ~~In each monitoring year, the investigators shall conduct fatality monitoring searches at the rates of frequency shown below.~~ Over the course of one monitoring year, the investigators will conduct ~~16~~ 24 searches, as follows:

Season	Frequency
Spring Migration	2 searches per month (4 searches)
Summer/Breeding	~~1~~ 2 searches per month (~~3~~ 6 searches)
Fall Migration	2 searches per month (5 searches)
Winter	~~1~~ 2 searches per month (~~4~~ 9 searches)

Sample Size

The sample size for fatality monitoring is the number of turbines searched per monitoring year. The investigators shall conduct fatality monitoring during each monitoring year in search plots at one-~~third~~ half of the turbines that are built~~ or 50 turbines, whichever is greater~~. ~~If fewer than 50 turbines are built, the certificate holder shall search all turbines.~~

As described in the site certificate, the certificate holder may choose to build the MWPF using turbine types in two size classes:

- Small: turbines having a rotor diameter of 82 m~~eters~~ or less
- Large: turbines having a rotor diameter greater than 82 m~~eters~~

MWPF has 56 turbines comprising 51 Vestas V136 with a 68-m rotor radius and 5 Vestas V126 turbines with a 63-m rotor radius. All Phase I turbines are "large" turbines with rotor diameters greater than 82 m as defined by the WMMP.

The 28 search plots for Phase 1 will be selected using a systematic sampling design that uses a random starting point, and then selects every other turbine. This provides for a spatial representation across the entire MWPF~~ site~~. During the second year fatality monitoring at Phase 1, the sample will comprise the remaining 28 turbines (50%) not searched during the initial year of monitoring, such that all 56 turbines are searched over the course of the two-year study. All turbines are located in dryland wheat, so there is not significant difference in vegetative cover types between the search plots, although some plots may include a portion of non-wheat areas (e.g. Turbine C3).~~ If the final design of the MWPF includes both small and large turbines, the certificate holder shall consult with an independent expert with experience in statistical analysis of avian fatality data to determine whether it would be possible to design a turbine sample with a sufficient number of turbines in each size class to allow a statistical comparison of fatality rates for all birds as a group. The certificate holder shall submit the expert's written analysis to the Department. If the expert's analysis shows that a comparison study is possible and if the Department approves, the certificate holder shall sample the appropriate number of turbines in each class and conduct the comparison study. The certificate holder may choose to sample more than 50 turbines in each monitoring year, if a larger sample size would allow the comparison study to be done.~~

Duration of Fatality Monitoring

The investigators shall perform fatality ~~one complete~~ monitoring ~~cycle~~ during the first full two years of facility operation (Year 1 and Year 2). At the end of each full~~the first~~ year of monitoring, the certificate holder will report the results for joint evaluation by the Department, the certificate holder and ODFW. In the evaluation, the certificate holder shall compare the results for the MWPF with the thresholds of concern described in Section 1(g) of this plan and with comparable data from other wind power facilities in the Columbia Basin, as available. For the purpose of determining whether a threshold has been exceeded, the ~~C~~certificate holder shall calculate the average annual fatality rates for the species groups after the initial two years of monitoring. ~~If the fatality rates for the first year of monitoring at the MWPF do not exceed any of the thresholds of concern and are within the range of the fatality rates found at other wind power facilities in the region, then the investigators will perform a second year of monitoring in Year 5 of operations.~~

If fatality rates for the combined first two years of monitoring at the MWPF exceed any of the thresholds of concern or exceed the range of fatality rates found at other wind power facilities in the region, the certificate holder shall propose additional mitigation for Department and ODFW review within 6 months after reporting the fatality rates to the Department. ~~Alternatively, the certificate holder may opt to conduct a second year of fatality monitoring immediately if the certificate holder believes that the results of Year 1 monitoring were anomalous. If the certificate holder takes this option, the investigators still must perform the monitoring in Year 5 of operations as described above.~~

Use of Road and Pad Sampling Methodology

The c~~C~~ertificate h~~H~~older requests the ability to use a road and pad (R&P) sampling method as an alternative to full plot (FP) searches if tall vegetation (i.e., wheat) results in poor searcher efficiency. Tall wheat can obscure detection of bird and bat carcasses and result in low carcass detection, and consequently the fatality estimates are skewed upward to account for potentially missed carcasses. A R&P method defines the search plot as the high visibility areas within 150 m of each turbine (typically graveled areas along roads and turbine bases), and excludes areas with low visibility (tall wheat). The search area at each turbine will be less for the road and pad searches, however, a larger sample of turbines will be searched to make up for the lost search area. While the amount of high visibility area for each R&P search plot will vary between turbines, it is estimated that the search area will comprise between 20% and 40% of the area encompassed by the full 150-m radius plot (Figure 2). For the R&P method, the number of fatalities found will be adjusted to account for fatalities potentially occurring in the unsearched (low visibility) portions of the 150-m radius plots, and therefore, missed by searchers. Huso and Dalthorp (2014) present one such method of adjusting fatality estimates to account for unsearched portions of the sampling plot. Their method uses models relating carcass density to distance from turbine to estimate the proportion of carcasses expected to fall in searched areas and evaluates the statistical costs of restricting searches to high visibility areas (Huso and Dalthorp 2014). A R&P sampling methodology is often employed at certain times of the year during PCFM studies conducted at facilities within agricultural landscapes, particularly in the Midwest, when crops become too tall or dense to effectively detect carcasses. Other PCFM studies have used a similar method to adjust for areas not searched due to dangerous terrain or impenetrable brush/forest within portions of the search plots.

~~During standardized monitoring searches a transition from FP searches to R&P searches can be feasible while still producing a robust estimate of mortality. Because carcasses are not uniformly distributed throughout a turbine search plot (i.e., carcasses are more likely to be found at some distances than others), an important component of correcting for the area not searched in a R&P search (i.e., search area adjustment) involves estimating the carcass density distribution within the plot. Two common ways in which this density distribution is estimated involves using a truncated weighted likelihood (TWL) approach (Khokan et al. 2013) or a Hull and Muir (2010) distribution. When enough casualties are found at a particular site, these data can be used to create a site-specific carcass density distribution. A TWL approach can then be used to account for carcasses which may fall outside of the searched area. When there are not enough carcasses present at a site to fit a carcass density distribution, a distribution such as Hull and Muir (2010) may be used. Hull and Muir (2010) does not depend on site-specific data, but rather estimates the maximum distance a carcass is expected to fall from a turbine and assumes a linear distribution~~

~~of carcasses from the turbine base to the maximum fall distance. Using either method, the area adjustment is calculated by multiplying the probability of a carcass occurring in a one-unit increment with the proportion of area searched in the same one-unit increment, then summed across all distances. The area adjustment is the proportion of carcasses expected to fall in the searched areas. Conceptually, this is the same as searcher efficiency, or the proportion of carcasses searchers are expected to find. Searcher efficiency adjusts the carcass counts as does the area adjustment.~~

~~For a circular FP, the area adjustment is the proportion of the carcass distance distribution within the search radius. For R&P plots, it is a little more complicated because for some distance, say between 80 and 150 meters, not all of the area around the turbine is searched. However, this proportion of area searched "weights" the distance distribution accounting for the unsearched areas (as described above). The area adjustment for R&P searches is the proportion of carcasses expected to land on the R&P. Thus we can account for unsearched areas.~~

~~As vegetation within search plots changes over time, and searchers become ineffective at finding carcasses in areas of tall wheat, a switch to a R&P search methodology may be warranted for all search plots, or a subset of plots. From a statistical standpoint, it is not problematic to switch from a FP search to a R&P search, either on a project-wide basis or for individual turbines. The main adjustments to carcass count is searcher efficiency, carcass persistence, and area adjustment. We know that adjustments depend on certain variables such as season and/or plot type. For example, searcher efficiency is typically much better on R&P than full plots. Each adjustment is applied to each carcass individually based on the season and/or plot type. If, for example, Turbine 1 has full plot searches completed for the first 4 searches, then for search 5 switches to R&P, any carcasses found on Turbine 1 during search 5 will get the R&P adjustment rather than the FP adjustment. In this way carcasses are adjusted according to their specific conditions of being found.~~

~~A R&P searches does not provide as good of spatial coverage as a full plot~~FP searches at a single turbine, but because ~~they~~ R&P searches are less time intensive, they allow better spatial coverage across the facility (i.e., more turbines searched in the same amount of time). R&P searches also typically have very high searcher efficiency rates, meaning carcasses have a higher likelihood of actually being discovered, given they are present. Additionally, conditions on the roads and pads are typically better controlled and thus less hazardous to searchers and do not cause damage to crops.

At M~~ontagu~~WPFe, a road and pad sampling method would only be used within sampling plots containing cropland, and only if/when vegetation becomes tall enough to impede detection of fatalities. The c~~C~~ertificate h~~H~~older is negotiating with landowners to not plant wheat in the sample plots during the one year monitoring period but some landowners may not agree as the sample plots are large and typically located the middle of fields. For example, for one land owner the sample plots represent 137 acres of their property that could not be farmed during the monitoring period.

(b) Removal Trials

The objective of the removal trials is to estimate the length of time avian and bat carcasses remain in the search area. Estimates of carcass removal rates will be used to adjust

carcass counts for removal bias. "Carcass removal" is the disappearance of a carcass from the search area due to predation, scavenging or other means such as farming activity.

The investigators shall conduct carcass removal trials within each of the seasons defined above during the first year of fatality monitoring. For each trial, the investigators shall use 10 to 15 carcasses of small- and large-bodied species. After the first year of fatality monitoring, the investigators may reduce the number of removal trials and the number of removal trial carcasses during any subsequent year of fatality monitoring, subject to the approval of the Department. The investigators must show that the reduction is justified based on a comparison of the first-year removal data with published removal data from nearby wind energy facilities.

The investigators shall use game birds or other legal sources of avian species as test carcasses for the removal trials, and the investigators may use fresh avian carcasses found in fatality monitoring searches. The investigators shall select species with approximately the same coloration and size attributes as species found within the site boundary. If suitable trial carcasses are available, trials during the spring, summer, and fall season will include ~~several~~ small brown birds or brown mice to simulate bat carcasses. Legally obtained bat carcasses, or bat carcasses encountered during fatality monitoring, will be used if available.

Trial carcasses will be marked discreetly for recognition by searchers and other personnel. Carcasses will be placed in a variety of postures to simulate a range of conditions. For example, birds will be: (1) placed in an exposed posture (e.g., thrown over the shoulder), (2) hidden to simulate a crippled bird (e.g., placed beneath a shrub or tuft of grass) or (3) partially hidden. The trial carcasses will be placed randomly within the carcass removal trial plots. Trial carcasses will be left in place until the end of the carcass removal trial.

An approximate schedule for assessing removal status is once daily for the first 4 days, and on days 7, 10, 14, 21, 28 and 35. This schedule may be adjusted depending on actual carcass removal rates, weather conditions and coordination with the other survey work. The condition of scavenged carcasses will be documented during each assessment, and at the end of the trial all traces of the carcasses will be removed from the site. Scavenger or other activity could result in complete removal of all traces of a carcass in a location or distribution of feathers and carcass parts to several locations. This distribution will not constitute removal if evidence of the carcass remains within an area similar in size to a search plot and if the evidence would be discernable to a searcher during a normal survey.

Before beginning removal trials for any subsequent year of fatality monitoring, the certificate holder shall report the results of the first-year removal trials to the Department and ODFW. In the report, the certificate holder shall analyze whether four removal trials per year, as described above, provide sufficient data to accurately estimate adjustment factors for carcass removal. The number of removal trials may be adjusted up or down, subject to the approval of the Department.

(c) Searcher Efficiency Trials

The objective of searcher efficiency trials is to estimate the percentage of bird and bat fatalities that searchers are able to find. The investigators shall conduct searcher efficiency trials on the fatality monitoring search plots in both grassland/shrub-steppe and cultivated agriculture habitat types. A pooled estimate of searcher efficiency will be used to adjust carcass counts for detection bias.

The investigators shall conduct searcher efficiency trials within each of the seasons defined above during the years in which the fatality monitoring occurs. Each trial will involve approximately 4 to 15 carcasses. The searchers will not be notified of carcass placement or test dates. The investigators shall vary the number of trials per season and the number of carcasses per trial so that the searchers will not know the total number of trial carcasses being used in any trial. In total, approximately ~~80~~ 120 carcasses will be used per year, or approximately ~~15 to 25~~30 per season.

For each trial, the investigators shall use small- and large-bodied species. The investigators shall use game birds or other legal sources of avian species as test carcasses for the efficiency trials~~, and the investigators may use carcasses found in fatality monitoring searches~~. The investigators shall select species with approximately the same coloration and size attributes as species found within the site boundary. If suitable test carcasses are available, trials during the fall season will include several small brown birds or brown mice to simulate bat carcasses. Legally obtained bat carcasses, or bat carcasses encountered during fatality monitoring searches, will be used if available. The investigators shall mark the test carcasses to differentiate them from other carcasses that might be found within the search plot and shall use methods similar to those used to mark removal test carcasses as long as the procedure is sufficiently discreet and does not increase carcass visibility.

The ~~certificate holder~~ investigators shall distribute trial carcasses in varied habitat in rough proportion to the habitat types within the facility site. On the day of a standardized fatality monitoring search (described below) but before the beginning of the search, investigators will place efficiency trial carcasses randomly within search plots (one to three trial carcasses per search plot) within areas to be searched. If scavengers appear attracted by placement of carcasses, the carcasses will be distributed before dawn.

Efficiency trials will be spread over the entire season to incorporate effects of varying weather and vegetation growth. Carcasses will be placed in a variety of postures to simulate a range of conditions. For example, birds will be: (1) placed in an exposed posture (thrown over the shoulder), (2) hidden to simulate a crippled bird or (3) partially hidden.

The number and location of the efficiency trial carcasses found during the carcass search will be recorded. The number of efficiency trial carcasses available for detection during each trial will be determined immediately after the trial by the person responsible for distributing the carcasses. Following plot searches, all traces of test carcasses will be removed from the site.

If new searchers are brought into the search team, additional searcher efficiency trials will be conducted to ensure that detection rates incorporate searcher differences. The certificate holder shall include a discussion of any changes in search personnel and any additional detection trials in the reporting required under Section 5 of this plan.

Before beginning searcher efficiency trials for any subsequent year of fatality monitoring, the certificate holder shall report the results of the first-year efficiency trials to the Department and ODFW. In the report, the certificate holder shall analyze whether the efficiency trials as described above provide sufficient data to accurately estimate adjustment factors for searcher efficiency. The number of searcher efficiency trials for any subsequent year of fatality monitoring may be adjusted up or down, subject to the approval of the Department.

(d) Fatality Monitoring Search Protocol

The objective of fatality monitoring is to estimate the number of bird and bat fatalities that are attributable to facility operation as an indicator of the impact of the facility on habitat quality. The goal of bird and bat fatality monitoring is to estimate fatality rates and associated variances. The investigators shall perform fatality monitoring using standardized carcass searches according to the schedule described above.

Personnel trained in proper search techniques ("the searchers") will conduct the carcass searches by walking parallel transects approximately 6 meters apart within the search plots. A searcher will walk at a rate of approximately 45 to 60 meters per minute along each transect, searching both sides out to 3 meters for casualties. Search area and speed may be adjusted by habitat type after evaluation of the first searcher efficiency trial.

Searchers shall flag all avian or bat carcasses discovered. Carcasses are defined as a complete carcass or body part, 10 or more feathers or three or more primary feathers in one location. When parts of carcasses and feathers from the same species are found within a search plot, searchers shall make note of the relative positions and assess whether or not these are from the same fatality.

All carcasses (avian and bat) found during the standardized carcass searches will be photographed, recorded and labeled with a unique number. Searchers shall make note of the nearest two or three structures (turbine, power pole, fence, building or overhead line) and the approximate distance from the carcass to these structures. The species and age of the carcass will be determined when possible. Searchers shall note the extent to which the carcass is intact and estimate time since death. Searchers shall describe all evidence that might assist in determination of cause of death, such as evidence of electrocution, vehicular strike, wire strike, predation or disease. ~~When assessment of the carcass is complete, all traces of it will be removed from the site.~~While the c~~C~~ertificate h~~H~~older does not currently hold a federal SPUT Permit to allow collection of most native bird carcasses, the investigators conducting the fatality monitoring study possess an ODFW Scientific Taking Permit to allow salvage of bat carcasses found during the study. Each bat carcass will be bagged and frozen (assuming the necessary permits have been acquired) for future reference and possible necropsy or (if the carcass is fresh and whole) for use in trials. A copy of the data sheet for each bat carcass will be kept with the carcass at all times.

For each bird or bat carcass found, searchers will record species, sex, and age when possible, date and time collected, location, condition (e.g., intact, scavenged, feather spot) and any comments that may indicate cause of death. Searchers will photograph each carcass as found and will map the find on a detailed map of the search area showing the location of the wind turbines and associated facilities. The certificate holder shall coordinate collection of state endangered, threatened, sensitive or other state protected species with ODFW. The certificate holder shall coordinate collection of federally listed endangered or threatened species ~~and Migratory Bird Treaty Act protected avian species~~ with the U.S. Fish and Wildlife Service (USFWS). ~~The certificate holder shall obtain appropriate collection permits from ODFW and USFWS.~~

The investigators shall calculate fatality rates using the statistical methods described in Section (f), except that the investigators may use different notation or methods that are mathematically equivalent with prior approval of the Department. In making these calculations,

the investigators may exclude carcass data from the first search of each turbine plot (to eliminate possible counting of carcasses that were present before the turbine was operating).

The investigators shall estimate the number of avian and bat fatalities attributable to operation of the facility based on the number of avian and bat fatalities found at the facility site. All carcasses located within areas surveyed, regardless of species, will be recorded and, if possible, a cause of death determined based on blind necropsy results. If a different cause of death is not apparent, the fatality will be attributed to facility operation. The total number of avian and bat fatalities will be estimated by adjusting for removal and searcher efficiency bias.

On an annual basis, the certificate holder shall report an estimate of fatalities in eight categories: (1) all birds, (2) small birds, (3) large birds, (4) raptors, (5) grassland birds, (6) nocturnal migrants, (7) state and federally listed threatened and endangered species and State Sensitive Species listed under OAR 635-100-0040 and (8) bats. The certificate holder shall report annual fatality rates on both a per-MW and per-turbine basis.

(e) Incidental Finds and Injured Birds

The searchers might discover carcasses incidental to formal carcass searches (e.g., while driving within the project area). For each incidentally discovered carcass, the searcher shall identify, photograph, record data and collect the carcass as would be done for carcasses within the formal search sample during scheduled searches. If the incidentally discovered carcass is found within a formal search plot, the fatality data will be included in the calculation of fatality rates. If the incidentally discovered carcass is found outside a formal search plot, the data will be reported separately. The certificate holder shall coordinate collection of incidentally discovered state endangered, threatened, sensitive or other state protected species with ODFW. The certificate holder shall coordinate collection of incidentally discovered federally-listed endangered or threatened species ~~and Migratory Bird Treaty Act protected avian species with the USFWS~~.

The certificate holder shall develop and follow a protocol for handling injured birds. Any injured native birds found on the facility site will be carefully captured by ~~a trained project biologist or technician and transported to~~ a qualified rehabilitation specialist approved by the Department.[2] The certificate holder shall pay costs, if any, charged for time and expenses related to care and rehabilitation of injured native birds found on the site, unless the cause of injury is clearly demonstrated to be unrelated to the facility operations.

(f) Statistical Methods for Fatality Estimates

Carcasses included in the fatality rate estimation will include those found within the search areas and with an estimated time of death within the study period. Fatality estimates, on both a per-MW and a per-turbine basis, will be calculated for the following categories: (1) all birds, (2) small birds, (3) large birds, (4) raptors, (5) grassland birds, (6) nocturnal migrants, (7) state and federally listed threatened and endangered species and State Sensitive Species listed under OAR 635-100-0040 and (8) bats. Consistent with current industry standards, fatality rates will be estimated using GenEst (a generalized estimator of fatality; Dalthorp et al. 2018, Simonis

[2] Approved specialists include Lynn Tompkins (wildlife rehabilitator) of Blue Mountain Wildlife, a wildlife rehabilitation center in Pendleton, and the Audubon Bird Care Center in Portland. The certificate holder must obtain Department approval before using other specialists.

et al. 2018). The GenEst software, available as an open source R-package, was developed through a collaborative effort led by US Geological Survey to specifically estimate the number of bird and bat fatalities at wind and solar energy facilities. GenEst estimates the size of an open population (bird and bat fatalities) when detection probabilities (searcher efficiency and carcass persistence) and search coverages are less than one. To obtain an overall estimate of mortality, each carcass included in the analysis will be adjusted for searcher efficiency, carcass persistence, and search area. Additionally, to account for the change in searcher efficiency between successive searches, GenEst requires input of a detection reduction factor (*k*). A value for *k* of 0.67 has been estimated for bats (Huso et al. 2017), and this value will be assumed for both bird and bats for this study (i.e., searcher efficiency is reduced by 33% for each successive search). Fatality estimates and confidence intervals will be calculated using a parametric bootstrap (Dalthorp et al. 2018) for each individual category listed above, assuming more than five fatalities within each category are detected.

~~The estimate of the total number of wind facility-related fatalities is based on:~~

~~(1) The observed number of carcasses found during standardized searches during the two monitoring years for which the cause of death is attributed to the facility.[3]~~
~~(2) Searcher efficiency expressed as the proportion of planted carcasses found by searchers.~~
~~(3) Removal rates expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during the entire survey period.~~

~~Definition of Variables~~

~~The following variables are used in the equations below:~~

~~c_i — the number of carcasses detected at plot *i* for the study period of interest (e.g., one year) for which the cause of death is either unknown or is attributed to the facility~~

~~n — the number of search plots~~

~~k — the number of turbines searched (includes the turbines centered within each search plot and a proportion of the number of turbines adjacent to search plots to account for the effect of adjacent turbines on the search plot buffer area)~~

~~$\bar{c}$ — the average number of carcasses observed per turbine per year~~

~~s — the number of carcasses used in removal trials~~

~~s_e — the number of carcasses in removal trials that remain in the study area after 35 days~~

~~se — standard error (square of the sample variance of the mean)~~

~~t_i — the time (days) a carcass remains in the study area before it is removed~~

~~$\bar{t}$ — the average time (days) a carcass remains in the study area before it is removed~~

~~d — the total number of carcasses placed in searcher efficiency trials~~

~~p — the estimated proportion of detectable carcasses found by searchers~~

~~[3] If a different cause of death is not apparent, the fatality will be attributed to facility operation.~~

~~I — the average interval between searches in days~~

~~$\hat{\pi}$ — the estimated probability that a carcass is both available to be found during a search and is found~~

~~m_t — the estimated annual average number of fatalities per turbine per year, adjusted for removal and observer detection bias~~

~~C — nameplate energy output of turbine in megawatts (MW)~~

~~Observed Number of Carcasses~~

~~The estimated average number of carcasses ($\bar{c}$) observed per turbine per year is:~~

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k}. \quad (1)$$

~~Estimation of Carcass Removal~~

~~Estimates of carcass removal are used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) is the average length of time a carcass remains at the site before it is removed:~~

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c}. \quad (2)$$

~~This estimator is the maximum likelihood estimator assuming the removal times follow an exponential distribution and there is right-censoring of data. Any trial carcasses remaining at 35 days are collected, yielding censored observations at 35 days. If all trial carcasses are removed before the end of the trial, then s_c is 0, and $\bar{t}$ is just the arithmetic average of the removal times. Removal rates will be estimated by carcass size (small and large), habitat type and season.~~

~~Estimation of Observer Detection Rates~~

~~Observer detection rates (i.e., searcher efficiency rates) are expressed as p, the proportion of trial carcasses that are detected by searchers. Observer detection rates will be estimated by carcass size, habitat type and season.~~

~~Estimation of Facility-Related Fatality Rates~~

~~The estimated per turbine annual fatality rate (m_t) is calculated by:~~

$$m_t = \frac{\bar{c}}{\hat{\pi}}, \quad (3)$$

~~where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and observer detection bias assuming that the carcass removal times t_i follow an exponential distribution. Under these assumptions, this detection probability is estimated by:~~

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I} \cdot \left[\frac{\exp\left(I/\bar{t}\right) - 1}{\exp\left(I/\bar{t}\right) - 1 + p} \right] \quad (4)$$

The estimated per MW annual fatality rate (m) is calculated by:

$$m = \frac{m_t}{C} \quad (5)$$

The final reported estimates of *m*, associated standard errors and 90% confidence intervals will be calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. For each iteration of the bootstrap, the plots will be sampled with replacement, trial carcasses will be sampled with replacement, and $\bar{c}$, $\bar{t}$, p, $\hat{\pi}$ and m will be calculated. A total of 5,000 bootstrap iterations will be used. The reported estimates will be the means of the 5,000 bootstrap estimates. The standard deviation of the bootstrap estimates is the estimated standard error. The lower 5th and upper 95th percentiles of the 5000 bootstrap estimates are estimates of the lower limit and upper limit of 90% confidence intervals.

Nocturnal Migrant and Bat Fatalities

Differences in observed nocturnal migrant and bat fatality rates for lit turbines, unlit turbines that are adjacent to lit turbines and unlit turbines that are not adjacent to lit turbines will be compared graphically and statistically.

(g) Mitigation

The certificate holder shall use a worst-case analysis to resolve any uncertainty in the results and to determine whether the data indicate that additional mitigation should be considered. The Department may require additional, targeted monitoring if the data indicate the potential for significant impacts that cannot be addressed by worst-case analysis and appropriate mitigation.

Mitigation may be appropriate if fatality rates exceed a "threshold of concern."[4] For the purpose of determining whether a threshold has been exceeded, the certificate holder shall calculate the average annual fatality rates for species groups after the initial two~~each~~ years of monitoring. Based on current knowledge of the species that are likely to use the habitat in the area of the facility, the following thresholds apply to the MWPF:

[4] The Council adopted "thresholds of concern" for raptors, grassland species, and state sensitive avian species in the Final Order on the Application for the Klondike III Wind Project (June 30, 2006) and for bats in the Final Order on the Application for the Biglow Canyon Wind Farm (June 30, 2006). As explained in the Klondike III order: "Although the threshold numbers provide a rough measure for deciding whether the Council should be concerned about observed fatality rates, the thresholds have a very limited scientific basis. The exceeding of a threshold, by itself, would not be a scientific indicator that operation of the facility would result in range-wide population level declines of any of the species affected. The thresholds are provided in the Wildlife Monitoring and Mitigation Plan to guide consideration of additional mitigation based on two years of monitoring data."

Species Group	**Threshold of Concern** (fatalities per MW)
Raptors (All eagles, hawks, falcons, and owls, including burrowing owls.)	0.09
Raptor species of special concern (Swainson's hawk, ferruginous hawk, peregrine falcon, golden eagle, bald eagle, burrowing owl and any federal threatened or endangered raptor species.)	0.06
Grassland species (All native bird species that rely on grassland habitat and are either resident species occurring year round or species that nest in the area, excluding horned lark, burrowing owl and northern harrier.)	0.59
State sensitive avian species listed under OAR 635-100-0040 (Excluding raptors listed above.)	0.2
Bat species as a group	2.5

If the data show that a threshold of concern for a species group has been exceeded, the certificate holder shall implement additional mitigation if the Department determines that mitigation is appropriate based on analysis of the data, consultation with ODFW and consideration of any other significant information available at the time. In addition, the Department may determine that mitigation is appropriate if fatality rates for individual avian or bat species (especially State Sensitive Species) are higher than expected and at a level of biological concern. If the Department determines that mitigation is appropriate, the certificate holder, in consultation with the Department and ODFW, shall propose mitigation measures designed to benefit the affected species. This may take into consideration whether the mitigation required or provided in conjunction with raptor nest monitoring, habitat mitigation, or other components of the *Wildlife Monitoring and Mitigation Plan* or *Habitat Mitigation Plan*, would also benefit the affected species.

The certificate holder shall implement mitigation as approved by the Department, subject to review by the Council. The Department may recommend additional, targeted data collection if the need for mitigation is unclear based on the information available at the time. The certificate holder shall implement such data collection as approved by the Council.

The certificate holder shall design mitigation to benefit the affected species group. Mitigation may include, but is not limited to, protection of nesting habitat for the affected group of native species through a conservation easement or similar agreement. Tracts of land that are intact and functional for wildlife are preferable to degraded habitat areas. Preference should be given to protection of land that would otherwise be subject to development or use that would diminish the wildlife value of the land. In addition, mitigation measures might include: enhancement of the protected tract by weed removal and control; increasing the diversity of native grasses and forbs; planting sagebrush or other shrubs; constructing and maintaining artificial nest structures for raptors; improving wildfire response; and conducting or making a contribution to research that will aid in understanding more about the affected species and its conservation needs in the region.

If the data show that the threshold of concern for bat species as a group has been exceeded, the certificate holder shall implement additional mitigation if the Department

determines that mitigation is appropriate based on analysis of the data, consultation with ODFW and consideration of any other significant information available at the time. For example, if the threshold for bat species as a group is exceeded, the certificate holder may contribute to Bat Conservation International or to a Pacific Northwest bat conservation group to fund new or ongoing research in the Pacific Northwest to better understand wind facility impacts to bat species and to develop possible ways to reduce impacts to the affected species.

2. Raptor Nest Surveys

The objectives of raptor nest surveys are: (1) to estimate the size of the local breeding populations of raptor species that nest on the ground or aboveground in trees or other aboveground nest locations in the vicinity of the facility; and (2) to determine whether operation of the facility results in a reduction of nesting activity or nesting success in the local populations of the following raptor species: Swainson's hawk, golden eagle, ferruginous hawk, and burrowing owl.

The certificate holder shall conduct short-term and long-term monitoring. The investigators will use ground surveys to evaluate nest success by gathering data on active nests, on nests with young and on young fledged. The investigators will analyze the data as described in Section 3(c) and will share the data with state and federal biologists.

(a) Short-Term Monitoring

~~-~~Short-term monitoring will be done in two monitoring seasons. The first monitoring season will be in the first raptor nesting season after completion of construction of the facility. The second monitoring season will be in the fourth year after construction is completed. The certificate holder shall provide a summary of the first-year results in the monitoring report described in Section 5. After the second monitoring season, the investigators will analyze two years of data compared to the baseline data.

For Raptor Species that Nest Aboveground

During each monitoring season, the investigators will conduct a minimum of one aerial and one ground survey for raptor nests in late May or early June and additional surveys as described in this section. The survey area is the area within the facility site and a 2-mile buffer zone around the site. For the ground surveys while checking for nesting *success* (conducted within the facility site and up to a maximum of ½ mile from the facility site), nests outside the leased project boundary will be checked from an appropriate distance where feasible, depending on permission from the landowner for access.

All nests discovered during pre-construction surveys and any nests discovered during post-construction surveys, whether active or inactive, will be given identification numbers. Nest locations will be recorded on U.S. Geological Survey 7.5-minute quadrangle maps. Global positioning system (GPS) coordinates will be recorded for each nest. Locations of inactive nests will be recorded because they could become occupied during future years.

Determining nest *occupancy* may require one or two visits to each nest. Aerial surveys for nest occupancy will be conducted within the facility site and a 2-mile buffer. For occupied nests, the certificate holder will determine nesting *success* by a minimum of one ground visit to determine the species, number of young and young fledged within the facility site and up to ½

mile from the facility site. "Nesting success" means that the young have successfully fledged (the young are independent of the core nest site).

For Burrowing Owls

If burrowing owl nest sites are discovered, the investigators will monitor them according to the following protocol. This species is not easily detected during aerial raptor nest surveys. The investigators shall record active burrowing owl nest sites in the vicinity of the facility as they are discovered during other wildlife monitoring tasks. Any nests discovered during post-construction surveys, whether active or showing signs of intermittent use by the species, will be given identification numbers. Nest locations will be recorded on U.S. Geological Survey 7.5-minute quadrangle maps. Global positioning system coordinates will be recorded for each nest site. Coordinates for ancillary burrows used by one nesting pair or a group of nesting pairs will also be recorded. Locations of inactive nests will be recorded because they could become occupied during future years.

The investigators shall conduct burrowing owl monitoring in the same years as the raptor nest surveys described above. For occupied nests, the investigators shall determine nesting *success* by a minimum of one ground visit to determine species, number of young and young fledged. "Nesting success" means that the young have successfully fledged (the young may or may not be independent of the core nest site). Three visits to the nest sites may be necessary to determine outcome. Nests that cannot be monitored due to the landowner denying access will be checked from a distance where feasible.

If burrowing owl nests are discovered during the first year of post-construction raptor nest surveys (the first raptor nesting season after construction is completed), the investigators shall monitor those nest locations during the second year of surveys in the fourth year after construction is completed. Thereafter, the investigators shall monitor all known burrowing owl nest locations as a part of the long-term raptor nest monitoring program described in Section 2(b) below.

(b) Long-Term Monitoring

In addition to the two years of post-construction raptor nest surveys described in Section 2(a), the investigators shall conduct long-term raptor nest surveys at 5-year intervals for the life of the facility.[5] Investigators will conduct the first long-term raptor nest survey in the first raptor nesting season that is at least 5 years after the completion of construction and is in a year that is divisible by five (i.e., ~~2020,~~ 2025, 2030, 2035); and will repeat the survey at 5-year intervals thereafter. In conducting long-term surveys, the investigators will follow the same survey protocols as described above in Section 2(a) unless the investigators propose alternative protocols that are approved by the Department. In developing an alternative protocol, the investigators will consult with ODFW and will take into consideration other monitoring conducted in adjacent areas. The investigators will analyze the data and report after each year of long-term raptor nest surveys.

[5] As used in this plan, "life of the facility" means continuously until the facility site is restored and the site certificate is terminated in accordance with OAR 345-027-0110.

(c) Analysis

The investigators will analyze the raptor nesting data to determine whether a reduction in either nesting success or nest use has occurred in the survey area. If the analysis indicates a reduction in nesting success or nest use by Swainson's hawks, ferruginous hawks, or burrowing owls, then the certificate holder will propose appropriate mitigation for the affected species as described in Section 2(d) and will implement mitigation as approved by the Department, subject to review by the Council.

Reductions in nesting success or nest use could be due to operation of the MWPF, operation of another wind facility in the vicinity or some other cause. The investigators shall attribute the reduction to operation of the MWPF if the wind turbine closest to the affected nest site is an MWPF turbine, unless the certificate holder demonstrates, and the Department agrees, that the reduction was due to a different cause. At a minimum, if the analysis shows that a Swainson's hawk, ferruginous hawk or burrowing owl has abandoned a nest territory within the facility site or within ½ mile of the facility site or has not fledged any young over two successive surveys within that same area, the investigators will assume the abandonment or unsuccessful fledging is due to operation of the facility unless another cause can be demonstrated convincingly.

Given the low raptor nesting densities in the area and the presence of other wind energy facilities nearby, statistical power to detect a relationship between distance from an MWPF wind turbine and nesting parameters (e.g., number of fledglings per reproductive pair) will be very low. Therefore, impacts may have to be judged based on trends in the data, results from other wind energy facility monitoring studies and literature on what is known regarding the populations in the region.

(d) Mitigation

If the analysis shows a reduction in nesting success or nest use, the certificate holder shall implement mitigation if the Department determines that mitigation is appropriate. The certificate holder shall propose mitigation for the affected species in consultation with the Department and ODFW and shall implement mitigation as approved by the Council. In proposing appropriate mitigation, the certificate holder shall advise the Department if any other wind project in the area is obligated to provide mitigation for a reduction in raptor nesting success at the same nest site. Mitigation should be designed to benefit the affected species or contribute to overall scientific knowledge and understanding of what causes nest abandonment or nest failure. Mitigation may be designed to proceed in phases over several years. It may include, but is not limited to, additional raptor nest monitoring, protection of natural nest sites from human disturbance or cattle activity (preferably within the general area of the facility) or participation in research projects designed to improve scientific understanding of the needs of the affected species. Mitigation may take into consideration whether the mitigation required or provided in conjunction with other components of the *Wildlife Monitoring and Mitigation Plan* or *Habitat Mitigation Plan* would also benefit the raptor species whose nesting success was adversely affected.

3. Washington ground squirrel surveys

The certificate holder shall conduct long-term post-construction surveys to collect data on Washington ground squirrel (WGS) activity within the site boundary. Qualified professional

biologists will monitor the locations within the facility site where WGS were detected in pre-construction surveys (beginning in 2017). The survey area includes the identified burrow areas and the buffer areas within 785 feet in suitable habitat. The investigators will walk standard protocol-level transects twice between late March and late May and record level of use, notes on natal sites, physical extent of the sites and any noticeable land use or habitat changes that may have occurred since the preconstruction survey in 2017. The investigators shall report any new WGS detections.

The certificate holder shall conduct surveys during the year following construction and every three years thereafter for the life of the facility. After each survey, the certificate holder shall report the results to ODFW and to the Department and shall include maps of the areas surveyed and detection locations.

4. Wildlife Reporting and Handling System

The Wildlife Reporting and Handling System (WRHS) is a monitoring program to search for and handle avian and bat casualties found by maintenance personnel during operation of the facility. Maintenance personnel will be trained in the methods needed to carry out this program. This monitoring program includes the initial response, handling, and reporting of bird and bat carcasses discovered incidental to maintenance operations ("incidental finds").

All avian and bat carcasses discovered by maintenance personnel will be photographed and data will be recorded as would be done for carcasses within the formal search sample during scheduled searches. If maintenance personnel discover incidental finds, the maintenance personnel will notify a project biologist. ~~The project biologist (or the project biologist's experienced wildlife technician) will collect the carcass or will instruct maintenance personnel to have an on-site carcass handling permittee collect the carcass. The certificate holder's on-site carcass handling permittee must be a person who is listed on state and federal scientific or salvage collection permits and who is available to process (collect) the find on the day it is discovered. The find must be processed on the same day as it is discovered.~~

During the years in which fatality monitoring occurs, if maintenance personnel discover incidental finds outside the search plots for the fatality monitoring searches, the data will be reported separately from fatality monitoring data. If maintenance personnel discover carcasses within search plots, the data will be included in the calculation of fatality rates. The maintenance personnel will notify a project biologist. ~~The project biologist will collect the carcass or will instruct maintenance personnel to have an on-site carcass handling permittee collect the carcass. As stated above, the on-site permittee must be available to process the find on the day it is discovered.~~ The certificate holder shall coordinate collection of state endangered, threatened, sensitive or other state protected species with ODFW. The certificate holder shall coordinate collection of federally-listed endangered or threatened ~~species and Migratory Bird Treaty Act protected avian species~~ with the USFWS.

5. Data Reporting

The certificate holder will report wildlife monitoring data and analysis to the Department for each calendar year in which wildlife monitoring occurs. Monitoring data include fatality monitoring program data, raptor nest survey data, WGS survey data, WGS incidental observation and assessment reports, and WRHS data. The certificate holder may include the reporting of wildlife monitoring data and analysis in the annual report required under OAR 345-026-0080 or

submit this information as a separate document at the same time the annual report is submitted. In addition, the certificate holder shall provide to the Department any data or record generated in carrying out this monitoring plan upon request by the Department.

The certificate holder shall notify USFWS and ODFW immediately if any federal or state endangered or threatened species are killed or injured on the facility site.

Within 30 days after receiving the final versions of reports that are required under this plan, the Department will make the reports available to the public on its website and will specify a time in which the public may submit comments to the Department.[6]

6. Amendment of the Plan

This *Wildlife Monitoring and Mitigation Plan* may be amended from time to time by agreement of the certificate holder and the Council. Such amendments may be made without amendment of the site certificate. The Council authorizes the Department to agree to amendments to this plan and to mitigation actions that may be required under this plan. The Department shall notify the Council of all amendments and mitigation actions, and the Council retains the authority to approve, reject or modify any amendment of this plan or mitigation action agreed to by the Department.

7. Literature Cited

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Hallingstad, E. C., P. A. Rabie, A. C. Telander, J. A. Roppe, and L. R. Nagy. 2018. Developing an Efficient Protocol for Monitoring Eagle Fatalities at Wind Energy Facilities. PLoS ONE 13(12): e0208700. doi: 10.1371/journal.pone.0208700.

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[6] The certificate holder may establish a Technical Advisor Committee (TAC) but is not required to do so. If the certificate holder establishes a TAC, the TAC may offer comments to the Council about the results of the monitoring required under this plan.

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Urquhart, B., S. Hulka, and K. Duffy. 2015. Game Birds Do Not Surrogate for Raptors in Trials to Calibrate Observed Raptor Collision Fatalities. Bird Study 62(4): 552-555. doi: 10.1080/00063657.2015.105375.