



COUNTY OF HUMBOLDT
PLANNING AND BUILDING DEPARTMENT
CURRENT PLANNING DIVISION

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Hearing Date: November 7, 2019

To: Humboldt County Planning Commission

From: John H. Ford, Director of Planning and Building Department

Subject: **Humboldt Wind Energy Project Conditional Use Permit and Special Permit**
Record Number: PLN-13999-CUP

Assessor Parcel Numbers (APNs): 102-132-004 et al.
Monument and Bear River Ridges, Scotia, Shively, and Bridgeville areas

The attached executive summary for the Humboldt Wind Energy Project is provided as an orientation to the project for the Planning Commission hearing on November 7, 2019. No resolutions or findings are included with this staff report as no action is recommended at this hearing. A full staff report with recommended resolutions and conditions of approval will be available in advance of the November 14, 2019 Planning Commission hearing.

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Please contact Steve Werner, Supervising Planner at 268-3726 if you have any questions about the scheduled public hearing item.

AGENDA ITEM TRANSMITTAL

Hearing Date: November 7, 2019	Subject: Humboldt Wind Energy Project Conditional Use Permit and Special Permit	Contact: Steve Werner
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Project Description:

The applicant has applied for a Conditional Use Permit and Special Permit to construct and operate an electrical wind generation facility with up to 60 wind turbine generators (WTGs) and associated infrastructure with a nameplate generating capacity (i.e., theoretical maximum energy generation) of up to 155 megawatts (MW). The exact footprint of the WTGs within the project site would be determined during final engineering design but would generally be placed along Monument and Bear River Ridges. The WTGs would be a maximum height of 600 feet, with a rotor diameter of 492 feet.

The project is primarily located within the Timber Production Zone (TPZ) and Agricultural Exclusive (AE) zoning designations. The Use Permit is required because wind generating facilities are a conditionally permitted use in all land use designations except Resource Dependent ("MR"). The Special Permit is required for work within streamside management areas and wetlands. This work will be limited to temporary disturbance and road crossings.

The project as described in the application would include the following components:

- up to 60 WTGs (capable of generating 2–5 MW of electricity each) erected on tubular steel towers set on concrete foundations, as well as the associated WTG pads, temporary staging areas, and transformers;
- an up to 25-mile long, 115 kV gen-tie, including crossing of the Eel River, following Shively Ridge and ultimately connecting to the existing PG&E transmission system;
- Expansion of the Bridgeville substation site;
- an on-site project substation;
- an underground electrical collection system linking WTGs to each other and to the project substation;
- an underground communication system (fiber optic cable) adjacent to the collection system;
- a Supervisory Control and Data Acquisition (SCADA) system between each WTG and the substation and between the project substation and the Bridgeville Substation to monitor and control project output and the transmission of energy into the system;
- an up to 5-acre O&M facility, including an operations building, a parking area, and an outdoor storage area with perimeter fencing;
- a 10-acre temporary staging area and a construction trailer and parking area located within the O&M facility;
- a component offloading location at Fields Landing;
- two temporary bypasses off U.S. Highway 101 (Hookton Overpass and 12th Street Bypass) for transporting oversize loads;
- up to six permanent meteorological towers;
- three 5-acre, temporary staging areas distributed throughout the project site, one of which would include one temporary cement batch plant on Monument Ridge; and
- construction of up to 17 miles of new 24-foot access roads.

A wind turbine generator (WTG) consists of the tower, nacelle, hub, blades/rotor, controller, central SCADA system for communication, transformer, Federal Aviation Administration (FAA) lighting where required, and lightning protection system. Maximum WTG height, as measured at the highest point of the rotor blade rotation, would be up to 182 meters (600 feet) from the base of the turbine. Ground clearance for the rotor blades at their lowest point of rotation would be 23 meters (76 feet). The WTGs would have an off white or light grey color with a nonreflective finish,

consistent with FAA requirements. Each WTG would be supported by a rectangular pad measuring about 350 feet by 350 feet (2.8 acres), leveled to a 2 percent slope or less. A portion of the WTG pad would remain graded as a permanent soil-compacted crane pad to provide a stable foundation for the crane during placement of the WTG components. The WTG foundations would be buried to a depth of 10 feet below grade with a pedestal extending approximately 1 foot above the ground. The foundation would be 60–70 feet in diameter, depending on the WTG model selected. Once construction is completed, a permanent gravel ring 25 feet in diameter would be established around the base of the foundation to form the permanent WTG pad. The gravel would provide a stable surface for maintenance vehicles and would minimize erosion and runoff.

Each WTG contains electronic devices that continuously monitor turbine performance. A SCADA system installed in the generation area would collect operational and performance data from each WTG and the project as a whole and would allow for remote WTG operation. The collection system would consist of 34.5 kV lines located underground on dedicated paths or within project roads. Collection lines would be buried in trenches and would terminate at individual WTGs, where they would connect to junction boxes, or at the project substation. Each trench would contain power cables, a ground wire, a fiber optic communication cable for the SCADA system to transmit data from the WTG controllers to the substation and O&M facility, and markers to alert anyone digging in the area. The main power transformer within the project substation would increase the voltage of the electricity from the 34.5 kV collection system to 115 kV for transmission to the Bridgeville Substation.

A 115-kV gen-tie line would transport the energy generated by the wind turbines to the power grid at the Bridgeville substation site. The overhead, 115 kV transmission interconnect lines would be constructed on wooden H-frames, wood poles, or metal monopole structures placed within a 100-foot-wide transmission corridor. All energized project components, including the entire gen-tie line and all power lines, would be constructed in accordance with the current suggested practices of the Avian Power Line Interaction Committee. The gen-tie line would begin at a new substation located west of Highway 101, span in an eastward direction, and cross the Eel River. Once across the river, the gen-tie would continue eastward as an overhead line and connect to the existing PG&E Bridgeville Substation for distribution into the power grid. PG&E substation expansion and improvements would be required. A 19-mile underground fiber optics communications system and electrical collection system would link the turbines to each other and to a substation for distribution into the gen-tie line.

Proposed throughout the project area are temporary and permanent operations, maintenance, and staging facilities, one temporary cement batch plants, and up to 17 miles of new access roads. Existing access roads will be widened to accommodate oversized truck-trailer loads.

A permanent operations facility that includes related buildings and offices would be constructed on the west side of Highway 101 at the Pepperwood/Avenue of the Giants exit. The O&M facility is proposed for placement on up to 5 acres of land with a building footprint of 5,000 to 6,000 square feet. The O&M facility would include a water storage tank, which would be supplied with potable water obtained from a new well drilled within the footprint of the O&M facility. Wastewater generated at the O&M facility would be treated by a new appropriately sized septic system. Meteorological towers (METs) and/or Light Detection and Ranging units would be installed on-site to allow project planners to assess the project's viability and determine the optimum WTG layout, and to ensure optimal operation of the installed WTGs. METs would be 80–120 meters (262–394 feet) tall and would comply with FAA lighting regulations. Up to 12 METs would be constructed within the project footprint. Up to six of these METs would remain on-site permanently after the completion of WTG optimization testing.

The wind turbines with related components would enter Humboldt County via Humboldt Bay. Off

loading would occur at Fields Landing. No permanent improvements to facilitate the offloading from ships or barges are proposed. Temporary improvements to increase turning radii at South Bay Depot Road and Fields Landing Drive and off-ramp modifications along Highway 101 to accommodate the oversized loads will be required. These temporary improvements would occur within the Coastal Zone, both within the County and state retained jurisdictions. The applicant will apply for a consolidated Coastal Development Permit (CDP) from the California Coastal Commission. No Coastal Development Permit is being processed as part of this application.

The Humboldt County General Plan land use designations along the project alignment consist primarily of Timberland (T), with Industrial, General (IG), Agricultural Grazing (AG), and Urban Development Area overlay where the gen-tie crosses Highway 101. Lands crossed by the project are primarily zoned Agriculture Exclusive (AE) and Timber Production Zone (TPZ), except for limited intermittent segments of the gen-tie. The land is currently in timber production.

Project Location: The project is located in Humboldt County, beginning approximately 5.5 miles southwest of Scotia, extending east to the Bridgeville area, on both side of Highway 101 and on the south side of State Highway 36. The project is distributed over a maximum of 124 parcels extending approximately 22 miles east from the eastern terminus of Bear River Ridge (APN: 102-132-004) and along Monument Ridge, continuing east and terminating at the PG&E substation (207-311-002) in Bridgeville.

Present Plan Land Use Designation: AG – Agricultural Grazing, CF – Conservation Flood Plain, IG – Industrial General, PF – Public Facility, RCC – Rural Community Centers, RL – Residential Low Density, RA40 – Residential Agriculture (40 acres), and T – Timberland; Slope stability rating: 1 - Low instability and 2 - Moderate Instability

Present Zoning: AE - Agricultural Exclusive, AE-B-5(160) – Agriculture Exclusive, Minimum Building Site Area of 160 acres, MH-Q – Heavy Industrial – Qualified, Railroad, TPZ – Timberland Production Zone, and U - Unclassified

Record Number: PLN-13999-CUP

Assessor Parcel Numbers: 102-132-004 et al.

102-132-004-000; 207-124-005-000; 207-126-004-000; 205-021-005-000; 205-021-006-000; 205-021-014-000; 205-021-015-000; 205-021-017-000; 205-021-019-000; 205-021-021-000; 205-021-022-000; 205-021-023-000; 207-311-002-000; 209-191-001-000; 209-191-002-000; 209-191-003-000; 209-191-012-000; 209-191-013-000; 209-201-002-000; 209-201-003-000; 209-201-007-000; 209-201-008-000; 209-201-010-000; 211-453-002-000; 211-453-003-000; 211-461-001-000; 211-462-004-000; 211-471-001-000; 211-472-001-000; 207-341-001-000; 207-181-005-000; 207-181-016-000; 207-181-019-000; 207-182-009-000; 207-182-011-000; 207-183-003-000; 103-012-004-000; 205-051-001-000; 205-051-008-000; 205-051-009-000; 205-051-010-000; 205-051-011-000; 205-051-012-000; 205-061-002-000; 205-061-007-000; 205-061-011-000; 208-114-002-000; 208-121-001-000; 208-121-007-000; 208-121-010-000; 208-131-006-000; 208-135-001-000; 208-135-003-000; 208-135-004-000; 208-135-005-000; 208-141-001-000; 208-141-011-000; 209-401-001-000; 209-401-002-000; 209-401-010-000; 209-401-015-000; 209-401-016-000; 205-311-002-000; 205-311-004-000; 205-321-032-000; 205-321-033-000; 205-321-034-000; 205-331-003-000; 205-331-006-000; 205-331-007-000; 205-341-006-000; 205-341-008-000; 205-341-011-000; 205-341-013-000; 205-341-018-000; 205-341-019-000; 205-351-012-000; 209-401-023-000; 207-226-001-000; 207-231-003-000; 207-231-007-000; 207-232-001-000; 207-232-002-000; 208-111-009-000; 208-111-014-000; 209-281-004-000; 211-011-004-000; 211-012-002-000; 211-013-001-000; 211-023-002-000; 207-183-004-000; 207-184-004-000; 207-184-006-000; 207-185-002-000; 207-185-003-000; 207-186-005-000; 207-186-007-000; 207-186-009-000; 207-186-013-000; 207-211-001-000; 207-211-002-000; 207-212-002-000; 207-213-001-000; 207-213-002-000; 207-213-003-000; 207-221-001-000; 207-221-003-000; 209-081-022-000; 207-074-027-000; 106-

191-010-000; 106-191-011-000; 106-191-012-000; 206-262-007-000; 209-211-008-000; 209-211-009-000; 209-211-010-000; 209-211-011-000; 209-251-002-000; 209-261-002-000; 209-261-003-000; 205-221-001-000; 205-351-026-000; 205-351-030-000; 205-311-001; 205-321-006; 205-051-003; 205-061-004; and 205-341-019

Applicant

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Owners:

Listed below

Agent

Yasmine Akky
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Owners: Humboldt Redwood Company LLC, Russ Ranch and Timber Company LLC, Kay and Glen Brown, Sierra Pacific Industries, Kathleen and Uwe Saler, Gloria and Leslie and Janet Barnwell, GM Gabrych Family Limited Partnership, Richard Miller, Dunn Diamond D Ranch LLC, Northwest Pacific Railroad Co, Pacific Gas and Electric Company.

Environmental Review: Environmental review is required. An Environmental Impact Report (EIR) was prepared for the project (SCH #201872076).

Major Issues: Visual impacts, biological impacts (potential take of at-risk species), cultural resources, tribal cultural resources

State Appeal Status: Project is NOT appealable to the California Coastal Commission.

Humboldt Wind Energy Project Conditional Use Permit and Special Permit
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Recommended Planning Commission Action

1. Describe the application as a public hearing.
2. Request that staff present the project.
3. Open the public hearing and receive questions of clarification regarding the project; and
4. Continue the public hearing until November 14, 2019 and take no action on the project.

1. Executive Summary

The Draft EIR (DEIR) prepared for the project presents a detailed analysis of all significant and potentially significant environmental impacts of the proposed project; identifies feasible mitigation measures, where available, that could avoid or reduce these impacts; and identifies whether these mitigation measures would reduce these impacts to less-than-significant levels.

The DEIR analysis was informed by multiple surveys and studies including those related to visual, cultural, and biological resources in addition to noise and transportation impacts.

The project site identified in the DEIR represents an approximately 2,218-acre area study corridor within which the WTGs and associated infrastructure would be placed. Within that study corridor, a representative project footprint was developed that conservatively included approximately 900 acres of temporary or permanent impacts. The DEIR acknowledged that the actual project footprint is likely to be less but would be located within the study corridor. The study area was defined based on a 1,000-foot-wide corridor centered on the representative locations of WTGs; a 200-foot-wide corridor centered on project roadways, the electrical collection line, and the generation transmission line (gen-tie); and a 500-foot-wide buffer around proposed staging areas, temporary impact areas, and the project substation.

Since issuance of the Draft EIR, the project applicant has continued to coordinate with County staff and the regulatory agencies to further refine the project layout based on the presence of sensitive resources and other factors. Supplemental technical studies conducted in support of the project were used to further refine the project footprint. The project applicant also reviewed public comments submitted in response to the DEIR to assess whether project refinements that respond to concerns stated by commenters could be incorporated. As a result, the project applicant has made a number of refinements to the proposed project since circulation of the DEIR, which include the following:

- a. ***Reduction in projected ground disturbance.*** The project changes would reduce the amount of ground disturbance from approximately 900 acres of permanent and temporary impacts to approximately 655 acres.
- b. ***Realignment and shortening of gen-tie to avoid northern spotted owl activity centers and foraging and roosting habitat.*** The total length has been reduced from approximately 25 miles to approximately 22 miles. Where possible, the realigned gen-tie corridor has been co-located with existing access roads to avoid and minimize site disturbance. For those limited instances in which the realigned corridor would be located outside the survey corridor presented in the DEIR, additional field surveys have been conducted to confirm that the realigned location would not change conclusions from the DEIR and would not be considered significant new information requiring recirculation.
- c. ***Reduction in the number of turbines from 60 to 47.*** All turbines would continue to be located within the study corridor analyzed in the DEIR, spread across Monument and Bear River Ridges. The applicant has reduced the number of turbines on Bear River Ridge from

23 to 20 turbines, and on Monument Ridge, reduced the number of turbines from 37 to 27 turbines. This change has allowed the applicant to further avoid and/or minimize impacts, including avoidance of certain known cultural resource sites; avoidance and minimization of impacts on biological resources; and elimination of significant noise impacts on sensitive receptors.

- d. **Overhead crossing of gen-tie line over Eel River.** Originally, the gen-tie line was proposed to be underground under the Eel River using horizontal directional drilling. The gen-tie is now proposed to be relocated 1.8 miles east of the previous route to further reduce visibility of the gen-tie line to surrounding communities and will use wooden H-frame and steel monopole structures. The gen-tie will cross at the same level as the Highway 101 bridge.
- e. **Realignment of access roads.** Since publication of the DEIR, the applicant has agreed to incorporate into the project the "realigned Jordan Creek access" at the Jordan Creek staging area that is described in Alternative 2 in the DEIR, which will completely avoid northern spotted owl activity centers and minimize impacts on northern spotted owl nesting, roosting, and foraging habitat.
- f. **Reduced substation footprint.** The proposed footprint of the substation has been reduced from approximately 5 acres to 2.5 acres, to reduce overall site disturbance.

This now reflects the project presented in the FEIR and being presented to the Planning Commission for consideration. The project description in the Agenda Item Transmittal reflects what was presented in the application and evaluated in the DEIR. Consistent with the objective of CEQA to minimize and mitigate impacts, the project has been refined.

2. Background

A Conditional Use Permit to allow for electrical generation and transmission facilities in the Timber Production Zone (TPZ) and Agricultural Exclusive (AE) zoning designations is required. A Special Permit to allow for work within streamside management areas (road crossings) and wetlands is also required.

In approving the project, the Planning Commission will need to make the required findings to issue a Conditional Use Permit and Special Permit. These findings include that the project is in conformance with the County General Plan; the proposed development is consistent with the purpose of the zone in which the site is located; the proposed development conforms with all applicable standards and requirements of the zoning regulations; the project is not detrimental to public health, safety or welfare or materially injurious to properties or improvements in the vicinity; and the proposed development does not reduce the residential density for any parcel below that utilized below what is identified as the midpoint density in the housing element.

General Plan Policy E-P3 states that the County supports renewable energy development projects, such as wind. Standard E-S3 states the following: Unless allowed by right pursuant to California Government Code, Section 65892.13(f) as amended, wind generating facilities shall be a conditionally permitted use in all land use designations except "Resource Dependent" (MR).

Staff has reviewed the proposed project and supporting materials and believes the project is in compliance with all required findings. Further articulation of the project's compliance with all required findings will be provided in the resolutions in the staff report prepared for November 14, 2019.

The stated objectives of the application are to contribute to a diversified energy portfolio that will reduce exposure to price volatility associated with electricity and natural gas, while assisting the state in meeting the renewable-energy requirements established in Senate Bill (SB) 350 and SB 100;

develop a wind project that is feasible to finance, construct, and operate; develop a wind energy project that can meet the criteria to achieve the maximum federal tax credit requiring placement into operation by December 30, 2020; promote sustainable energy and utilization of alternative energy systems throughout the County; develop a wind energy facility as near as possible to existing transmission infrastructure; develop a wind energy facility in Humboldt County that supports the economy by creating short- and long-term employment opportunities and increasing tax revenue; and displace emissions of approximately 372,000 metric tons per year of carbon dioxide that would otherwise be required to generate the same amount of electricity as this 155-megawatt project.

3. EIR Impact Analysis

The DEIR contains a thorough impact analysis. Some impacts were found to not to be significant and were not discussed further, some were found to be less than significant and not requiring mitigation, others were potentially significant and required mitigation to bring them to a less than significant level, and, finally, some impacts, despite employing all feasible mitigation, were found to be significant and unavoidable. A complete list of impacts and the impact conclusion is found in Attachment A. Although some mitigation measures have been refined, which are all included in Chapter 9 of the FEIR, the impact conclusions have not changed.

Less than Significant Impacts with Mitigation Incorporated

The full list of impacts requiring mitigation is found in Attachment A of this staff report. Of these, construction impacts to northern spotted owls and operational impacts to bats have generated a large volume of comments and concern. A master response is written for both of these topics in Chapter 2 of the FEIR. Archeological impacts are also discussed below.

Northern Spotted Owl

The northern spotted owl is federally listed as threatened and state listed as threatened. The biological study area is located within the range of the northern spotted owl, but not within critical habitat designated for this species. The northern spotted owl habitat assessment survey determined that, with the project as refined, could impact up to 404.61 acres of northern spotted owl habitat and additional acres could be impacted due to habitat fragmentation. DEIR Table 3.5-11 reproduced below, shows the breakdown of potentially impacted habitat based on the refined project footprint.

Table 3.5-11. Temporary, Permanent, and Fragmentation Impacts of the Proposed Project on Northern Spotted Owl Habitat

Habitat Type	Disturbance Type	Acres Affected
Foraging	Temporary (road edges)	125.95
	Permanent (turbine pads, new roads, gen-tie)	164.01
	Fragmentation Edge effect (gen-tie 100' buffer)	292.13
Roosting	Temporary (road edges)	38.04
	Permanent (turbine pads, new roads, gen-tie)	49
	Fragmentation Edge effect (gen-tie 100' buffer)	107.34
Nesting	Temporary (road edges)	10.22
	Permanent (turbine pads, new roads, gen-tie)	17.39
	Fragmentation Edge effect (gen-tie 100' buffer)	37.61
Total		841.69

While no direct take of northern spotted owl is anticipated as a result of project construction and operation, the loss of habitat was found to be potentially significant and required mitigation. Mitigation measure 3.5-7 was included in the DEIR to avoid, minimize, and compensate for

construction impacts on northern spotted owl.

Comments were received that the DEIR did not include the results of protocol-level surveys for northern spotted owls for the project and asked for clarification regarding the areas in and near the project for which surveys were conducted, and for information on the number and location of spotted owl activity centers in relation to project features.

In August 2018, Stantec conducted a northern spotted owl habitat assessment in the project area using the guidelines provided by the Northern Spotted Owl Protocol. This information along with historical data from Humboldt Redwood Company spotted owl surveys was used to inform the analysis in the DEIR. In order to be responsive to the comments received during the DEIR, in addition to the habitat assessment previously conducted, between March and August 2019, northern spotted owl surveys were conducted in all suitable habitat within 0.25-mile of the project area. This survey augments the regular ongoing property-wide survey efforts conducted by the Humboldt Redwood Company (HRC). Information about the occurrences of known activity centers were compiled using the results of the 2019 surveys, information about the activity centers managed by HRC as of 2018, and activity centers documented in the California Department of Fish and Wildlife's (CDFW's) Spotted Owl Observations Database (the database query included reported data between 2015–2018). In addition, CDFW's Spotted Owl Observations Database was queried for data between 1996–2017 for an analysis of historic activity centers. This survey data was sufficient for the County to be able to address the impact questions required for an adequate CEQA analysis, namely whether the project, as mitigated, would "have a substantial adverse effect, either directly, or through habitat modifications, on [the] species" (CEQA Guidelines, Appendix G, Environmental Checklist, Section IV[a]).

The 2019 surveys resulted in 23 northern spotted owl detections, which are attributed to 12 activity centers. Ten (10) of the 12 activity centers were pre-existing, while the remaining two are newly-identified activity centers. The gen-tie line has been realigned and shortened and co-located with existing roads wherever possible to avoid all northern spotted owl activity centers and to maintain a 1,000-foot buffer around all activity centers. The one exception is the Goat Rock activity center. At this activity center, no work would occur during the northern spotted owl breeding season (March 1–August 31) within the 1,000-foot buffer; the closest work outside of the breeding season would occur approximately 800 feet from this activity center. Project refinements since circulation of the DEIR have resulted in a 26 percent reduction in the total acreage of northern spotted owl habitat that would be affected by the project.

Mitigation Measure 3.5-7 has been refined to include a detailed mitigation ratio for foraging, roosting, and nesting habitat in relation to permanent, temporary, and edge effects. The gen-tie has been classified as a permanent effect. Compensatory mitigation options are also further developed. More detail has been provided in the option for barred owl management, which was noted by many commenters to be an effective tool in aiding in species recovery. Barred owl management may be undertaken independently of land dedication.

Bolstered by project refinements and supplemental survey information, the revisions to Mitigation Measure 3.5-7 will be more effective at mitigating construction impacts to northern spotted owls. The impact conclusion continues to be less than significant with mitigation incorporated.

Bats

No bats listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or CDFW occur in the study area. However, nine (9) of the 13 bat species that are expected to occur at the project site are species of conservation concern. Townsend's big-eared bat is a widespread but rare species of particular conservation concern in the project area and in California in general. The hoary bat is a widespread but uncommon species of particular conservation concern in the project area and in relation to WTGs. Hoary bats have been captured in

exceptionally high numbers at the nearby Bull Creek study site, especially during the fall. This discovery of what could be considered fall swarming behavior of hoary bats in the redwoods has not yet been documented anywhere else; it could represent a vital life history component for this species.

Several potential impacts to bats are noted in the DEIR and listed in Attachment A of this staff report. Construction impacts to bat populations can be largely avoided through mitigation which requires conducting habitat assessments, identifying and avoiding roosts, and adjusting the timing of tree removal when a roost is found. If a roost is impacted, compensatory mitigation is required.

Operational impacts to bats include collision with turbines and barotrauma. Although threats associated with the proposed project are similar for the other bat species found in the area, the high hoary bat mortality rates associated with wind farms and the number of hoary bats documented near the project site provide substantial evidence that the project could cause a large number of hoary bat fatalities on an annual basis over the 30-year life of the project. Because little empirical demographic and population data exist for the species, it is difficult to evaluate what the actual impact will be. The CEQA Guidelines for a species that is not listed as protected identifies an adverse impact as being when the impact results in a population level decline contributing to the species not being able to maintain a stable population.

Mitigation Measure 3.5-18a requires that the project avoid and minimize bat population level decline through consultation with a technical advisory committee (TAC). This mitigation measure has been refined in the FEIR to clarify the way and when the TAC will be established, their reporting structure, and thresholds for implementing operational minimization measures. These measures include installing bat deterrents and low-wind speed curtailment. Operational minimization measures have been shown to reduce bat mortality by up to 93 percent and deterrents have been shown to reduce bat mortality by up to approximately 50 percent.

The revisions to Mitigation Measures 3.5-18a and 3.5-18d will be more effective at mitigating operational impacts to bats because they add clarity to TAC responsibility and the action thresholds. The impact conclusion continues to be less than significant with mitigation incorporated.

Archeological

As noted during the Tribal Consultation process and evidenced by site specific cultural resource surveys that covered the extent of the project area, a large number of archeological sites exist within the project area. The mitigation calls for avoidance of potential impacts and where they cannot be completely avoided, improvements shall be constructed such that no excavation is undertaken. The intact resources shall be preserved in place by capping. This is consistent with the approach outlined in the Humboldt County General Plan.

No excavation was originally planned at the Bridgeville substation. However, since the release of the DEIR, the applicant has determined that excavation will be required within the footprint that was identified in the DEIR. Because of this change, the site has been subjected to surface and subsurface investigations to determine whether significant cultural resources are present in the area of expansion. These studies resulted in data that indicated that while significant cultural resources are present at Bridgeville, the portion of the site that occurs in the expansion area lacks integrity and is not eligible for inclusion in the California Register of Historic Resources/National Register of Historic Places. Mitigation Measure 3.6-1b has been revised to strike the reference to the Bridgeville substation expansion area because with the additional study that has been undertaken, it is determined conclusively that eligible resources are not present.

Significant Unavoidable Impacts

CEQA requires that all feasible mitigation to reduce an impact to a less than significant level be

adopted. Where mitigation cannot reduce an impact to a less than level, the impacts are significant and unavoidable and require the adoption of a statement of overriding considerations.

The statement of overriding considerations will be presented with the resolutions for the November 14, 2019 Planning Commission hearing. For all significant unavoidable impacts discussed below, the Planning Commission must conclude that there is no feasible way to lessen or avoid the significant effects, and that the benefits of the project outweigh the unavoidable adverse effects. Benefits can include economic, legal, social, technological, or other benefits, including region-wide or statewide environmental benefits. If these benefits outweigh the unavoidable adverse environmental effects, the adverse environmental effects may be considered "acceptable" (14 CCR 15091(a)).

Staff is recommending adoption of the statement of overriding considerations because of the environmental and economic benefits of implementing a renewable energy project locally. The project will assist California in maintaining its legislated Global Warming Solutions Act criteria that require reductions in carbon dioxide and other greenhouse gas emissions, which in turn represent benefits in the region. Approval of the project will aid the County in meeting energy needs and is consistent with the County General Plan policies, which encourage utilization of renewable energy resources including wind power.

Even with employing feasible mitigation, the following impacts would remain significant and unavoidable.

Aesthetics

The aesthetic impact of placing WTGs on prominent ridges which otherwise provides relatively intact natural landscape will be unavoidable. Bear River and Monument Ridges are a highly visible element of the landscape. Bear River Ridge in particular can be seen from locations around Humboldt Bay. The WTGs would be visible from Scotia, Rio Dell, areas of Fortuna, Hydesville, the Ferndale bottoms, Highway 101, and Mattole Road. Mitigation is required to reduce the impacts, such as ensuring that they will be painted off-white or grey and have low reflectivity, which will assist in muting the visual impacts, but they can not be avoided. No feasible mitigation is available.

The WTGs will require lighting compliant with the Federal Aviation Administration (FAA) standards. Depending on the FAA requirements, which have yet to be determined, lighting on the WTGs could be steady red, blinking red, or blinking white. Lights likely would not be mounted on every WTG, but would be located on several strategically selected WTGs, to mark the extent of the WTGs adequately. Because this is an FAA requirement and the lighting can not be obscured or eliminated, there are no feasible mitigation measures to avoid this impact.

Air Quality

The project will not have a long-term effect on air quality. However, during construction, when there will be heavy equipment mobilized, there is anticipated to be an exceedance of the daily threshold of NO_x (oxides of nitrogen) established by the North Coast Unified Air Quality Management District (NUAQMD). The threshold is 50 pounds of NO_x per day and during the construction phase, the project could emit as much as 321.42 pounds per day. However, this is for a short duration and the annual threshold of 40 tons of NO_x per year would not be exceeded. Over the course of a year construction emissions of NO_x are estimated to be 22.75 tons. Mitigation has been required to have all heavy-duty diesel engines used during construction be compliant with Air Resources Board current-phase equipment standards. This mitigation would reduce construction-related emissions and NO_x, but would still exceed NCUAQMD daily threshold of significance. No other feasible mitigations have been identified.

Biological Resources

Marbled Murrelet

The project site is located within the range of the marbled murrelet, which is federally listed as threatened and state-listed as endangered. Designated critical habitat for the marbled murrelet is located near the site, immediately east of Highway 101 in Humboldt Redwoods State Park along the northern end of Avenue of the Giants. There have now been two years of surveys of marbled murrelet behavior and flight patterns through the site. This has been used to estimate the operational impacts to marbled murrelet and to refine the project layout to minimize impacts.

The project has been revised to eliminate WTGs in areas characterized by high passage rates for marbled murrelets. There are also multiple mitigation measures in the DEIR and as refined in the FEIR that serve to reduce impacts to the marbled murrelet.

Construction impacts would be minimized by avoiding the removal of any nesting habitat (old growth redwood or mature coniferous forest). Indirect impacts would be avoided by providing buffers from murrelet nesting habitat to the construction areas during the nesting season.

Based on the analysis provided in the DEIR and refined in the FEIR, approximately 7.77 murrelets are expected to be taken over the life of the project. Compensatory mitigation is required for this take and will come in the form of a corvid management plan at Van Duzen County Park. The corvid management program is projected to result in reproductive success for 48 to 97 murrelets over the life of the project, resulting in a net gain in marbled murrelets. Once the project is operational, post construction mortality monitoring would occur along with monitoring for the success of the corvid management plan. In the unlikely event that the mortality monitoring indicated higher take levels than anticipated or the corvid management plan is not as successful as anticipated, additional mitigations such as relocation of recreational facilities out of murrelet habitat, habitat enhancement on buffer forests, and removal of derelict fishing gear would be implemented.

With the avoidance, minimization, compensatory mitigation, and adaptive management discussed above, the overall benefit to the marbled murrelet is expected to be positive. However, because the marbled murrelet is an extremely rare species that is hard to monitor because of its remote habitat (open ocean and old-growth canopy high above the ground) and elusive habits (flying at high speed at dawn and dusk), verifying the estimate of operational take predicted by the model is therefore difficult, as is verifying the number of marbled murrelets produced as a result of implementing corvid management. Because any loss of such a rare species is considered significant, and because of the uncertainty in confirming the actual take of marbled murrelets and the numbers of marbled murrelets produced by the mitigation, there is a conservative conclusion of significant unavoidable effects.

Raptors

Operational impacts on raptors have also been found to be significant and unavoidable. The DEIR provided an analysis of operational impacts to raptors. The analysis included looking at raptor mortality data from other operating wind farms and concluded that the low range of impacts would be 4-29 raptor fatalities per year and the high range could be up to 114 raptors per year.

During the FEIR process, the applicant submitted additional information relating to the potential mortality rates of raptors. This additional analysis indicated that the actual mortality rate would likely be approximately 25 raptors per year. The additional analysis was based on a large raptor mortality dataset and information about rates of raptor use at the project site relative to other sites where both raptor use rates and mortality rates were known. Although raptor use rates alone do not predict operational impacts, the weight of evidence based on habitat, climate, and observed rates of raptor use at the project site suggest the number of annual raptor fatalities resulting from

operational impacts would likely be closer to the lower end (4-29 fatalities/year) than the upper end (114 fatalities/year) of the ranges given in the DEIR. However, due to remaining information gaps and the fact that no single wind energy site can be considered an ideal proxy to predict risk to raptors at the project site, a conservative estimate would be to predict up to 50 raptor fatalities per year.

Feasible mitigation is included to avoid, minimize, and ultimately compensate for operational impacts to eagles. This includes specific WTG tower and gen-tie design guidelines that reduce the impacts to raptors, and compensatory mitigation in the form of pole retrofits or reframing or donation to raptor rehabilitation center, implemented to reduce potential impacts. Additionally, the project now includes undergrounding of 5 miles of existing PG&E distribution lines occurring within the project site that poses a hazard to raptors and other birds. Even with the feasible mitigation measures and the reduced estimate of raptor fatalities, the impact still has the potential to be significant and unavoidable.

Cultural Resources, Including Tribal Cultural Resources

The project has the potential to change the significance of the Bear River Ridge and Valley Historic Landscape. The proposed project would construct access roads and WTGs within the Bear River Ridge and Valley Historic Landscape, which is assumed eligible for the California Register of Historic Resources. None of the historic-age ranching properties within the historic landscape would be directly adversely affected by the project, although, of the identified historic-age ranching properties, the existing historic-age hay barn on the R. M. Ranch is sited in close proximity to a proposed WTG, and a new access road would be cut through two existing dirt roadways leading into the property from the north side of Bear River Road. Construction of the WTGs would negatively affect the design, setting, feeling, and association of the rural agricultural setting of the historic landscape during the 30-year life span of the project, and possibly longer if a separate repowering permit is approved, at which time the WTGs, cables, and other infrastructure support facilities would be removed.

Section 15064.5 of the State CEQA Guidelines defines "substantial adverse change" as physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings. No proposed components of the wind generation facility would directly affect individual resources within the Bear River Ridge and Valley Historic Landscape; however, as designed, construction of the WTGs and access roads would result in a significant impact on the immediate surroundings and setting of the historic landscape.

Feasible mitigation includes preparing an Historic American Landscape Survey Report to fully document the resource prior to construction. However, preparing this report does not fully mitigate for the impact and no other feasible mitigation is available. Therefore, this impact was found to be significant and unavoidable.

Several Tribal Cultural Resources have been identified in the project area through consultation with the Wiyot Tribe and Bear River Band of the Rohnerville Rancheria. Identified Tribal Cultural Resources (TCRs) that could be affected by the project include Bear River Ridge (Tsakiyuwit), the associated ethnobotanical landscape, and the California condor.

Bear River Ridge is a sacred high prayer spot to the Wiyot People, visible from all of the ancestral Wiyot territory. The Wiyot Tribe has expressed that placing WTGs on the ridge will impact this resource. Project refinements since the release of the DEIR have resulted in a reduction in the number of turbines that would be placed on Bear River Ridge and have reduced the project's disturbance area on the ridge, but they do not eliminate the impact. Therefore, the impact remains significant and unavoidable.

There is an associated ethnobotanical area along Bear River Ridge which has evidence of historic Wiyot land management and has been identified as a Tribal Cultural Resource. This area will also be impacted by the development of the project, and feasible mitigation includes incorporating plants from the "Wiyot List of Plant Species of Environmental and Cultural Concern" into the Reclamation, Revegetation, and Weed Control Plan for the project. The Reclamation, Revegetation, and Weed Control Plan contains language that the Wiyot Tribe will be able to select up to 100 plants to be salvaged and placed into 1-gallon containers and/or up to 200 cuttings or plants less than 3-feet in height to be salvaged and remain bare rooted during transfer to a location designated by the Wiyot Tribe. Even with feasible mitigation incorporated, the impact to the ethnobotanical area remains significant and unavoidable.

Both the Wiyot Tribe and the Bear River Band of the Rohnerville Rancheria identified the California condor as a TCR. The condor is sacred and part of the Wiyot creation story. Although condors do not currently occupy the project area, the National Park Service, USFWS, and Yurok Tribe are partnering to reintroduce California condors in the Bald Hills region of Redwood National Park. Condors released from this location will have a range that includes the Humboldt Bay region and the project location. Although the condors have not yet been released, the reintroduction program is reasonably foreseeable in the near future, and certainly within the 30-year project time frame. To minimize the impact to condors, a mitigation measure has been added to detect the presence of condors and curtail operations to avoid collision. The original mitigation measure in the DEIR allowed for a 6-month period to initiate the curtailment regime after the release. In the Final EIR this mitigation measure has been refined to require that the curtailment be in place as soon as the condors are released. This detection and curtailment system has been used successfully at other wind farms in California, and to date no condors fatalities have occurred. With implementation of this curtailment program, the potential collision risk to condors will be very low, and this potential impact will have been reduced to the extent feasible. Nonetheless, the DEIR identifies the impact on condors as significant and unavoidable due to the spiritual significance of the species.

Significant and Unavoidable Cumulative Impact Areas

The direct project impacts that would be significant and unavoidable related to air quality, biological resources and Tribal Cultural Resources also contribute to cumulative impacts that would be significant and unavoidable.

Alternatives

A DEIR must describe a range of reasonable alternatives which would feasibly attain most of the basic project objectives while avoid or substantially less an environmental effect (14 CCR Section 15126.6) and identify the environmentally superior alternative. If the No Project Alternative is superior, the EIR must also identify an environmentally superior alternative from among the others considered. A range of alternatives (a total of 5, including the No Project Alternative) to the project were evaluated for comparison in the DEIR. These include:

- Alternative 1- No Project
- Alternative 2- Realigned Gen-Tie and Access Road
- Alternative 3- Reduced Turbine Footprint- Avoidance of Monument Ridge
- Alternative 4- Reduced Turbine Count (31 total)
- Alternative 5- Reduced Turbine Footprint- Avoidance of Bear River Ridge

Alternative 1 (No Project) was found to be environmentally superior. Of the other alternatives, Alternative 5 (Reduced Turbine Footprint – Avoidance of Bear River Ridge) was identified as environmentally superior to the project. This is because compared to the proposed project, this alternative would reduce impacts on all resource areas except greenhouse gas (GHG) emissions and fire hazards, which would be greater than or similar to the level of significance anticipated

under the project. Alternative 5 would avoid impacts on Bear River Ridge, would result in less ground disturbance, fewer visual impacts, and be anticipated to reduce mortality of birds and bats from collisions with rotor blades. However, it would not go as far as the proposed project toward meeting the project objectives, as it would not generate 155 MW of energy. It should be noted since the release of the DEIR, the project applicant has informed the County that due to wake effect, interference with existing microwave beam paths, and the steepness of the terrain Alternative 5 would not be able to support 37 turbines and only 27 WTGs could be feasibly located there. This further reduces the ability of Alternative 5 to meet the project objective of generating 155 MW of energy.

4. EIR Process

The application was filed by the project applicant on May 29, 2018. A Notice of Preparation (NOP) was prepared on July 31, 2018, to inform interested parties and all recipients on the distribution list of the County's determination that an EIR would be required for the project, solicit input about the desired content and scope of the DEIR, announce the dates and times of three public scoping meetings, and provide information on where documents were available for review and where comments could be sent on the project. The NOP was posted at the County Recorder's office; mailed to property owners and tenants of parcels within project area and parcels adjacent to/just outside of the project area boundary, all property owners/tenants within the Town of Scotia, and to relevant agencies within the region; circulated through the State Clearinghouse; and published in the Times Standard on August 2, 2018. In addition, the NOP and related project documents were available for public review at the Humboldt County Planning and Building Department office in Eureka, as well as on the County's website. The NOP was circulated for a period of 30 days, ending on August 30, 2018. During this time two scoping meetings were held on August 14 and 15, 2018, to solicit input from the regulatory agencies and public.

The DEIR was completed in April 2019. The Notice of Availability (NOA) was prepared and mailed out on April 15, 2019. The Notice of Completion (NOC) was posted and filed with the State Clearinghouse on April 15, 2019, along with the NOA, describing the project, list of significant environmental effects, review period, where to direct comments, and locations of where the DEIR was available for review. The DEIR was circulated for public review beginning on April 15 and ending on June 5, 2019. The deadline to comment on the DEIR was extended to June 14, 2019, making the total comment period 60 days. The extension was announced through radio, newspaper, and public posting. The DEIR was made available online at the County's website, with hard copies available for review during normal business hours at the following locations: Humboldt County Public Library (Eureka, Ferndale, and Rio Dell branches), Scotia Community Services District office, the Multi-Generational Center in Fortuna, and the Humboldt County Planning and Building Department office in Eureka.

During the DEIR public review period a large volume of comment letters were received. These include individually written letters from federal agencies (2), state agencies (5), regional and local agencies (4), Tribes (2), organizations (16), and individuals (244). A form letter was also submitted by 109 individuals. Written comments intermix points and opinions relevant to the project's merits with points and opinions relevant to potential environmental effects of the project.

During the public comment period for the DEIR several time extensions were requested, and many expressed feelings that the project has been rushed. The County has attempted to balance the need to be sensitive to CEQA's intent not to delay projects while affording the public opportunity to provide meaningful comments. CEQA Guidelines Section 15108 states that the Lead Agency (County of Humboldt) shall complete and certify the Final EIR within one year after the date when the Lead Agency accepted the application as complete.

5 Final EIR

A Final EIR (FEIR) was published on November 1, 2019 and includes written responses to all

comments received, in addition to the project changes proposed by the applicant and supplemental technical information. The responses acknowledge comments addressing points and opinions relevant to the project's merits and discuss as necessary the points relevant to the adequacy of the environmental review required by CEQA. Additionally, the FEIR includes information showing that impacts identified in the FEIR are less severe than those in the DEIR and contained appropriately refined mitigation measures. The FEIR was made available for review by agencies for the minimum requirement of 10 days prior to certifying a FEIR (14 CCR 15089[b]).

After release of the DEIR the applicant continued several scheduled studies such as additional bat acoustical monitoring, northern spotted owl surveys, and eagle use count surveys that were able to inform the FEIR. The results of these studies and the incorporation the supplemental technical analysis the County requested based on comments received in the DEIR (see FEIR Appendix B Updated Technical Information), led to the project refinements discussed above.

In responding to the large volume of comment of letters received (382 total), several issues were identified that could be addressed globally and a master response was prepared. Master response topics include: (1) Site Planning and Avoidance Measures; (2) Marbled Murrelet; (3) Northern Spotted Owl; (4) Bats; (5) Migratory and Special-Status Birds; (6) Eagles and Other Raptors; (7) Special Status Plans and Sensitive Communities; (8) Conflict with Adopted HCP; (9) Adequacy of Greenhouse Gas Analysis; (10) Wildfire; and (11) Alternatives.

In navigating the FEIR, Chapter 9 (Revisions to the Draft DEIR) and Chapter 2 (Mater Responses), give the best overview of how the project has been refined since the DEIR and how global concerns have been addressed.

6. Adequacy of EIR

The project EIR, consisting of the Draft EIR (DEIR) and the Final EIR (FEIR), has been completed in accordance to the requirements of the California Environmental Quality Act (CEQA) and the State CEQA Guidelines, and is based upon the best available information. The primary purpose of the EIR is to disclose environmental impacts associated with the project and mitigate impacts to the extent feasible. s mentioned above, where there is not feasible mitigation available to bring an impact to a less than significant level, the decision maker must balance the identified environmental impacts against the benefits of the project and adopt a statement of overriding considerations.

Through the review process the County has relied upon numerous technical studies and consultation with agencies to determine where impacts may exist. The methodology and conclusions presented in the technical studies prepared by the applicant have been peer reviewed by the County's independent EIR consultant, AECOM. Where potential mitigation was identified, the County endeavored to understand if it would have a known benefit, if it was proportional to the impacts caused by the project, and if it was feasible to implement. In some cases, such as aesthetics, no mitigation was identified that would reduce the impact below a significant level.

Disagreement among experts does not make an EIR inadequate (14 CCR Section 15126.6). In some impact areas such as bats and marbled murrelets, all best available information has been used to disclose the level of anticipated impact and the effectiveness of proposed mitigation. The County has exercised independent judgement based on the evidence in the record. The standard for CEQA review is not perfection but adequacy, completeness, and a good faith effort at full disclosure.

Recirculation

Pursuant to Section 15088.5 of the State CEQA Guidelines, recirculation of a DEIR is required when new significant environmental impacts have been identified, the severity of an impact has

increased, feasible project alternatives or mitigation measure considerably different from those analyzed would reduce an environmental effect, or if the EIR was inadequate for meaningful public review.

The project refinements have been made to reduce environmental impacts. The corridor approach presented in the DEIR was purposefully designed to allow for project refinements to occur. Without knowing the exact locations of turbines, the DEIR included an evaluation of the entire study corridor and conservatively assumed all of it would be subject to project impacts. Since the publication of the DEIR, the actual project disturbance limits have been identified and reduced significantly from the assumptions presented in the DEIR.

Public review of the DEIR has been significant with 382 comment letters received. All of these comments have been responded to in the FEIR. Some of these comments led the County to request additional information from the applicant to confirm that level of impact assumptions in the DEIR were correct and that mitigation would be as effective as anticipated. The additional technical information submitted is included as an appendix to the FEIR. In some cases, mitigation was revised to improve the effectiveness and certainty of the outcome.

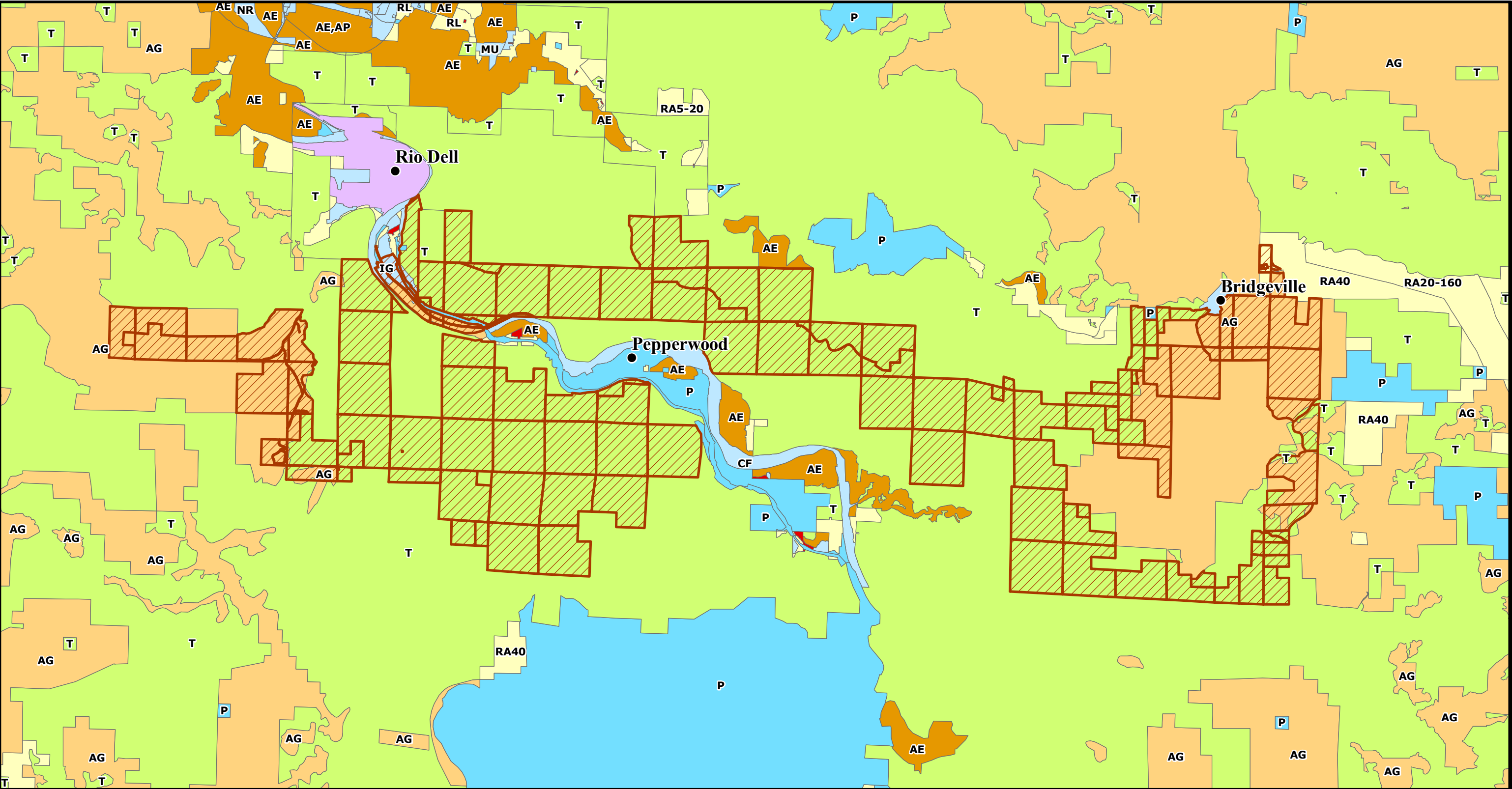
No new impacts were identified, nor was the severity of an identified impact increased as a result of the refined project footprint and the additional technical information. Changes proposed to mitigation measures only increase the effectiveness of the measure. No new alternatives have been identified. The supplemental technical information received has been used to make project refinements, but only re-enforces the DEIR impact conclusions. No impact conclusions are recommended to change from the DEIR.


Based on the above, recirculation of the DEIR is not recommended.

7. Planning Commission Process

The November 7, 2019 Planning Commission Hearing is intended to allow for staff to introduce the project and the EIR, provide the applicant an opportunity to present information about the project, and provide for public and Planning Commission questions to gain clarity on the project. Public testimony on the project can be initiated, but because there has not been enough time for the public or agency review of the FEIR, no action will be taken at this hearing.

The public hearing will be continued to November 14, 2019 to allow adequate time for review of the FEIR. Prior to the hearing on November 14, 2019, a staff report containing resolutions for the Commission's consideration will be provided. The primary public comment opportunity will occur beginning on November 14, 2019.






Map location shown with red symbol

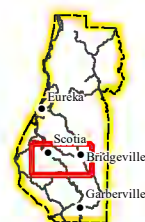
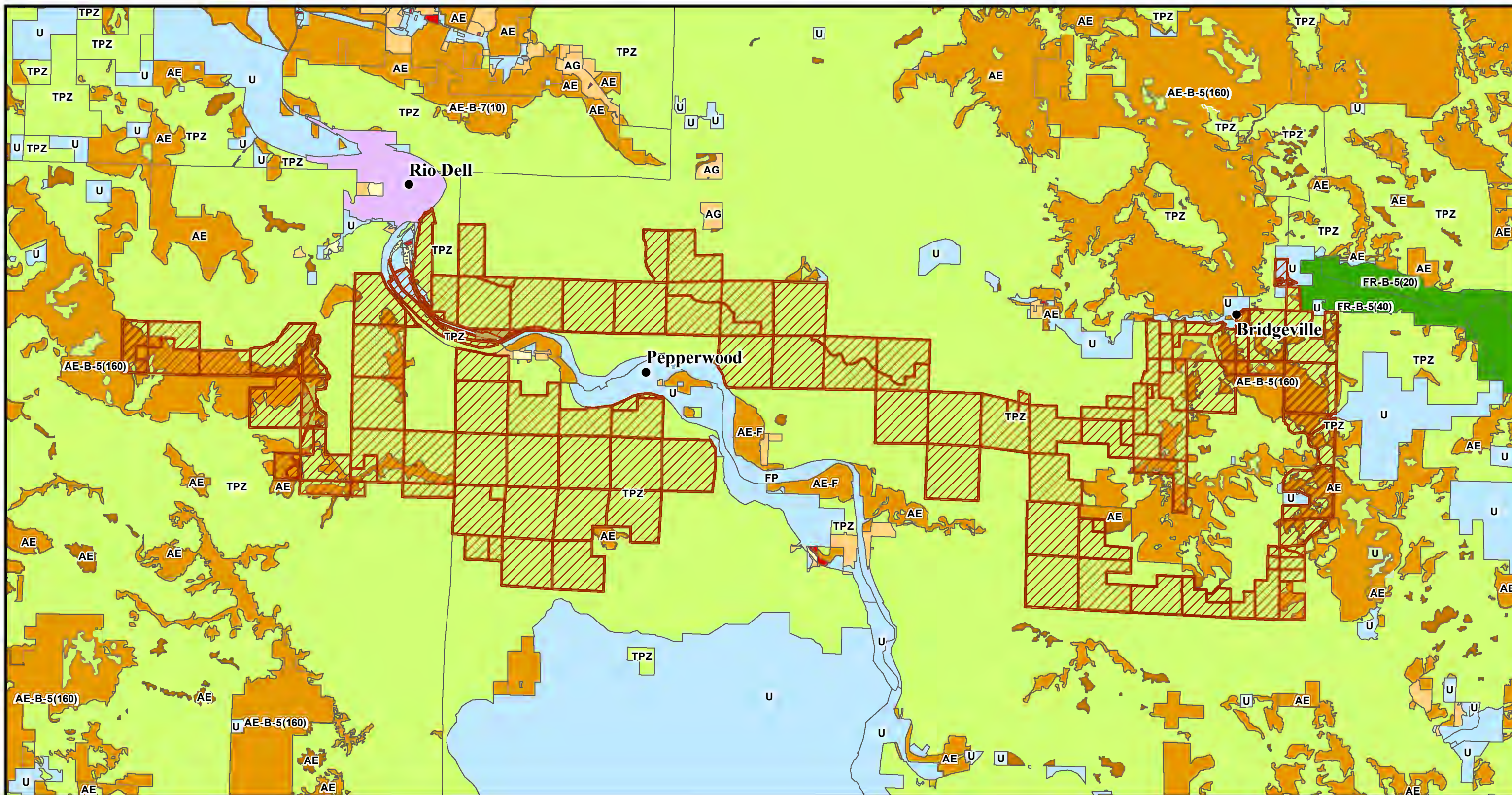
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	Project Area		P
General Plan			R
	Other Values		C
	CITY		
	AE		
	AG		
	T		

GENERAL PLAN MAP
PROPOSED HUMBOLDT WIND, LLC
CONDITIONAL USE PERMIT
SCOTIA-BRIDGEVILLE AREA
PLN-13999-CUP; CUP-18-002
APN: 102-132-004 et seq



0 0.5 1 2 3 Miles

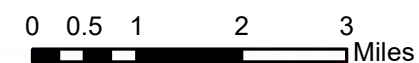


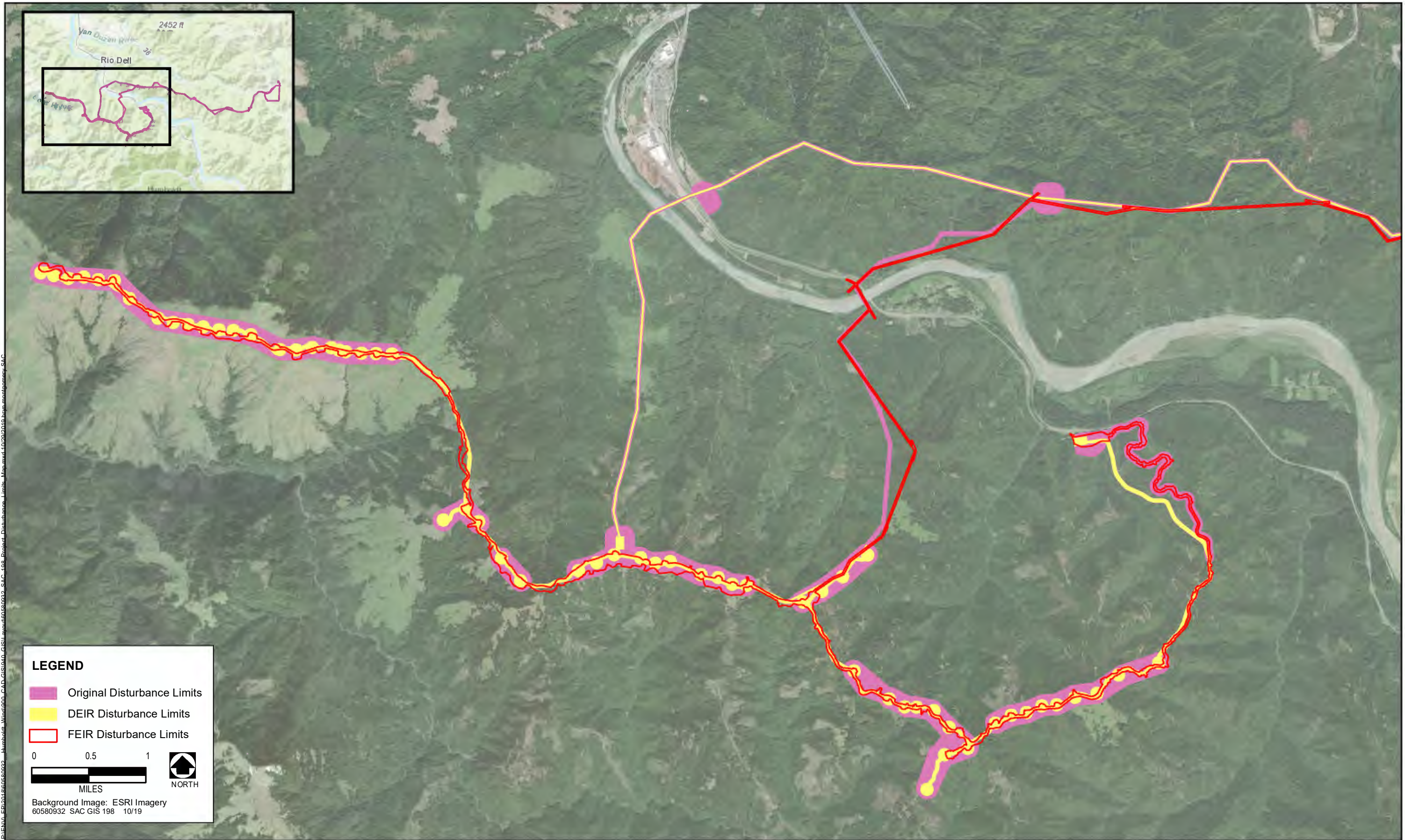
Map location shown with red symbol

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	Project Area		FR
Zoning			R
	Other Values		C
	CITIES		
	AE		
	AG		
	TPZ		

ZONING MAP
PROPOSED HUMBOLDT WIND, LLC
CONDITIONAL USE PERMIT
SCOTIA-BRIDGEVILLE AREA
PLN-13999-CUP; CUP-18-002
APN: 102-132-004 et seq





Source: Stantec

Figure 1a Comparison of Original (DEIR) and Refined (FEIR) Project Disturbance Limits



Figure 1b Comparison of Original (DEIR) and Refined (FEIR) Project Disturbance Limits



Source: Stantec

Figure 2-2 Project Site Boundaries and Surrounding Land

ATTACHMENT A

List of Project Impacts

Impacts Not Discussed Further:

- **Land Use and Planning**
- **Population and Housing**
- **Utilities**
 - Water supply
 - Wastewater
 - Stormwater facilities
 - Solid waste
- **Recreation**
- **Public Services**
 - Schools, parks, and other public facilities
 - Police protection services
- **Energy**
- **Mineral Resources**
- **Paleontological Resources**

Less Than Significant Impacts (No Mitigation Required):

- **Aesthetics**
 - Impact 3.2-2: Project Impacts on Scenic Resources along a State Scenic Highway
 - Impact 3.2-4: Shadow Flicker Effects
- **Air Quality**
 - Impact 3.4-2: Long-Term, Operational (Regional) Emissions of Criteria Air Pollutants
 - Impact 3.4-3: Inconsistency of the Project with Air Quality Planning Efforts
 - Impact 3.4-4: Exposure of Sensitive Receptors to Toxic Air Contaminants
 - Impact 3.4-5: Exposure of Sensitive Receptors to Odorous Emissions
- **Biological Resources**
 - Impact 3.5-4: Construction Impacts on Bald and Golden Eagle Foraging and Nesting Habitat
 - Impact 3.5-10: Removal and Modification of Special-Status Raptor Nesting and Foraging Habitat during Construction
 - Impact 3.5-16: Construction Disturbance of Bachelor Groups, Migratory Roosts, or Solitary Bats
 - Impact 3.5-17: Loss of Bat Foraging Habitat and Nonessential Roosts
 - Impact 3.5-20: Operational Impacts on Special-Status Mammals
 - Impact 3.5-26: Impacts on Migratory Corridors during Project Construction and Operation
 - Impact 3.5-27: Impacts on Nursery Sites
- **Cultural Resources, Including Tribal Cultural Resources**
 - Impact 3.6-3: Change to the Significance of a Historical Resource (Scotia Historic District)
- **Geology and Soils**
 - Impact 3.7-1: Surface Rupture Along a Known Earthquake Fault
 - Impact 3.7-2: Possible Risks to People and Structures Caused by Strong Seismic Ground Shaking

- Impact 3.7-3: Possible Risks to People and Structures Caused by Seismic-Related Ground Failure, Liquefaction, and Landslides
- Impact 3.7-4: Erosion during Project Construction and Operation
- Impact 3.7-5: Potential Geologic Hazards Related to Construction in Expansive Soils
- Impact 3.7-6: Potential Insuitability of Soils for Use with Septic Systems
- **Greenhouse Gas Emissions**
 - Impact 3.8-1: Generation of Greenhouse Gas Emissions
 - Impact 3.8-2: Consistency with Applicable Plans, Policies, and Regulations Adopted for the Purpose of Reducing the Emissions of GHGs
- **Hazards and Hazardous Materials**
 - Impact 3.9-1: Accidental Spills of Hazardous Materials from Routine Transport, Use, or Disposal of Hazardous Materials
 - Impact 3.9-4: Potential Hazards Associated with Operation of Wind Turbine Generators
 - Impact 3.9-5: Interference with Air Navigation
 - Impact 3.9-6: Release and Handling of Hazardous Materials within One-Quarter Mile of Existing Schools
- **Hydrology and Water Quality**
 - Impact 3.10-2: Potential to Increase the Rate or Amount of Surface Runoff in a Manner that Would Result in Flooding On- or Off-site
 - Impact 3.10-3: Potential Water Quality Impacts from Project Operations
 - Impact 3.10-4: Potential to Deplete Groundwater Supplies or Interfere Substantially with Groundwater Recharge Such that the Project May Impede Sustainable Groundwater Management
- **Noise**
 - Impact 3.11-1: Generation of a Substantial Temporary Increase in Ambient Noise Levels in the Vicinity of the Project in Excess of Standards Established in the Local General Plan or Noise Ordinance, or Applicable Standards of Other Agencies (Note: this impact was determined to be less than significant, the project applicant has voluntarily agreed to implement Mitigation Measure 3.11-1 as an enforceable condition of approval.)
 - Impact 3.11-2: Temporary and Short-Term Exposure of Sensitive Receptors to, or Temporary and Short-Term Generation of, Excessive Groundborne Vibration
 - Impact 3.11-3: Long-Term Increases in Project-Generated Noise
- **Transportation and Traffic**
 - Impact 3.12-1: Potential to Conflict with a Program, Plan, Ordinance, or Policy
 - Impact 3.12-3: Potential to Impede Emergency Access (Note: this impact was determined to be less than significant, the project applicant has voluntarily agreed to implement Mitigation Measure 3.12-3 as an enforceable condition of approval.)

Impacts Reduced to Less Than Significant with Mitigation Incorporated:

- **Biological Resources**
 - Impact 3.5-1: Construction Impacts on Marbled Murrelet Nesting
 - Impact 3.5-2: Operational Impacts on Marbled Murrelet
 - Impact 3.5-3: Construction Impacts on Bald and Golden Eagle Nesting Activity
 - Impact 3.5-6: Disturbance of Roosting and Nesting Northern Spotted Owls by

- Construction Activities
 - Impact 3.5-7: Removal, Fragmentation, and Modification of Northern Spotted Owl Habitat during Construction
 - Impact 3.5-8: Operational Impacts on Northern Spotted Owls
 - Impact 3.5-9: Construction Impacts on Nesting Raptors
 - Impact 3.5-12: Construction Impacts on Avian Foraging and Nesting Habitat
 - Impact 3.5-13: Construction Impacts on Nesting Birds
 - Impact 3.5-14: Operational Impacts on Nonraptor Birds
 - Impact 3.5-15: Construction Impacts on Bat Maternity Roosts or Hibernacula and Loss of Essential Roost Habitat
 - Impact 3.5-18: Operational Impacts on Bats
 - Impact 3.5-19: Construction Impacts on Special-Status Mammals
 - Impact 3.5-21: Construction Impacts on Special-Status Amphibians and Reptiles
 - Impact 3.5-22: Impacts of Project Construction on Special-Status Fish
 - Impact 3.5-23: Impacts on Special-Status Plants during Project Construction and Operation
 - Impact 3.5-24: Loss or Disturbance of Sensitive Natural Communities and Riparian Habitat
 - Impact 3.5-25: Disturbance and Loss of Wetlands and Other Waters during Project Construction
 - Impact 3.5-28: Potential Inconsistency with the Humboldt Redwood Company Habitat Conservation Plan
- **Cultural Resources, Including Tribal Cultural Resources**
 - Impact 3.6-1: Change to the Significance of an Archaeological Resource
 - Impact 3.6-2: Disturbance of Human Remains
- **Hazards and Hazardous Materials**
 - Impact 3.9-2: Exposure to Hazardous Materials Existing at the Project Site or Location of the Project on a Site Included on a List of Hazardous Materials Sites Compiled Pursuant to Government Code Section 65962.5
 - Impact 3.9-3: Potential Safety Hazards Associated with Project Construction
- **Hydrology and Water Quality**
 - Impact 3.10-1: Potential Temporary, Short-Term Construction-Related Drainage and Water Quality Effects
- **Noise**
 - Impact 3.11-3: Long-Term Increases in Project-Generated Noise
- **Transportation and Traffic**
 - Impact 3.12-2: Creation of Hazards from Truck Traffic
- **Fire Protection Services and Wildfire Hazards**
 - Impact 3.13-1: Increased Demand for Fire Protection Services
 - Impact 3.13-2: Increased Risk of Wildland Fires

Significant and Unavoidable Impacts:

- **Aesthetics**
 - Impact 3.2-1: Project Impacts on Scenic Vistas and Potential for Substantial Degradation of Existing Visual Character or Quality of Public Views of the Site and Surroundings
 - Impact 3.2-3: New Source of Substantial Light or Glare that Would Adversely Affect Day or Nighttime Views in the Area

- **Air Quality**
 - Impact 3.4-1: Short-Term, Construction-Generated Emissions of ROG, NO_x, and PM₁₀
- **Biological Resources**
 - Impact 3.5-2: Operational Impacts on Marbled Murrelet
 - Impact 3.5-11: Operational Impacts on Raptors
- **Cultural Resources, Including Tribal Cultural Resources**
 - Impact 3.6-3: Change to the Significance of a Historical Resource (Bear River Ridge and Valley Historic Landscape and Bear River Ridge Ethnobotanical/Cultural Landscape)
 - Impact 3.6-4: Change to the Significance of a Tribal Cultural Resource
- **Cumulative Impact Areas**
 - Air Quality
 - Biological Resources
 - Cultural Resources, Including Tribal Cultural Resources

ATTACHMENT B

Draft Environmental Impact Report (DEIR)

<https://humboldt.gov.org/2408/Humboldt-Wind-Energy-Project>

(Previously provided)

ATTACHMENT C

Final Environmental Impact Report

<https://humboldt.gov.org/2408/Humboldt-Wind-Energy-Project>

(Provided via binder or electronically)

ATTACHMENT D

Public Comments



October 11, 2019

Humboldt County Planning Commission
Planning and Building Department
3015 H St. Eureka, CA 95501

RE: Comments on Memo Supplements to Cultural and Botanical Reports for the Humboldt Wind Project

He'bla'lo (Greetings),

This letter is to reiterate Wiyot Tribe comments on findings from the Cultural Resources Phase 1 Inventory and the Botanical Inventory for the Humboldt Wind Energy Project, based on supplemental findings from 2019 in areas not previously inventoried or presented within the DEIR. The Wiyot Tribe have vehemently expressed opposition to this wind development proposal due to the cultural and biological diversity found within the project and surrounding areas. Environmental impacts and impacts to tribal cultural resources (TCRs) and areas potentially eligible for listing under the National Register of Historic Places (NRHP), and the Bear River Ridge (*Tsakiyuwit*) cultural and ethnobotanical landscape would be significant (Impact 3.6-3).

Recently identified sites DN01 and DN02 (Stantec 2019) add to the body of evidence that *Tsakiyuwit* was an actively used cultural landscape by Indigenous peoples, including the Wiyot and other groups pre-historically. These two sites are also located within the designated Wiyot ethnobotanical landscape, which further validates the value of the ridge as a TCR. Site DN02 is quite large with two potential house pits and 27 artifacts discovered, including Borax Lake pattern projectiles, and "cumulatively, approximately 200 +/- flakes were observed, with varying colors including reddish-brown, red, brown, grey, tan, grey-green, lavender, orange, pink and rainbow colored cryptocrystalline silica (CCS) and quartzite. Tools observed included: six flake tools, ten projectile points; six bifaces; four core tools, and one awl", which contribute to significance of the site (Eidsness pers. comm 2019). While the memo notes that the site is outside the impact area of the project, it is immediately adjacent to Monument Road, the primary access road for the project, which has a potential expanded project footprint of 200 feet across. While Stantec assumes that the site has low integrity, it is likely that there is a buried deposit (Eidsness pers. comm 2019). With the density of known sites found along *Tsakiyuwit*, it is likely that other lithic scatters and sites are present sub-surface, which would be impacted by the project turbine foundations, string roads, and primary road expansion. Without the schematics of the proposed road improvements, we are not able to fully evaluate impacts. Due to the number of truck trips per turbine, the potential for additional road and construction complications, combined with the unstable geology of the area, it is likely that more sites will be exposed and impacted. This is significant in that the area has both Tuluwat and Borax Lake pattern artifacts, which gives emphasis to the cultural and archaeological value of the ridges. This site is potentially eligible for listing under the National Register of Historic Places/California Register of Historic Places (NRHP/CRHP) under Criterion D "Information Potential" due to the density and types of artifacts found at the site.

The expanded botanical report does not include several areas which were also not surveyed during the 2018 report, nor does it explain why areas were not surveyed, other than claiming "no access". Additionally, there is no mention to the natural communities and vegetation alliances and associations present within the 2019 survey areas. This is significant in the project area is a large ecological transect extending over 30 miles from the coastal zone and coastal prairies in the west, to the oak woodlands and grasslands around Bridgeville in the east, encompassing one of the more diverse regions of California. Evaluation of sensitive natural communities within all portions of the project should be available for review by the Tribes, agencies, and the public.

As noted in the Wiyot Tribe's comments during the Assembly Bill No. 52 (AB 52) consultation process, the Tribe made clear the importance and richness of the cultural and natural values and resources found on Bear River Ridge, *Tsakiyuwit*, a hugely significant component, piece, and defining feature of the larger Wiyot cultural landscape, a protected tribal cultural resource (TCR) in the State of California under the California Environmental Quality Act (CEQA). The site has been noted as a "high prayer spot" by Wiyot Tribal chairman, Ted Hernandez. The environmental, physical, and spiritual impacts that up to sixty (60), six-hundred foot-tall (600 ft.) wind turbine generators (WTGs) and the combined road and infrastructure expansion would have upon the cultural landscape and cultural sites of the Wiyot Tribe, and greater community, are un-mitigatable, and it is the recommendation of the Tribe that the project be denied, and the County select the "No Project" alternative. The "No Project" alternative is also noted in section 6.4 of the DEIR to be the environmentally superior alternative, re-affirming the position of the Wiyot. The position for "No Project" was reiterated by a unanimous vote at the June 10, 2019 Wiyot Tribal Council meeting.

The commanding view from *Tsakiyuwit* provides a vantage of virtually all of Wiyot ancestral territory, and as such, has been presumed by Tribal elders to have been a high prayer spot (Ted Hernandez, pers. comm 2019). In retrospect, *Tsakiyuwit*, can be viewed from the rest of Wiyot ancestral territory, including Table Bluff and the Humboldt Bay area. The impact from sixty 600 foot-tall wind turbines would, for a likely many generations, alter the spiritual and sacred viewshed of the Wiyot cultural landscape, and there is no possible way to mitigate the impacts that this project would have upon the rights of the Wiyot Tribe. For even longer, the large concrete pads will forever impact the hydrology of the ridge crest. Recent power outages and extreme wildfire conditions in northern California highlight the danger of remote transmission lines along this gen-tie route, which could jeopardize the massive carbon storage within the Humboldt Redwoods State Park and the Van Duzen River corridor forests. This is unacceptable.

The Tribe recommends that the project be denied on the grounds of un-mitigatable impacts to *Tsakiyuwit*, its culturally important sites, flora, fauna, and the remainder of Wiyot territory that is within its viewshed. The Wiyot Tribe have experienced mass genocide and been robbed of most of their sacred lands around Humboldt Bay and the lower Eel River. Much of their ancestral land has been developed, or the native vegetation types they helped to shape and tend, converted to alien pasture grasses and weeds. In the spectrum of impacted landscapes, *Tsakiyuwit* has persisted to the present as an iconic gem of native coastal prairie, that still holds the signs of the Wiyot's caretaking and stewardship. Thank you for your time, consideration, and concern regarding our concerns over the magnitude of this development project.

Rra'dutwas (with kindness)



Adam N. Canter,
Tribal Botanist, GIS, and THPO Cultural Assistant
Table Bluff Reservation
1000 Wiyot Dr., Loleta, CA 95551
adam@wiyot.us 707-733-5055

From: Tom Wheeler <tom@wildcalifornia.org>
Sent: Thursday, September 12, 2019 7:51 AM
To: Ford, John <JFord@co.humboldt.ca.us>
Subject: Joint letter re: Terra-Gen

Dear John,

Attached please find a joint letter from the North Coast conservation community about the necessary changes and conditions for the Terra-Gen project. These largely mirror the comments EPIC submitted earlier this summer.

Please let us know if you have any questions about this letter. Thank you for your openness throughout this process.

--

Tom Wheeler
Executive Director and Staff Attorney
Environmental Protection Information Center
145 G Street Suite A
Arcata, CA 95521
Office: (707) 822-7711
Cell: (206) 356-8689
tom@wildcalifornia.org
www.wildcalifornia.org

"If EPIC had not undertaken its lonely efforts on behalf of the Marbled Murrelet, it is doubtful that the species would have maintained its existence throughout its historical range in California." - Judge L. Bechtle, *Marbled Murrelet v. Pacific Lumber Co.*



Sent via email on date shown below

September 27, 2019

Director John Ford
Humboldt County Planning Department
3015 H St
Eureka, CA 95501

Dear Director Ford,

On behalf of the Environmental Protection Information Center (EPIC), please accept these comments concerning recently published science on the decline of hoary bats in the Pacific Northwest, likely because of wind energy development. This new science may affect the Planning Department's consideration of the proposed Humboldt Wind Project.

Rodhouse et al. (2019) investigated potential bat populations declines in the Pacific Northwest for both the little brown bat and the hoary bat. Based on eight years of survey data, Rodhouse et al. found evidence of region-wide summertime decline for the hoary bat since 2010 yet no apparent decline for little brown bats. As the study concluded, given the conservative construction of the survey, such evidence of decline is "alarming." The study's authors theorize that the most likely cause for this decline is fatalities from wind energy facilities.

This study is important because it provides support for the modeled population decline presented in Frick et al. (2017). Frick et al., using population models, estimated that the population of hoary bats could decline by as much as 90% in the next 50 years because of existing wind energy projects.

Rodhouse et al. (2019) further reinforces the DEIR's conclusion that the Humboldt Wind Project is likely to result in significant impacts to hoary bats. As the DEIR recounts:

[H]oary bats have been captured in exceptionally high numbers, especially during the fall, at the Humboldt Redwoods State Park study site approximately 4 miles from the project site. This discovery of what may be fall swarming behavior of hoary bats has not yet been documented anywhere else, it could represent a vital life history component for this species, and it may demonstrate a seasonal concentration of mating hoary bats from all over western North America.

Environmental Protection Information Center
145 G Street, Suite A, Arcata, CA 95521 | (707) 822-7711
www.wildcalifornia.org
Page 1 of 3

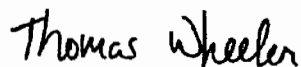
Locating a wind farm so close to this unique concentration of hoary bats may increase the mortality of this species if they use or are attracted to the project site following construction.

Although threats associated with the proposed project are similar for the other bat species found in the area, the high hoary bat mortality rates associated with wind farms and the exceptionally high numbers of hoary bats documented near the project site provide substantial evidence that the project could cause a large number of hoary bat fatalities on an annual basis over the 30-year life of the project. Because little empirical demographic and population data exist for the species, it is difficult to evaluate the significance of such high fatality. Recent contradictory genetic studies have indicated that hoary bats may reproduce within local populations with a small effective size, or that all North American hoary bats may represent a large and well-mixed population. If the former, the proposed project would have the potential to eliminate a high proportion of a local population of hoary bats over a long period of time. If the latter, the proposed project would have the potential to create a population sink for a large and widespread population over a long period of time. Either would be an adverse effect that could cause a wildlife population to drop below self-sustaining levels or threaten to eliminate an animal community. This impact would be potentially significant. (DEIR at 3.5-135–136 (internal citations omitted)).

EPIC is concerned that the Humboldt Wind Project, as described in the DEIR, is likely to further contribute to the decline of the hoary bat. Given the likely significant impact, the county has an obligation to adopt all feasible mitigation measures to reduce the impact of the project. Thankfully, operational curtailment can significantly reduce hoary bat mortality with minimal power loss and has been adopted at other project sites. EPIC continues to insist that operational curtailment be included as a required mitigation measure.

Should you have any questions or concerns, please do not hesitate to contact me at tom@wildcalifornia.org or (707) 822-7711. Thank you for your attention to our concerns.

Sincerely,



Thomas Wheeler
Executive Director and Staff Attorney

Attachments: Rodhouse, T. J., Rodriguez, R. M., Banner, K. M., Ormsbee, P. C., Barnett, J., & Irvine, K. M. (2019). Evidence of region-wide bat population decline from long-term monitoring and Bayesian occupancy models with empirically informed priors. *Ecology and Evolution*.

CC: Natalynne DeLapp, Terra-Gen
Kevin Martin, Terra-Gen
Nathan Vajdos, Terra-Gen

Gordon Leppig, California Department of Fish and Wildlife
Michael van Hattem, California Department of Fish and Wildlife
Jennifer Olson, California Department of Fish and Wildlife

From: Nathan Madsen <n84now@gmail.com>
Sent: Thursday, August 22, 2019 8:57:12 PM
To: Ford, John <JFord@co.humboldt.ca.us>
Subject: TerraGen

John,

I hope this finds you well.

I am attaching the Joint letter to this email as it more or less accurately represents my views on the TerraGen wind project.

Though I generally am a strong proponent of alternative "green" energy, this is the wrong project for all the right reasons. Simply put we are never going to "save the planet" by spoiling our last incredibly precious, biologically sensitive, and as of yet unspoiled locations. This is one of those locations.

Please do support a diverse power generative program with rooftop solar (power infill if you will) and other alternative projects. For example, those rooftop solar installations would benefit from north side wind generation using alternative bird-friendly harnessing techniques. They come in a variety of alternative to blade driven turbines. Also, micro-hydro is a great alternate option and could be done with rooftop rain catchment if we prefer not to tamper with the creeks. If we do use creek sourced hydro power then we should use headwaters regions i.e. above fish and other sensitive species habitat and implement biota friendly water intake systems.

Just a few ideas as alternatives to the proposed project. The next phase of human development needs to model a distributed power model where production is localized and sited appropriately.

The current proposal is unfortunately placed in one of the most precious bird meccas of our region. Simply poor siting for the wrong project.

In Stong Support of Clean Energy; Not this Project,

Nathan Madsen, Esq.
n84now@gmail.com
(707) 223-2565
P.O. Box 128
Petrolia, CA 95558

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From: McQuillen, Kassandra <Kassandra.McQuillen@ttu.edu>
Sent: Wednesday, October 30, 2019 1:25 PM
To: Shortridge, Tricia <TShortridge@co.humboldt.ca.us>
Cc: serc@humboldt.edu
Subject: Humboldt Wind Energy Project

Hello Ms. Shortridge. I am an HSU alumni and former Eureka resident. I happened upon the Humboldt Wind Energy Project today while searching for information on offshore wind projects on the west coast. I am not an instructor at the National Wind Institute at Texas Tech University and have a fair bit of experience with land-based wind development in California. I have worked with Terra-Gen on wind energy projects quite a bit in Kern County.

I have a fondness for Humboldt County and thought I would make sure that the county is protecting its landowners and properties and asking the right questions of the developers. I negotiated many landowner lease agreements with Terra Gen and those agreements often omit the decommissioning and/or remediation bond requirements. Terra Gen will form an LLC to construct and operate the project. Once the project passes its useful (profitable) life, that LLC will dissolve and there will be no funds for the remediation of the project and Humboldt County will be left with the blight and no funds to clean up. This is happening across the U.S. right now as local communities realize once the wind site is no longer profitable, the developer and operator will leave. Just google "abandoned wind farms". There are 80,000 wind turbines in the U.S. these days and this is going to be a big issue in the coming decades.

Specific issues to address to protect Humboldt County include:

1. Posting of a decommissioning bond sufficient to pay for remediation (currently minimum of \$200,000+ per turbine with only \$60,000 scrap value.) Just ask Terra Gen what the plan is for this. Make sure you set up a fund or bond to be paid out by the LLC at certain stages of the project - usually after years 10, 15 and 20. Request assurances of ability to pay.
2. Wind turbine blades are not recyclable. The current practice is to cut them into smaller sections and put them in landfills. Modern blades (3 per turbine) are 200-300 feet in length. Imagine what the county will do with 300 football field length chunks of fiberglass composite? Are the county landfills prepared for this?
3. Wind turbines are known to have fatigue, performance problems and wear down more quickly when placed on ridge lines. Ask Terra Gen for data on their Alta projects in Kern County to see the operations and maintenance issues involved with ridge-sited turbines. The industry frowns upon this practice as irresponsible. The wildlife impacts are often far greater in mountainous regions as well.
4. Good luck and feel free to call me to discuss this if you'd like. I am not against wind energy development and I understand the crisis PG&E has caused in Humboldt County, but wind projects must be sited responsibly.
5. All of these concerns flow over into the offshore wind projects as well.

Hopefully you have addressed these issues and I am just being a meddling former resident.

Best regards,

Kassandra McQuillen, J.D.

Instructor

National Wind Institute

Texas Tech University

<https://www.depts.ttu.edu/nwi/education/BSWE/index.php>

National Wind Institute, Room 104A

From: Jesse Noell <noelljesse@gmail.com>
Sent: Friday, August 30, 2019 12:16 PM
To: Lippre, Suzanne; McGuigan, Connor; Madrone, Steve
Subject: Front End Loading by TerraGen's DEIR

Hi Suzanne, Connor, and Steve:

My comments regarding the DEIR and project impacts use the terms "front end loading" and "heat engine". I would like to elaborate to include the meaning of climate forcing into my use of front end loading in my comments, so that the Planning Commission provides an apt response to my comments.

My point is that a proper impact analysis would compare the corresponding effects and impacts of other feasible alternatives. In point, the long term climate forcing by generating Humboldt's electricity using solar panels on rooftops will be different (likely much less) than by construction of TerraGen's proposed wind project.

Here is a study regarding climate forcing <https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1002/2015GL063514>

See below:

agupubs.onlinelibrary.wiley.com/doi/pdf/10.1002/2015GL063514

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AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER
10.1002/2015GL063514

Key Points:

- The Earth is heated both by thermal energy and by CO₂ greenhouse effect
- Time scales and ratios of warming from thermal versus CO₂ are quantified
- Approximately 1% of net anthropogenic climate forcing from direct thermal emissions

Supporting Information:

- Texts S1–S4, Figure S1, and Table S1

Correspondence to:
X. Zhang
xzhang@stanford.edu

Citation:
Zhang, X., and K. Caldeira (2015), Time scales and ratios of climate forcing due to thermal versus carbon dioxide emissions from fossil fuels, *Geophys. Res. Lett.*, 42, 4548–4555, doi:10.1002/2015GL063514.

Received 17 FEB 2015
Accepted 6 APR 2015
Published online 2 JUN 2015

Time scales and ratios of climate forcing due to thermal versus carbon dioxide emissions from fossil fuels

Xiaochun Zhang¹ and Kim Caldeira¹

¹Department of Global Ecology, Carnegie Institution for Science, Stanford, California, USA

Abstract The Earth warms both when fossil fuel carbon is oxidized to carbon dioxide and when greenhouse effect of carbon dioxide inhibits longwave radiation from escaping to space. Various important time scales and ratios comparing these two climate forcings have not previously been quantified. For example, the global and time-integrated radiative forcing from burning a fossil fuel exceeds the heat released upon combustion within 2 months. Over the long lifetime of CO₂ in the atmosphere, the cumulative CO₂ radiative forcing exceeds the amount of energy released upon combustion by a factor >100,000. For a new power plant, the radiative forcing from the accumulation of released CO₂ exceeds the direct thermal emissions in less than half a year. Furthermore, we show that the energy released from the combustion of fossil fuels is now about 1.71% of the radiative forcing from CO₂ that has accumulated in the atmosphere as a consequence of historical fossil fuel combustion.

1. Introduction

The Earth is heated both when reduced carbon is oxidized to carbon dioxide and when outgoing longwave radiation is trapped by carbon dioxide in the atmosphere (CO₂ greenhouse effect) (Washington, 1972; Nordell, 2003; Block et al., 2004; Chabson, 2008; Konner, 2009; Ma et al., 2011; G. J. Zhang et al., 2013; X. Zhang et al., 2013). The purpose of this study is to improve our understanding of time scales and relative magnitudes of climate forcing increase over time from pulse, continuous, and historical CO₂ and thermal emissions. We aim to (1) improve our understanding of time scales and relative magnitudes of the forcing increase over time due to pulse fossil fuel combustion thermal and CO₂ emissions; (2) identify for a pulse

Hope this helps,

Jesse Noell

From: Jesse Noell <noelljesse@gmail.com>
Sent: Friday, October 11, 2019 11:56 AM
To: mmarshall@redwoodenergy.org; Madrone, Steve; McGuigan, Connor; Lippre, Suzanne
Subject: What is the cost to underground Humboldt Wind Project transmission lines?

Dear RCEA Board and Humboldt County Planning Commission regarding Humboldt Wind Project:

Does RCEA's contract for Humboldt Wind power make economic sense without underground transmission lines? Who pays the insurance costs if the lines are not put underground? How much of this cost burden will the ratepayer assume? How much would a Humboldt County solar rooftop with V2G (vehicle to grid) battery system cost? Why is Humboldt Wind the least damaging alternative?

PGE's 134,000 miles of high voltage lines x \$5 million per mile = \$100 Billion
see <https://www.sfchronicle.com/bayarea/article/Underground-power-lines-don-t-cause-wildfires-12295031.php>

Based on the SF Chronicle's estimate, the cost to underground the Humboldt Wind lines---25 miles = \$125 million; who pays? If the ratepayer pays, can the ratepayer afford it or will implementation of Humboldt Wind Project assure that grid abandonment results?

Thank you for your consideration. I look forward to hearing your response to these questions soon. As a ratepayer I am directly affected.

Jesse Noell

From: Jesse Noell <noelljesse@gmail.com>
Sent: Tuesday, August 20, 2019 6:01 PM
To: Lippre, Suzanne
Subject: Fwd: <https://greenmountainpower.com/bring-your-own-device/>

Hi Suzanne, Would you please provide this information and links and comment to the Planning Commission re: Humboldt Wind Project?

I found the Humboldt Wind Project DEIR to be wildly misleading and inaccurate, furthermore Terra Gen is a solar installer so should have compared the impacts of the project to a Humboldt Solar Project in its determination of cumulative impacts and effects. It appears that RCEA as utility, the Planning Commission as planner, and the County Supervisors all have a fiduciary responsibility to assure that ratepayers the lowest carbon footprint project, and that other impacts are avoided or mitigated to the maximum. Overriding economic considerations require this, no?

----- Forwarded message -----

From: Jesse Noell <noelljesse@gmail.com>
Date: Tue, Aug 20, 2019 at 5:30 PM
Subject: <https://greenmountainpower.com/bring-your-own-device/>
To: McGuigan, Connor <cmcguigan1@co.humboldt.ca.us>, Madrone, Steve <smadrone@co.humboldt.ca.us>

Hi Connor and Steve,
Does Humboldt County offer these kinds of services to reduce our citizens' carbon footprint while providing battery to grid?
<https://greenmountainpower.com/bring-your-own-device/>

I recently got this quote, and it substantiates resilient rooftop as being the low cost and low impact leader, while keeping large amounts of "saved" money in the local economy--- instead of exporting profits from selling wind to local rate payers to wall street:

<https://www.solar-estimate.org/solar-estimate-results/iysvqsolei4h7xyq?cnsmr=1>

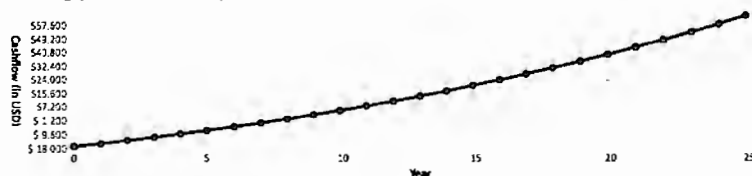
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Your total savings over the life of the system are estimated to be \$56,504

Estimated south facing roof space required	435 sq-ft	System cost reduction by upfront incentives	-\$6,994	Equivalent Return on Investment (IRR)	12.6%
Levelized cost of power from this system over 25 years	9¢ cents/kWh	Average cost of utility power over 25 years (if you don't get solar)	42¢ cents/kWh	Monthly Savings year 25 (for 100% energy usage)	\$431.41

System prices are estimated based on the average reported cost of systems installed in the past year. Payback Period and Equivalent Return on Investment are calculated based on a 100% cash purchase. Estimated Cost Per Watt is calculated after claiming all applicable incentives. This estimate assumes you are able to take full advantage of potential tax benefits.

Cash Flow graph - Cash Purchase of this system



The installers we work with have agreed to verify the ball park estimate given and provide a real and accurate estimate for your actual situation. They will contact you to do this.

It is very important that you take the time to talk with these installers as the estimate given by this site may be significantly improved because:

- Our estimator does not take into account characteristics of your

This Estimate generated for:

8050 Elk River Road,
Eureka, CA, 95503

In 2015, Rocky Mtn. Institute analyzed grid defection trends and predicted that rooftop solar / battery wins:

<https://reneweconomy.com.au/solar-and-storage-and-the-economics-of-load-defection-20064/>

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FIGURE ES1:
ECONOMICALLY OPTIMAL SYSTEM CONFIGURATION
RESIDENTIAL

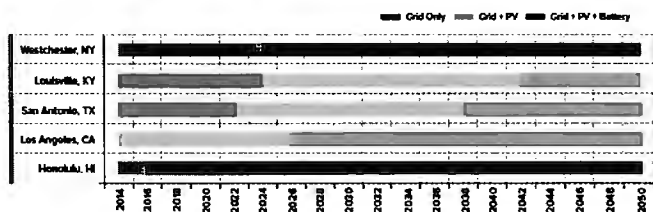
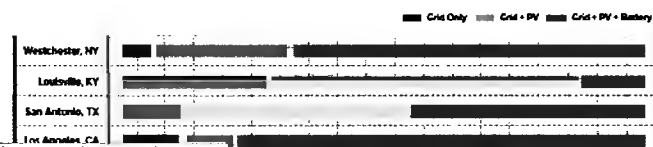


FIGURE ES2:
ECONOMICALLY OPTIMAL SYSTEM CONFIGURATION
COMMERCIAL



<https://reneweconomy.com.au/solar-and-storage-and-the-economics-of-load-defection-20064/>

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FIGURE ES1:
ECONOMICALLY OPTIMAL SYSTEM CONFIGURATION
RESIDENTIAL

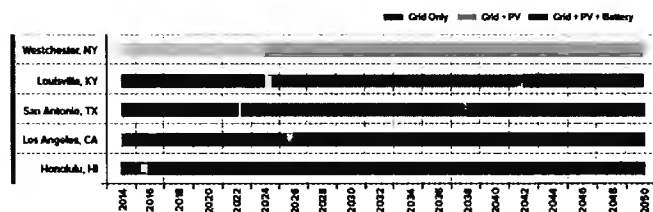
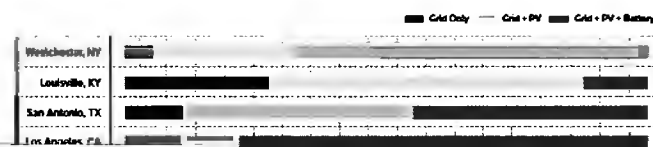


FIGURE ES2:
ECONOMICALLY OPTIMAL SYSTEM CONFIGURATION
COMMERCIAL



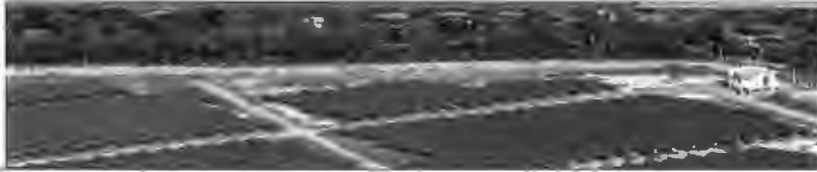
Solar rooftop/battery would also cut vehicle fossil fuel footprint and transmission line forest burn footprint:

© Jan 23, 2019

Amid Pacific Gas & Electric Bankruptcy, Rooftop Solar Could Help The Power Grid Fight Wildfires

By: Todd Davidson

Columns appearing on the service and this webpage represent the views of the authors, not of The University of Texas at Austin.



while helping PGE adapt to the future economy:

But in the process of litigating liabilities, local utilities and ratepayers might discover that rooftop solar has additional value that has been previously underestimated.

One of the weak-links that increases wildfire liability is long distance electricity transmission. Any electricity generation system placed in remote locations, including natural gas, hydro, and nuclear power plants, could be subject to increased liability if transmission lines pass through heavily forested areas.

In fact, even utility-scale solar (i.e. large collections of solar panels) would be subject to the same concerns since fields of photovoltaic panels require an open plot of land, moving the system to remote locations. Underground transmission lines could help address the liability concern, but digging is expensive and might offset the benefits of reduced liability.

The fact that rooftop solar is located coincident with the consumption of electricity means that it does not require large, high voltage transmission lines that run through forests (or, at least, it could mean fewer lines). The reduction in transmission lines could reduce liability for companies that manage electricity generation and transmission. The lower liability could improve credit ratings and build additional public support, both of which could improve the economic viability of rooftop solar in comparison to conventional power generation solutions.

The liability that PG&E is facing arises from decades old power lines that are strung across central and northern California. A falling tree branch or high winds can down a power line, producing sparks and igniting a blaze that can destroy thousands of acres and endanger local

From: SUZANNE ATIYEH <pinkpainting@icloud.com>
Sent: Saturday, October 5, 2019 8:30 AM
To: tom@wildcalifornia.org; john_e_hunter@fws.gov; CEQAResponses
<CEQAResponses@co.humboldt.ca.us>; Bohn, Rex <RBohn@co.humboldt.ca.us>;
sbonfield@environmentamericas.org
Cc: Becky Borden <Beckyborden917@gmail.com>
Subject: Terra-gen wind project in Humboldt Co. California

In a recent review of a book that addresses the pros and cons of climate engineering it says:

"Science and technology should instead serve the more pragmatic goals of increasing societal resilience to weather risks, improving regional air quality and driving forward an energy technology transition. Seeking to reset the planet's thermostat is not the answer."

Not that the most current topic is about climate engineering, but the recent focus has been on the EMOTIONAL reaction to any change whatsoever in the climate. We have taken our eye off the ball. We have to be proactive, not frozen with fear making stupid choices. We have to shift our attention to what the right choices are. No matter what, the climate WILL change.

We should NOT let panic numb us to the industry that wants to waltz in and act like they are doing us a favor. Or we will live to regret it. Terra-Gen is taking advantage of our pure fear.

We have to utilize the best and certainly available technology. Not just what someone with a lot of funding brings us, that has an expensive ad campaign, and tells us it's cool, and a "Win, Win." They are offering destructive old technology in order to take advantage of our wind to makes lots of money.

And they are dangling "millions" of dollars in front of us via radio spots, knowing we have a delicate economy.

And they WILL kill off birds in one of the most avian important areas of the continent.

We should not be fooled by what is obviously comparable to an expensive political campaign against birds who have no money and no voice.

It's a company who wants our wind. Bottom line.

Most sincerely,
Suzanne E. Atiyeh
(503) 345-0835

S. E. A.

From: ninacolor@humboldt1.com <ninacolor@humboldt1.com>
Sent: Tuesday, September 17, 2019 11:06 AM
To: CEQAResponses <CEQAResponses@co.humboldt.ca.us>
Subject: Response to the wind project

Dear CEQAR,

Please do not proceed with your wind project as the estimated death toll of birds is horrifying!
It's impossible to justify this known scenario of slaughter to innocent birds.

Climate change is real but we have no idea of how it will change. Climate has changed for hundreds, thousands, millions of years.

The birds will learn to adapt just as all living creatures have done for millions of years.

We all evolve.

Sincerely, Nina Groth

From: Jane Hartford <jehartford9@gmail.com>

Sent: Thursday, September 12, 2019 10:06 AM

To: Ford, John <JFord@co.humboldt.ca.us>; Johnson, Cliff <CJohnson@co.humboldt.ca.us>; Planning Clerk <planningclerk@co.humboldt.ca.us>; CEQAResponses <CEQAResponses@co.humboldt.ca.us>; rsundberg@co.humboldt.ca.us; Wilson, Mike <Mike.Wilson@co.humboldt.ca.us>; Hayes, Kathy <KHayes@co.humboldt.ca.us>; Fennell, Estelle <EFennell@co.humboldt.ca.us>; Bass, Virginia <VBass@co.humboldt.ca.us>; Bohn, Rex <RBohn@co.humboldt.ca.us>

Cc: Frank Bacik <FBacik@townofscotia.com>; Leslie Marshall <lesliem@planwestpartners.com>

Subject: HRC & Terra Gen's proposed Humboldt Wind Project

Dear Supervisors, John & Cliff,

Please see the attached coalition letter from EPIC that was recently sent to John Ford via email.

None of the major environmental organizations in Humboldt County want this wind project on Bear River Ridge because of the unmitigated environmental damage to human communities, and to at-risk wildlife.

As you know, the Wiyot Tribe is strongly opposed to this project on their ancient sacred land on this Ridge, as are the most impacted communities of Scotia and Rio Dell.

Because the tree-line on the ridge is only 100 ft in height, and the proposed turbines are 650 ft high, the visual impact of this proposed project would be seen from Ferndale, Fortuna, Hwy 101 and beyond, completely destroying the natural beauty here for the foreseeable future for thousands of people--not to mention the unmitigated noise pollution before, during and after this proposed project.

As I have mentioned to you several times before, HRC & Terra Gen should move this proposed project to a more appropriate location (perhaps offshore of Petrolia).

Sincerely,

Jane Hartford
PO Box 143
Scotia, CA 95565

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Coalition Letter to Terra-Gen

By [Tom Wheeler](#)

Thursday, September 12th, 2019



Simulation showing what the view from Scotia would look like after large turbines are installed atop Monument Ridge. Photo courtesy of Terra-Gen.

Editor's Note: The letter below was sent to Planning Director Ford and reflects the opinion of the major conservation organizations of the North Coast. Our organizations are not opposed to wind energy development but recognize that such development must include proven mitigation measures to reduce impacts to wildlife. The project, as conceived in the draft environmental impact report, lacks these measures and is therefore incomplete. A final environmental impact report is expected at the end of September.

Sent via email to jford@co.humboldt.ca.us on date shown below

September 11, 2019

Director John Ford
3015 H St
Eureka, CA 95501

Dear Director Ford,

On behalf of the Environmental Protection Information Center, Northcoast Environmental Center, Humboldt 350, California Native Plant Society, Redwood Region Audubon, and Redwood Chapter of the Sierra Club,

please accept this letter on the proposed Terra-Gen wind project.

Our organizations urge rapid action at the local, national and international scale to address our climate crisis. In Humboldt, emissions associated with electricity use account for approximately 13% of total county carbon emissions, according to the county's forthcoming Climate Action Plan. We encourage the development of clean energy projects but recognize that wind energy development can have detrimental impacts to the natural environment. In most circumstances, these impacts can be minimized and mitigated to acceptable levels through sound planning, siting, and imposition of the best available technology. Here, as acknowledged in your draft environmental impact report, given the largely undeveloped landscape and presence of at-risk species, the Humboldt Wind Project will have significant impacts to the environment. At present, these impacts have not been minimized or mitigated to an acceptable level. While some of our organizations support the "No Project" alternative, others could support a modified project. Should the project move forward we unanimously insist that the following conditions be met:

- **Move Turbines Off Bear River Ridge.** The turbines on Bear River Ridge are the most impactful, both to the environment and to human communities. Bear River Ridge is home to Humboldt's isolated and unique population of horned larks, sits entirely within the Cape Mendocino Grasslands Important Bird Area, and is home to the majority of the rare plant species in the project area. What's more, the area is culturally significant to the Wiyot Tribe, who have voiced their opposition to placing turbines at this sensitive location.
- **Minimize and Mitigate Impacts to Ecosystems and Sensitive Species.** It is imperative to complete all survey protocols before the EIR concludes to best understand the nature and magnitude of wildlife impacts. Regardless of design, the project is likely to result in the "taking" of sensitive species and will impact overall ecosystem function. That said, these impacts can be minimized through smart design. The best way to minimize impacts is to stop operation when sensitive species are present or during survey-defined high-risk periods. Operational curtailment is an industry-standard approach to mitigating wildlife impacts and is a part of other Terra-Gen projects. Where impacts can't be minimized, such as the conversion of forests to brushfields, the project should compensate by fully mitigating these unavoidable impacts.
- **Provide Adaptive Management Throughout the Life of the Project.** Wind energy is still in its infancy and we can expect significant technological advances throughout the life of the project (30 years). As technology advances, and our ability to reduce impacts and increase efficiency increases, the project should adopt emerging technologies and adapt to changing conditions. The project needs to include an adaptive management program that works to continually refine the project to reduce operational impacts. Adaptive management requires strong data. To that end, it is imperative to modify existing mortality monitoring to include canine-assisted searches or other emerging detection technology to ensure that adaptive management uses the best available data and that mortality data be collected throughout the life of the project. In providing adaptive management, the county needs to guarantee a neutral and transparent process for determining necessary project modifications.
- **Reduce Sediment Impacts to the Maximum Extent Practicable.** The project will require significant ground disturbance, a known cause of sediment pollution and landslides. Our organizations are concerned about the impact of this sediment pollution. To the maximum extent practicable, all ground disturbance should occur outside the wet weather period, defined as Oct. 15 to May 15. Further efforts should also be made to reduce impacts from the Gen Tie line, such as by using existing power right of ways and other steps to reduce new ground disturbance and forest fragmentation.

Thank you for your attention to our concerns. Should you have any questions, please do not hesitate to contact us at (707) 822-7711 or tom@wildcalifornia.org.

Sincerely,

Thomas Wheeler
Executive Director
Environmental Protection Information Center

Larry Glass
Executive Director
Northcoast Environmental Center

Mary Sanger
350 Humboldt

Alicia Hamman
Interim Executive Director
Friends of the Eel River

Carol Pearson Ralph
President
North Coast Chapter
California Native Plant Society

Hal M. Genger
Redwood Region Audubon Society



Gregg Gold
Chair
North Group Redwood Chapter Sierra Club

This entry was posted on Thursday, September 12th, 2019 at 5:00 am and is filed under [Blog](#).

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From: Sherri Daignault <momofmayhem14@gmail.com>
Sent: Tuesday, August 20, 2019 11:02 AM
To: CEQAResponses <CEQAResponses@co.humboldt.ca.us>
Subject: Wind turbines

I am a resident of Rio Dell, and I oppose these wind turbines. After much research I have concluded they're not healthy for the environment or the people. Regardless of what you're saying about these things being able to put out the fires they cause or that you would be paying for more training for fire departments that's all irrelevant. These are bad. Bad for our planet!! I oppose this project with every fiber of my being and I oppose on the behalf of my children and their well beings. I oppose on the behalf of my entire extended family and 98% of my town. No. Just NO.

Sent from my iPhone

From: Christopher Dunnbier <prawnckd@gmail.com>
Sent: Saturday, August 17, 2019 3:00 PM
To: CEQAResponses <CEQAResponses@co.humboldt.ca.us>
Subject: Comment on Humboldt Wind Energy Project

Dear Project Planner,

Dear Planning Director Ford,

I am very concerned about the proposed wind project from Humboldt Wind, LLC. While climate change is a serious threat to Humboldt County, poorly sited and developed wind projects can cause drastic environmental impacts. As the DEIR makes clear, the project is likely to result in death of numerous special-status species, such as the marbled murrelet, and may cause population-level impacts to once-numerous species, such as the hoary bat.

In turn, the DEIR fails to take adequate measures to avoid, minimize, and compensate for these significant impacts. The DEIR must be revised to incorporate additional mitigation measures to reduce impacts below a level of significance.

These include, among other things, proper siting of wind turbines to avoid impacts, operational curtailments during high-risk periods, and incorporation of deterrence technologies. These project changes are reasonable, having been adopted at other wind projects elsewhere in California and the United States, and would reduce impacts to wildlife. Furthermore, the County needs to insist on a robust and meaningful adaptive management program to continue to monitor and minimize impacts throughout the life of the project.

Thank you for the opportunity to comment on this very important matter.

Sincerely,

Sincerely,
Christopher Dunnbier
PO Box 691
Healdsburg, CA 95448

From: Ken Miller <tamer1@suddenlink.net>
Sent: Saturday, September 28, 2019 2:10 PM
To: Alicia Hamann <alicia@eelriver.org>; Chris Beresford <thegang7@pacbell.net>; CJ Ralph <cjralph@humboldt1.com>; dan sealy <rangerdans@msn.com>; Gary Falxa <garyfalxa@gmail.com>; Jennifer Kalt <jkalt@humboldtbaykeeper.org>; Larry Glass <larryglass71@gmail.com>; margaret.gainer@gmail.com; Richard Kreis <rgkreis@gmail.com>; Tom Wheeler <tom@wildcalifornia.org>; Bella Waters Joan Tippetts <bella@yournec.org>; Carol Ralph <theralphs@humboldt1.com>; Gregory O'Connell <gregoconnell7@gmail.com>; Marisa D'arpino <marisa_nativecalifornian@yahoo.com>; Harriet Hill <harrieth6@gmail.com>; Gregg J. Gold <greggigold@aol.com>; Ned Forsyth <nedforsyth48@gmail.com>; Dave Imper <dimper@suddenlink.net>; Adam Canter <adam@wiyot.us>; Scott Frazer <genescottf@gmail.com>
Cc: Ford, John <JFord@co.humboldt.ca.us>
Subject: TS OpEd Response to Coalition Letter

FYI

A coalition of environmental groups has issued a letter supporting a “mitigated” TerraGen (TG) wind factory proposed for Monument and Bear River Ridges (<https://www.wildcalifornia.org/blog> 9/12)

Why is such a coalition letter necessary, since Fish & Wildlife has already requested similar mitigations in their June comments and the Final Environmental Report should address many concerns?

The sign-on letter is clearly intended to reassure the wildlife and other agencies, the Planning Commission and Board of Supervisors, that no local enviro groups will oppose a “mitigated” project, much less sue. TerraGen has lobbied for a similar “mitigated project.”

Signers were convinced that project approval is inevitable and that this was their chance to improve it, but the effect of the sign on letter is to ensure approval.

Could TerraGen have invented, or orchestrated, a better PR strategy?

There has never been such an industrial wind facility in terrain anywhere resembling this location, or in the midst of such unique biodiversity. So the letter includes “adaptive management” to reduce operational impacts, but makes no mention of Scotia, Rio Dell, or other Eel River residents’ opposition based on their legitimate un-mitigable fears of wildfires, night-time lights, infrasound, flicker, erosion and

landslides, water quality and quantity, industrial traffic, visual and industrial blight, property values, and rural feel. We expect TerraGen to disregard people's concerns, but not our enviros.

The letter asks for turbines to be moved off Bear River Ridge, sacred to the Wiyot. But adjacent to Monument, Bear River Ridge is the most commercially viable site for wind turbines in the County. There will be "adaptive" (economic) pressure to eventually extend turbines to Bear and elsewhere in concert with Redwood Coast Energy Association's (RCEA) plan to expand onshore wind-generated electricity and transmission capacity, before offshore in 2030.

600 foot tall turbines with an aerial sweep of 4.5 acres create turbulence and warming many miles downwind, yet the heightened risk of wildfires is ignored in their letter and given short shrift in the Draft Environmental Report, despite the 2018 updated CEQA emphasis on wildfire evaluation.

TerraGen's electricity may reduce our carbon footprint by 4.7%, but 60% of our emissions come from transportation, and this TerraGen project does nothing to alleviate those; nor does it make us resilient in the event of grid shutdowns or emergencies. Solar does both.

And that 4.7% may well be offset in the medium term because of TerraGen's greenhouse gas (GHG) emissions during the 2-year construction, right into our 10-year

climate emergency window. These emissions have been significantly underestimated, including modeling vehicle emissions assuming flat terrain, with the effects exacerbated by huge ongoing annual losses of carbon sequestration from associated logging, vegetation, and soil disruption.

TerraGen's numbers only look good when divided by the 25-30 year presumed life of the facility, or when compared to those from our PGE plant, but not when compared to the minimal GHGs from wholesale public and private distributed solar energy.

Buying expensive electricity from the grid, forever, even if it comes in part from TerraGen, will not enrich our population (the \$2m in annual taxes amounts to \$15/person), incentivize anyone to acquire an electric vehicle (EV), nor necessarily result in reduced energy usage from our PGE plant.

RCEA and Schatz have all the solar programs, but their singular focus on utility scale onshore wind and upgraded transmission lines deprives us of soliciting the subsidies and incentives, carbon reduction, and energy resilience that over 250 US mayors are exploiting in order to massively solarize their communities, because of economics and resilience.

Increasingly affordable solar systems paired with electric vehicles (EV) pay for themselves in a few years. Maintenance-free EVs provide mobile storage for nighttime

or emergency electricity supply. Little new infrastructure is required, GHG emissions are minimal and job creation is maximal (TerraGen creates only 15 specialized jobs). Solar shares our energy wealth rather than concentrating it.

Best of all, solar means secure resilience when the grid goes dark:

“Renewable energy microgrids pair onsite resilience with global sustainability. Microgrid storage can help smooth the effects of intermittent power generation and increase overall grid stability. (<http://schatzcenter.org/microgrids/>)

" Greta Thunberg stated: “Changing one disastrous energy source for a slightly less disastrous one is not progress....Creative accounting will not help us. In fact, it’s the very heart of the problem.”

Without explanation, the enviro letter acknowledges “... some of our organizations support the “No Project” alternative.” Perhaps these anonymous organizations recognize the wisdom of the Wiyots and Greta Thunberg “

From: Tom Wheeler <tom@wildcalifornia.org>

Sent: Friday, September 27, 2019 4:34 PM

To: Ford, John <JFord@co.humboldt.ca.us>

Cc: Kevin Martin <kmartin@terra-gen.com>; Natalynne DeLapp <ndelapp707@gmail.com>; Nathan

Vajdos <NVajdos@terra-gen.com>; Olson, Jennifer@Wildlife <Jennifer.Olson@wildlife.ca.gov>;

Michael.vanHatten@wildlife.ca.gov; Gordon.Leppig@wildlife.ca.gov

Subject: New science concerning hoary bats

Dear John,

Attached please find a letter from EPIC concerning new science that may impact the Department's review of the Humboldt Wind Project. As EPIC has maintained, operational curtailment is a reasonable and necessary mitigation measure to reduce the expected significant impacts to hoary bats from the Humboldt Wind Project.

Please let me know if you have any questions.

Best,
Tom




--

Tom Wheeler
Executive Director and Staff Attorney
Environmental Protection Information Center
145 G Street Suite A
Arcata, CA 95521
Office: (707) 822-7711
Cell: (206) 356-8689
tom@wildcalifornia.org
www.wildcalifornia.org

"If EPIC had not undertaken its lonely efforts on behalf of the Marbled Murrelet, it is doubtful that the species would have maintained its existence throughout its historical range in California." - Judge L. Bechtle, *Marbled Murrelet v. Pacific Lumber Co.*

ORIGINAL RESEARCH

Evidence of region-wide bat population decline from long-term monitoring and Bayesian occupancy models with empirically informed priors

Thomas J. Rodhouse¹  | Rogelio M. Rodriguez² | Katharine M. Banner³  |
Patricia C. Ormsbee⁴ | Jenny Barnett⁵ | Kathryn M. Irvine⁶ 

¹National Park Service and Human and Ecosystem Resiliency and Sustainability Lab, Oregon State University-Cascades, Bend, OR, USA

²Human and Ecosystem Resiliency and Sustainability Lab and Northwestern Bat Hub, Oregon State University-Cascades, Bend, OR, USA

³Department of Mathematical Sciences, Montana State University, Bozeman, MT, USA

⁴Willamette National Forest, Springfield, OR, USA

⁵Mid-Columbia River National Wildlife Refuge Complex, U.S. Fish and Wildlife Service, Burbank, WA, USA

⁶Northern Rocky Mountain Science Center, US Geological Survey, Bozeman, MT, USA

Correspondence

Thomas J. Rodhouse, National Park Service, Oregon State University-Cascades, 1500 SW Chandler Ave., Bend, OR 97702, USA.
Email: Tom_Rodhouse@nps.gov

Present address

Patricia C. Ormsbee, Human and Ecosystem Resiliency and Sustainability Lab, Oregon State University-Cascades, 1500 SW Chandler Ave., Bend, OR 97702, USA

Funding information

Oregon Department of Fish and Wildlife, Grant/Award Number: ORPIN # ODFW-2903-16; Pacific Northwest Cooperative Ecosystem Studies Unit, Grant/Award Number: P15AC01598; US National Park Service; US Fish and Wildlife Service; US Forest Service; US Bureau of Land Management; US Geological Survey

Abstract

Strategic conservation efforts for cryptic species, especially bats, are hindered by limited understanding of distribution and population trends. Integrating long-term encounter surveys with multi-season occupancy models provides a solution whereby inferences about changing occupancy probabilities and latent changes in abundance can be supported. When harnessed to a Bayesian inferential paradigm, this modeling framework offers flexibility for conservation programs that need to update prior model-based understanding about at-risk species with new data. This scenario is exemplified by a bat monitoring program in the Pacific Northwestern United States in which results from 8 years of surveys from 2003 to 2010 require updating with new data from 2016 to 2018. The new data were collected after the arrival of bat white-nose syndrome and expansion of wind power generation, stressors expected to cause population declines in at least two vulnerable species, little brown bat (*Myotis lucifugus*) and the hoary bat (*Lasiurus cinereus*). We used multi-season occupancy models with empirically informed prior distributions drawn from previous occupancy results (2003–2010) to assess evidence of contemporary decline in these two species. Empirically informed priors provided the bridge across the two monitoring periods and increased precision of parameter posterior distributions, but did not alter inferences relative to use of vague priors. We found evidence of region-wide summertime decline for the hoary bat ($\hat{\lambda} = 0.86 \pm 0.10$) since 2010, but no evidence of decline for the little brown bat ($\hat{\lambda} = 1.1 \pm 0.10$). White-nose syndrome was documented in the region in 2016 and may not yet have caused regional impact to the little brown bat. However, our discovery of hoary bat decline is consistent with the hypothesis that the longer duration and greater geographic extent of the wind energy stressor (collision and barotrauma) have impacted the species. These hypotheses can be evaluated and updated over time within our framework of pre-post impact monitoring and modeling. Our approach provides the foundation for a strategic evidence-based

This article has been contributed to by US Government employees and their work is in the public domain in the USA.

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conservation system and contributes to a growing preponderance of evidence from multiple lines of inquiry that bat species are declining.

KEYWORDS

acoustic recording units, Chiroptera, extinction risk, monitoring, North American Bat Monitoring Program, population decline, trend, ultrasonic acoustic detectors

1 | INTRODUCTION

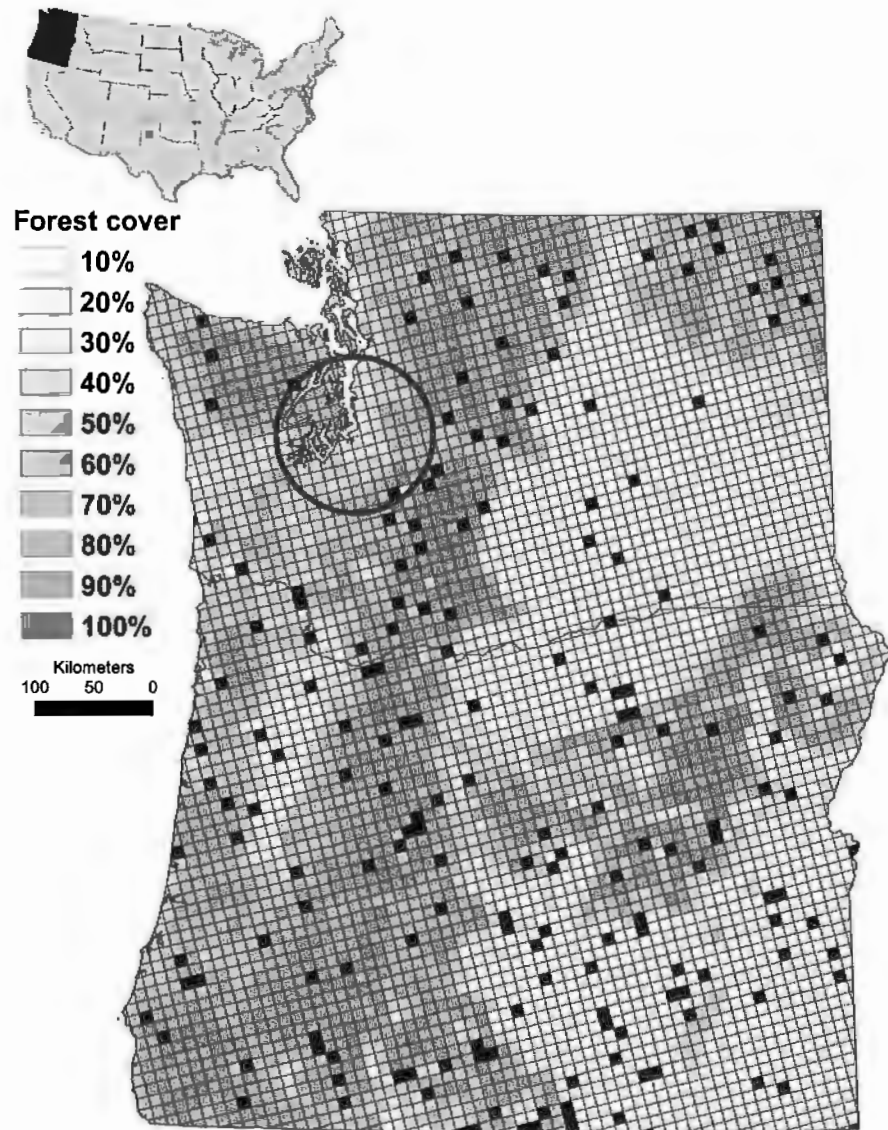
Evidence-based conservation of at-risk species is challenged by lack of information about population trends over time, particularly for those species that are cryptic and difficult to survey. In situations where directly counting individual organisms is infeasible, occupancy modeling of detection/nondetection survey data provides an alternative to abundance models for detecting regional-scale population declines (Jones, 2011; MacKenzie et al., 2002; Noon, Bailey, Sisk, & McKelvey, 2012). Multi-season occupancy models (e.g., MacKenzie, Nichols, Hines, Knutson, & Franklin, 2003; Royle & Kery, 2007) support inferences about changing occupancy probabilities and dynamic site turnover parameters over time. These parameters reflect changes in species distribution but are also expected to reflect the underlying latent changes in population size (Gaston et al., 2000; Holt, Gaston, & He, 2002; Zuckerberg, Porter, & Corwin, 2009) and extinction risk (Noon et al., 2012), albeit with some amount of elasticity (e.g., Kery & Royle, 2016; Royle & Kery, 2007; Steenweg, Hebblewhite, Whittington, Lukacs, & McKelvey, 2018). When harnessed to a Bayesian inferential paradigm, this modeling framework offers considerable flexibility for regional conservation monitoring programs that need to update prior model-based understanding with new data as they become available (e.g., Dorazio & Johnson, 2003; Ellison, 2004). Rather than starting anew after each cycle of data collection, model-fitting, evaluation, and inference, Bayes theorem allows for previous modeling results, in the form of posterior probability distributions, to be used as prior probability distributions that formally represent best-available understanding about model parameters (Crome, Thomas, & Moore, 1996; Hobbs & Hooten, 2015; McCarthy & Masters, 2005). With new data, this prior understanding can in turn be updated and represented as new, updated posteriors, with an expectation that clarity about population distribution and abundance, in the form of precision, will increase over time (Morris, Vesk, McCarthy, Bunyavejchewin, & Baker, 2015). In this way, the empirically informative Bayesian inferential paradigm, when harnessed to replicate geographically extensive large-sample encounter surveys, provides a way to "scaffold", or build upon, prior knowledge to improve conservation decision-making.

This scenario is exemplified by a bat monitoring program in an ~440,000 km² region of the Pacific Northwestern United States (Figure 1) in which the occupancy modeling results from 8 years of monitoring, which ended in 2010 (Rodhouse et al., 2012, 2015), require updating with new survey data gathered during 2016–2018

for contribution to the North American Bat Monitoring Program (NABat; Loeb et al., 2015). There is urgency to this opportunity to scaffold upon prior information because bat populations in the region are facing potentially catastrophic declines (e.g., O'Shea, Cryan, Hayman, Plowright, & Streicker, 2016) from the recent arrival of the bat disease white-nose syndrome (Lorch et al., 2016) and the rapidly expanding footprint of the wind power industry (Arnett et al., 2016). The cumulative impacts by these novel threats are likely exacerbated by accelerated environmental changes (Jones, Jacobs, Kunz, Willig, & Racey, 2009; Jung & Threlfall, 2016), including global entomofauna die-off (Sanchez-Bayo & Wyckhus, 2019), which is particularly worrisome given that the majority of North American bat species are insectivorous. In general, there is a global paucity of empirical knowledge about bat population trends and fewer still that evaluate trends over broad regions and long time periods (Jones et al., 2009). But there is growing evidence that many species are experiencing evolutionarily unprecedented, massive declines (O'Shea et al., 2016). Our emphasis on geographically extensive regional inference is noteworthy because bats are so vagile that a local-scale decline, for example one detected within a small national park, is difficult to interpret and use to motivate conservation without broader context (e.g., via replication elsewhere).

Here, we ask whether there is evidence of regional summer-time decline in the northwestern United States after three additional years of surveys for two vulnerable species, the little brown bat (*Myotis lucifugus*) and the hoary bat (*Lasiurus cinereus*). We focus on the little brown bat because it has been listed as threatened in Canada (Committee on the Status of Endangered Wildlife in Canada (COSEWIC), 2013) and considered for similar protection in the United States (Federal Register, 2015) following precipitous declines in eastern North America from white-nose syndrome (Dzal, McGuire, Veselka, & Fenton, 2011; Frick et al., 2010) and because the disease was first confirmed in the northwestern portion of our study region (Figure 1) in 2016 from a dead little brown bat (Lorch et al., 2016). We focus on the hoary bat because it is the most frequently encountered species in carcass recoveries at wind power generation facilities in many regions of North America and thought to be at risk of widespread decline (Arnett et al., 2016; Cryan & Barclay, 2009; Frick et al., 2017). We build upon the same dynamic occupancy model used by Rodhouse et al., (2015) and use their 2010 posterior estimates to create empirically informed priors as a way to formally incorporate best-available information about occupancy parameters into an updated assessment of decline.

FIGURE 1 The study area, Oregon and Washington, USA, overlaid with the grid-based sampling frame, average % forest cover of each frame sample unit (grid cell), and the 190 sample units surveyed during 2016–2018 (black squares) that follow a spatially balanced master sample design. The area where white-nose syndrome has been confirmed circa 2019 is circled in red



2 | METHODS

2.1 | Study area and biogeographic gradients

We monitored bats during summer (June–September) via coordinated acoustic surveys across Oregon and Washington states, in the northwestern region of the United States (Figure 1). The region is divided in half by the north–south trending Cascade Range that creates a distinct rain shadow over the eastern half of the region and a west-to-east forest cover gradient that is a dominant biogeographic influence on bats (Figure 1). The forest cover gradient in the region is strongly correlated with net primary productivity ($\rho = 0.7$) and moderately so with precipitation and elevation (Rodhouse et al., 2012, 2015). The little brown bat and hoary bat range widely across the region and are found in all habitat types but are associated with forested landscapes more than nonforested shrub steppe (Hayes, 2003; Kalcounis-Rüppell, Psyllakis, & Brigham, 2005; Rodhouse et al., 2015). Forests and also topographic roughness (SD of elevation)

provide the keystone structures (sensu Tews et al., 2004; e.g., live and dead standing trees, crevices in large cliffs) used by bats for summer and winter roosting that are additional biogeographic drivers of bat distributional patterns in the region (Humphrey, 1975; Pierson, 1998; Rodhouse et al., 2015). Forest cover (% of sample unit classified as any forest type), elevation (sample unit mean), 30-year mean annual precipitation (sample unit mean), and topographic roughness (SD of sample unit elevation) were included as occupancy model covariates both during initial modeling by Rodhouse et al., (2015) and in the present study.

2.2 | Study survey design

Our study protocol is described in detail by Rodriguez et al. (2019). We used a grid-based sampling frame of 100-km² square cells mapped across the study area to structure surveys and analyses (Figure 1). In 2003–2010 (Period 1), a combination of capture and acoustic surveys was conducted across the region in 241 grid

cells (see Rodhouse et al., 2015, p. 1404). In 2016–2018 (Period 2), acoustic surveys were conducted in 190 grid cells, informed by a statistical power analysis (Banner, Irvine, Rodhouse, Donner, & Litt, 2019; Figure 1). During Period 1, grid cells were selected using a combination of constrained simple random sampling and nonrandom contributions from land management agencies and researchers using compatible methodology (see Rodhouse et al., 2015 for additional details). During Period 2, grid cells were selected using the NABat spatially balanced (via the Generalized Random Tessellation Stratified design; Rodhouse et al., 2012; Rodhouse, Vierling, & Irvine, 2011; Stevens & Olsen, 2004) randomized master sample (Larsen, Olsen, & Stevens, 2008; Loeb et al., 2015). Approximately 80% ($n = 155$) of the 190 grid cells surveyed during Period 2 were chosen following the spatially balanced order of the master sample. Twenty per cent were chosen from the Period 1 legacy sample in order to provide spatio-temporal overlap between the two periods. This was less than the rule-of-thumb threshold suggested by Irvine, Rodhouse, Wright, and Olsen (2018) that, if exceeded, would require a more complex likelihood weighting in subsequent modeling in order to mitigate for an unrepresentative sample. This large ($n = 190$) and spatially balanced random sample is representative of the region of interest and supports robust scope of inference.

Spatially replicated within-season (June–September) single-night surveys were conducted in grid cells. Multiple-night replicates were avoided in order to maintain backward compatibility with the Period 1 revisit design and because Wright, Irvine, and Rodhouse (2016; and others, see Hayes, 1997) found evidence of serial correlation suggesting a lack of independence in bat activity among consecutive nights. Numbers of within-season revisits ranged from 1 to 12 per season in Period 1 and were standardized to four visits during Period 2. Surveys during Period 1 consisted of mist net capturing and/or recording of bats with Pettersson D240x and D500x ultrasonic detectors (Pettersson Elektronik) along watercourses. Survey method was included as a detection model covariate during initial modeling by Rodhouse et al. (2015). Period 2 surveys were conducted only by recording bats with Pettersson D500x ultrasonic detectors. Duration of surveys varied during Period 1 from 2 hr to overnight, but lasted all night during Period 2. Duration was included as a detection model covariate for the Period 1 model. Survey date was included as a detection model covariate for both periods. Species identification methods from captures and bat call recordings used during Period 1 were described in detail by Rodhouse et al., (2015), but included the use of version 3 of the Sonobat software program (Sonobat; <https://sonobat.com/>) to process and assign call files to species and ad hoc manual verification by a single expert (J. Szwczak). During survey Period 2, all call files were processed and assigned to species using version 4 of Sonobat and also verified manually by a single expert (R. Rodriguez) but that followed the REMOVE workflow strategy outlined by Banner et al. (2018, p. 6147) to remove all false-positive identification error from the data set prior to analysis so that the standard (false-negative only) occupancy model could be used. Manual verification was conducted specifically to

eliminate false-positive errors by carefully examining highest-quality call files used to make species detection decisions from each survey (e.g., focusing only on the few decision-pivotal call files per species per survey night). Only the unambiguous call files assigned to little brown bat and hoary bats were used as evidence for detection. This REMOVE verification strategy is inherently conservative and elevates false-negative error but our false-negative errors (detection probabilities) were still acceptable (>40%, see Section 3) to obtain unbiased occurrence model parameter estimates.

2.3 | Statistical analysis

We analyzed survey data from Period 2 only, using the results (specifically the estimated posterior mean and precision from occupancy model parameters) from Period 1 to construct empirically informative priors. Detection history matrices containing 190 rows and 12 columns (four single-night visits per season) were constructed for Period 2, with matrix elements assigned a 1 for unambiguous detection or 0 otherwise. We used the same autoregressive multi-season occupancy model (Royle & Dorazio, 2008) for Period 2 as for Period 1 presented by Rodhouse et al., (2012, 2015). Drawing on the Royle and Dorazio, (2008) autoregressive parameterization of the dynamic occupancy model, the initial occupancy state $z(i, t)$ for sample unit (grid cell) i in the first year ($t = 1$) of sampling was modeled as.

$z(i, 1) \sim \text{Bernoulli}(\Psi_{1i})$ for $i = 1, \dots, n$, with $\text{logit}(\Psi_{1i}) = \beta_0 + \beta_1 \text{ForestCover}_i + \beta_2 \text{Elevation}_i + \beta_3 \text{Precipitation}_i + \beta_4 \text{Topographic Roughness}_i$. Subsequent survey years $\{z(i, t)\}$ for $t = 2$ and 3) were modeled conditional on the previous state, $z(i, t) | z(i, t-1) \sim \text{Bernoulli}(\pi_{it})$, with $\text{logit}(\pi_{it}) = a_t + b_t z(i, t-1) + \beta_1 \text{ForestCover}_i + \beta_2 \text{Elevation}_i + \beta_3 \text{Precipitation}_i + \beta_4 \text{Topographic Roughness}_i$. The four environmental covariates were mean-centered and standardized for computational efficiency and so that interpretation of derived parameters could be made at average environmental conditions (i.e., when coefficients were 0). The derived parameters $\phi_t = \text{logit}^{-1}(a_t + b_t)$ represented the probability of a unit remaining occupied by a species (e.g., survival) and $\gamma_t = \text{logit}^{-1}(a_t)$ the probability of a unit becoming newly occupied (e.g., colonization) for each given time step ($t-1$ to t). The occupancy probabilities in years $t = 2, \dots, T$ were calculated recursively as $\Psi_t = \Psi_{t-1} \phi_t + (1 - \Psi_{t-1}) \gamma_t$. We used the total unit occurrence growth rate over Period 2, $\lambda = \Psi_{2018} / \Psi_{2016}$, as our trend metric. Given mean-centering of covariates, λ is interpreted as an overall region-wide measure of net decline. Exploration of how derived parameter values vary along the environmental gradients could be accomplished by plugging in different covariate values (i.e., at high and low elevations), which we do by obtaining posterior distributions of $\Psi_{2018, i}$ for each of the 4,500 grid cells in the study region and mapping posterior means to show an updated species distribution map of region-wide occurrence probabilities for comparison with the 2010 map. We used a simpler detection model than Rodhouse et al. (2015), including survey date as a covariate but no additional covariates for method and duration, given the survey design standardization of those two variables during Period 2, where $y_{jit} | z(i, t) \sim \text{Bernoulli}(p_{jit} * z(i, t))$ and $\text{logit}(p_{jit}) = \alpha_0 + \alpha_1 \text{date}_{jit}$.

TABLE 1 Posterior distribution means and standard deviations from Period 1 (2010) used as empirically informed priors for Period 2 (2016–2018) models

Parameters	Little brown bat	Hoary bat
β_0	3.53 \pm 1.62	0.15 \pm 1.15
α	0.14 \pm 1.57	-0.68 \pm 1.52
β	3.49 \pm 1.76	4.32 \pm 1.94
$\beta_{\text{elevation}}$	-0.29 \pm 0.27	-0.52 \pm 0.29
$\beta_{\text{precipitation}}$	1.59 \pm 0.97	-0.41 \pm 0.30
$\beta_{\text{topographic roughness}}$	0.00 \pm 0.29	-0.08 \pm 0.21
β_{forest}	0.46 \pm 0.34	0.64 \pm 0.26

Given the differences in the survey methodology and call processing and species identification workflow, we only used vague Normal(0,10) priors for detection-level parameters, effectively fitting our detection model without prior knowledge (i.e., from “scratch”). We used independent, empirically informed priors on the occupancy-level parameters [β , a_t , b_t]. Informative priors were specified as Normal distributions with mean and standard deviation based on the posterior distributions estimated from the final year (2010) of Period 1 models provided by Rodhouse et al., (2015; Table 1). We compared our results with the same model but where vague priors (Normal[0,10]) were used instead. Vague priors, also referred to as uninformative or weakly informative priors (Northrup & Gerber, 2018), are regularizing priors (Gelman, Simpson, & Betancourt, 2017) that stabilize the posterior distributions for parameters [β , a_{t-1} , b_{t-1}]

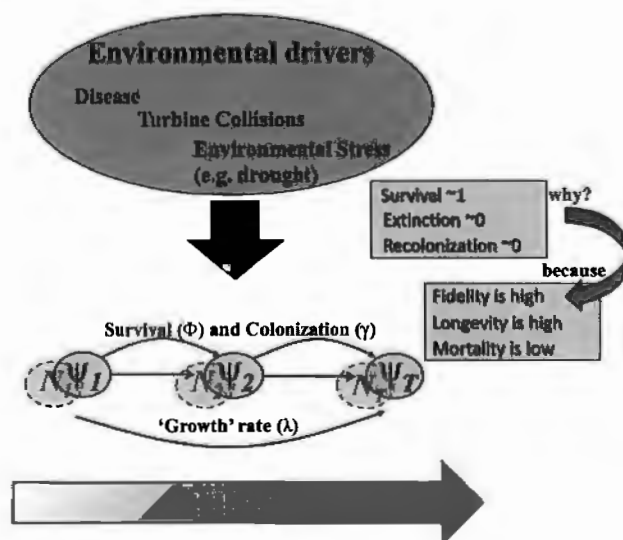


FIGURE 2 Conceptual diagram of occurrence state change (superimposed over latent abundance N) over time as a function of survival, recolonization, and extinction of sample unit occurrences from 1 year to the next. The net result of change can be characterized by the occurrence growth rate λ . The diagram outlines (right) hypothesized expectations for background rates of these parameters, drawing on knowledge of temperate-zone bat life history strategies, but suggests extrinsic environmental drivers (e.g., disease, top of diagram) may alter these background rates, elevating adult bat mortality rates

within a reasonable range on the logit scale but do not represent any substantive knowledge about their values a priori.

In Figure 2, we conceptualize this model parameterization as hypothesized inter-annual change in occurrence states (and in latent abundance), as a conditional Markov process governed by the dynamic rate parameters of sample unit occurrence survival (ϕ) and recolonization (γ), summarized by λ . We expect the background rates for these dynamic parameters to be stable and near 1 for ϕ and near 0 for γ because of the slow life history strategies of bats (low fecundity, adult longevity, and low adult mortality; Barclay & Harder, 2003; O'Shea et al., 2016; Promislow & Harvey, 1990) and high site fidelity (e.g., Barclay & Brigham, 2001; Lewis, 1995). We expect that novel extrinsic factors, particularly white-nose syndrome (for little brown bat) and widespread wind energy development and associated collision and barotrauma (for hoary bat) will influence those dynamic rate parameters (O'Shea et al., 2016), reflected in declining $\hat{\psi}$ and $\hat{\lambda} < 1$.

We used OpenBUGS 3.2.3 (Lunn, Spiegelhalter, Thomas, & Best, 2009), launched from R 3.5.1 (R Core Team, 2018) with the R2OpenBUGS library (Sturtz, Ligges, & Gelman, 2005) to implement Bayesian estimation of model parameters via Markov chain Monte Carlo (MCMC) samples from posterior distributions. Posterior summaries were based on 10,000 MCMC samples of the posterior distributions from three chains run simultaneously, thinned by a factor of 3, following an initial burn-in of 5,000 MCMC iterations. We assessed convergence of MCMC chains with trace plots and the Gelman-Rubin diagnostic; convergence was reached for all parameters according to the criteria $|\hat{R} - 1| < 0.1$. We evaluated prior sensitivity by comparing inference and by examining vague and informative prior and posterior density plots. We evaluated model predictive performance with posterior summaries of the area under the curve of the receiver operating characteristic (AUC; Zipkin, Campbell Grant, & Fagan, 2012) and compare against summaries provided by Rodhouse et al., (2015). We evaluated evidence of residual spatial autocorrelation by estimating the Moran's I statistic for the occupancy residuals (Wright, Irvine, & Higgs, 2019) at distance thresholds from 10 km (adjacent neighbors) to 50 km. Our spatially balanced master sample design reduced spatial proximity of sample units, and we found no evidence of autocorrelation.

3 | RESULTS

Our results provide evidence of decline in net summertime regional hoary bat occurrence probability during 2016–2018 relative to 2010 (Figure 3a) but no evidence of decline for the little brown bat (Figure 3b). These conclusions were supported by both the empirically informed and vague priors models (Figures 3 and 4). Choice of prior did not influence overall conclusions for trend although empirically informed priors provided more precise estimates (posterior probabilities with narrower 95% credible intervals; Figures 3 and 4) and therefore strengthened evidence of hoary bat decline. Estimates of trend ($\hat{\lambda}$) during 2016–2018 for hoary bat was

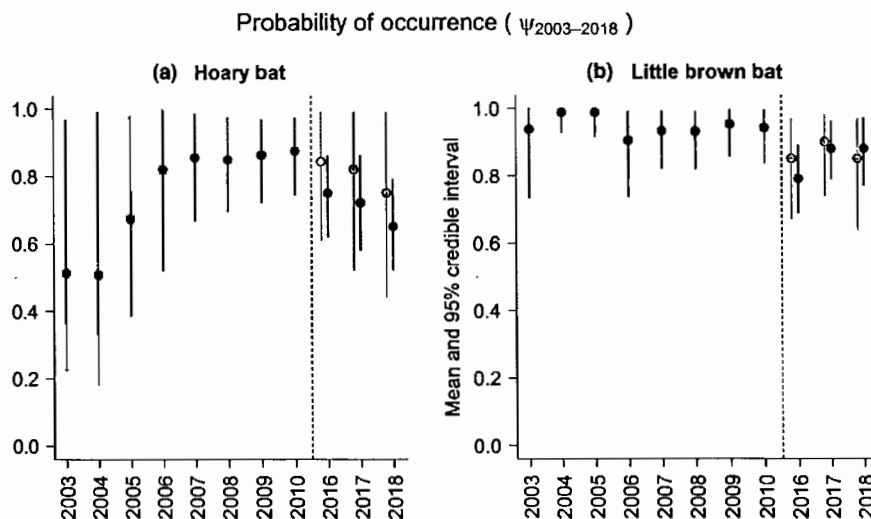


FIGURE 3 Posterior mean and 95% credible intervals for ψ from models fit to (a) hoary bat (*Lasiurus cinereus*) and (b) little brown bat (*Myotis lucifugus*) survey data. Comparisons are made for 2016–2018 between vague priors (gray) and empirically informative priors (black)

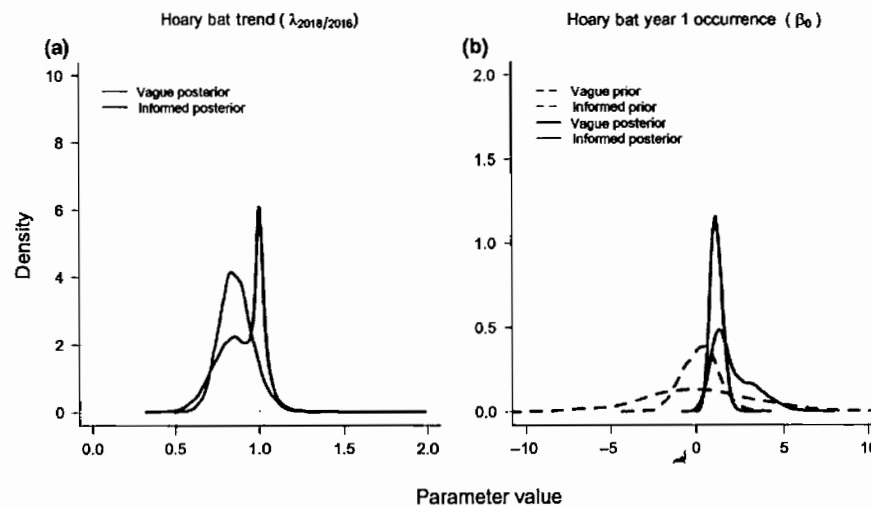


FIGURE 4 Comparison of empirically informed (red) and vaguely informed (black) priors and posteriors for hoary bat (left, a) trend and (right, b) year 1 occurrence probability (intercept parameter, logit scale; see Section 2 for auto-logistic parameterization and use of Normal priors)

0.86 ± 0.10 (0.89 ± 0.12 when vague priors were used; Figure 4a), an average annual rate of decline since 2010, manifesting a $\approx 2\%$ /year decline in net occurrence probability (i.e., from $\hat{\psi}_{2010} = 0.87$ to $\hat{\psi}_{2018} = 0.65$), and $\hat{\lambda} = 1.1 \pm 0.10$ (1.01 ± 0.10 when vague priors were used) for little brown bat. Detection probabilities were stable among years within each period but increased from $\sim 25\%$ for both species in Period 1 (see Rodhouse et al., 2015) to $\sim 40\%$ for hoary bat and $\sim 50\%$ for little brown bat in Period 2.

Mapped hoary bat occurrence predictions illustrated the overall net decline in the region for this species between 2010 and 2018 (Figure 5). Predictive performance of the 2018 hoary bat occurrence probability model, as measured by AUC posterior summary, was 0.80 (95% credible interval 0.74–0.86), an improvement over the 2010 predictions (AUC = 0.75) achieved by Rodhouse et al. (2015). For reference, we overlaid published wind turbine locations (Hoen et al., 2018) on our hoary bat occurrence probability maps which showed that development has not substantially increased since 2010 and that development is concentrated in the center of the study region along the breaks of the Columbia River along the Oregon/Washington border (Figure 5). We did not update predictive

maps for little brown bat given the evidence of no change since 2010 in occurrence probability (flat trend; Figure 3b and $\lambda \sim 1$).

Inferences on the effect sizes of the environmental covariates forest cover, elevation, precipitation, and topographic roughness did not vary for either species in direction and magnitude between Period 1 and Period 2 nor between vague and empirically informed prior models (Appendix S1). However, precision of estimated effect sizes increased when informative priors were used, strengthening the influence of forest cover on hoary bat occurrence. Strength of evidence for the positive influence of precipitation on little brown bat occurrence also increased in Period 2, illustrated by the right shift along the x axis in Appendix S1 (Figure S2d).

4 | DISCUSSION

We found evidence of decline for the summertime hoary bat population in the Pacific Northwest over the period 2003–2018, most notably since ~ 2007 , but no evidence of decline during the same time period for the little brown bat. White-nose syndrome was first

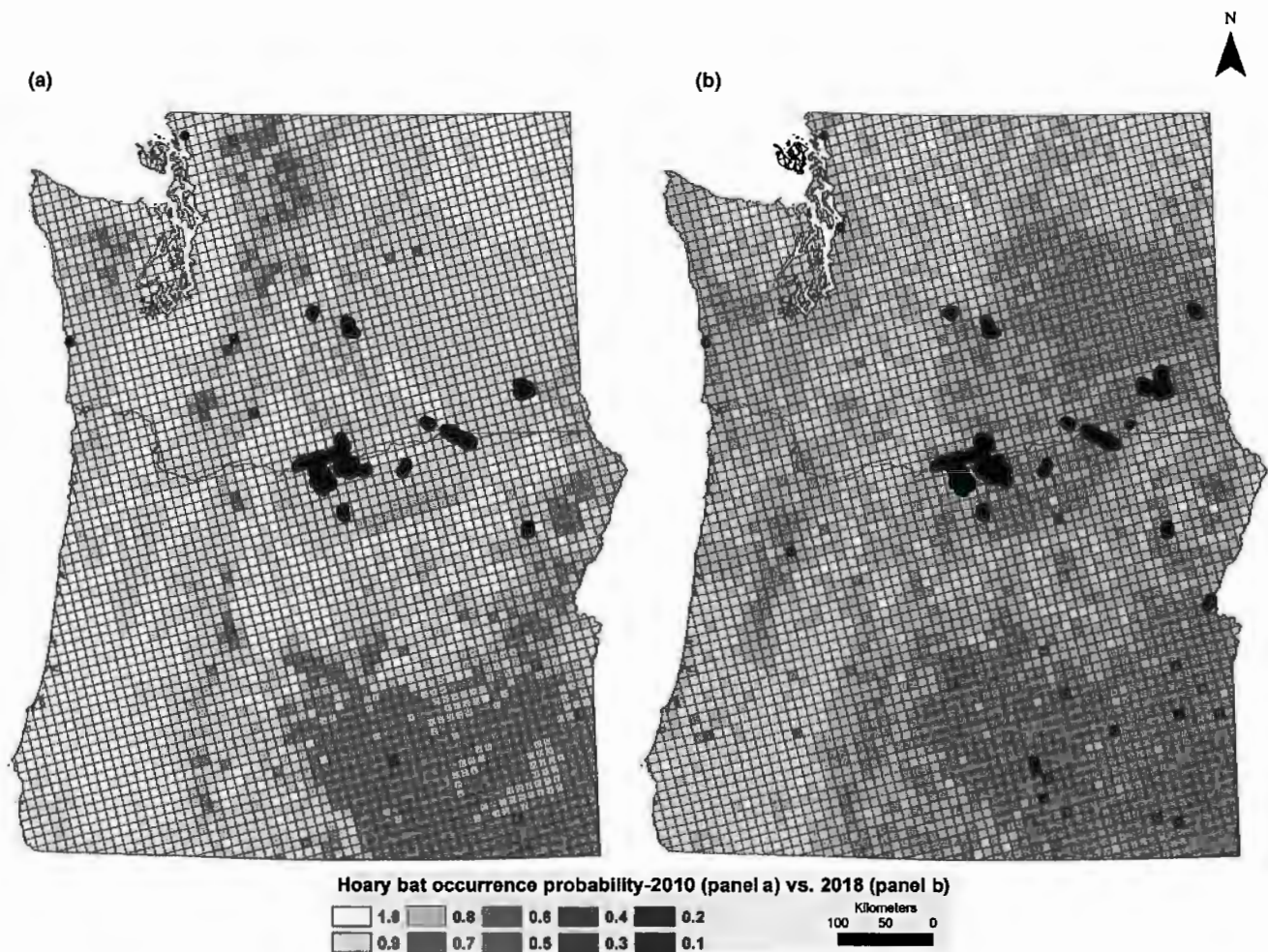


FIGURE 5 Comparative maps of 2010 (a, modified from Rodhouse et al., 2015) and 2018 (b) hoary bat predicted occurrence probabilities (\hat{p}_i). Wind energy turbines (Hoen et al., 2018) are shown with black symbols circa 2010 in (a) and circa 2018 in (b). cf. with continent-wide wind energy facility distribution at <https://eerscm.usgs.gov/uswtdb/> and also the Hayes et al. (2015) overlay of continental hoary bat seasonal migration distribution maps and wind facility distribution circa 2015

reported in the region in 2016 but has not yet resulted in widespread regional impact to the little brown bat as has occurred in eastern North America (Frick et al., 2015). At the time of data collection (2016–2018), reports of the disease within our study region had not yet spread outside of the Puget Sound region of NW Washington and had not yet been reported in surrounding states (Idaho, Montana, Nevada, California). Wind energy development, however, is much more extensive in western North America (although not conspicuously so within our study region relative to other regions of North America; cf. Figure 5 and Hayes, Cryan, & Wunder, 2015) and is likely to have caused many hoary bat fatalities over a longer period of time (e.g., since ~2000; Arnett et al., 2016; O'Shea et al., 2016). We emphasize that model uncertainty (e.g., wide credible intervals in early years of study), bat longevity, a 5-year gap in monitoring between Period 1 and Period 2, and only 3 years of additional data in Period 2 make these findings best considered as provisional evidence of decline that can guide conservation decisions, including the motivation to continue to allocate resources for further research and monitoring.

However, given the laxity (curvature) in the occupancy–abundance relationship, evaluating population decline with occupancy models is inherently conservative, and our finding of hoary bat decline is alarming. Compelling empirical evidence of regional and range-wide bat decline is difficult to obtain and rarely reported, and our study is unique in geographic and temporal extent, with evident implications for potential hoary bat extirpation risk proposed by Frick et al. (2017) if our observed hoary bat trend continues. Likewise, if WNS continues to spread throughout the region and exhibit the same levels of morbidity as has been reported from eastern North America then our monitoring and modeling framework, with many years of pre-WNS prior information now available, provides the foundation for evaluating post-WNS host population impacts as a replicated before–after impact study.

The evidence for hoary bat population decline and for species–environment relationships (i.e., hoary bats and forest cover and little brown bats and precipitation) provided by our study was strengthened when empirically informed priors were used. This is

consistent with previous applications of informative priors to ecological research (e.g., Morris et al., 2015), and our study contributes a new demonstration of the utility of using informative priors to gain efficiencies in long-term studies and monitoring. Historically, concerns were raised about the subjectivity and potential biases of using informative priors in Bayesian analyses that exerted too much influence on posterior distributions (e.g., Dennis, 1996), but with contemporary computing power, it has become straightforward to examine the influences of prior specification strategies (e.g., Dorazio & Johnson, 2003; Morris et al., 2015; Northrup & Gerber, 2018). Informative priors increase effective sample size (e.g., Hobbs & Hooten, 2015; McCarthy et al., 2005), and in our study, this benefit was realized by spanning the gap in data collection between 2010 and 2016. Data gaps are a common challenge for long-term studies, and the improved ability to span gaps will be appealing to monitoring practitioners.

The overlay of wind turbine locations on our predictive hoary bat occurrence maps revealed that turbine density has not increased greatly over the course of study and, in general, is not very extensive relative to other regions of the country (cf. <https://eerscmap.usgs.gov/uswtdb/viewer/>). Hoary bat migration patterns are still not well described, and it remains unclear where the hoary bats that occur in our study region during summer monitoring are being killed (Cryan, 2003; Cryan & Brown, 2007; Hayes et al., 2015). Cryan (2003) and Hayes et al. (2015) developed maps of seasonal hoary bat occurrence patterns that suggest bats that occur in our region during summer could spend winters in and migrate through regions where turbine densities are much higher, offering a possible explanation for decline in the Northwestern United States. Although available evidence supports the working hypothesis that regional hoary bat decline is likely caused by elevated adult mortality from turbine collisions and barotrauma during fall migration, our results reflect net cumulative impacts, and a limitation of our study is the imprecision with which stressor impacts can be ascribed. In part, one solution to this limitation is to strive for broader regional and range-wide replication of coordinated monitoring as advocated via NABat by Loeb et al. (2015) and using the modeling framework demonstrated here. A second solution will be to close the information gap about bat migration and other bat natural history using novel methods such as transmitter suturing developed by Castle, Weller, Cryan, Hein, and Schirmacher (2015) that has revealed long-distance movements of hoary bats (Weller et al., 2016). A third solution will be to integrate geographically extensive coordinated acoustic surveys into a conservation information system that draws on multiple lines of evidence.

Toward this third solution, we envision that our monitoring and modeling approach can provide the base of a strategic conservation information system "pyramid" (Figure 6), as has been done similarly through the integration of focal apex sites and broad-scale occupancy modeling by the Amphibian and Reptile Monitoring Initiative (see https://armi.usgs.gov/program_design.php). Figure 6 illustrates the inherent trade-offs in surveying across geographic extents with large sample sizes and depth of information content from more focused intensive study that can be ameliorated through strategic

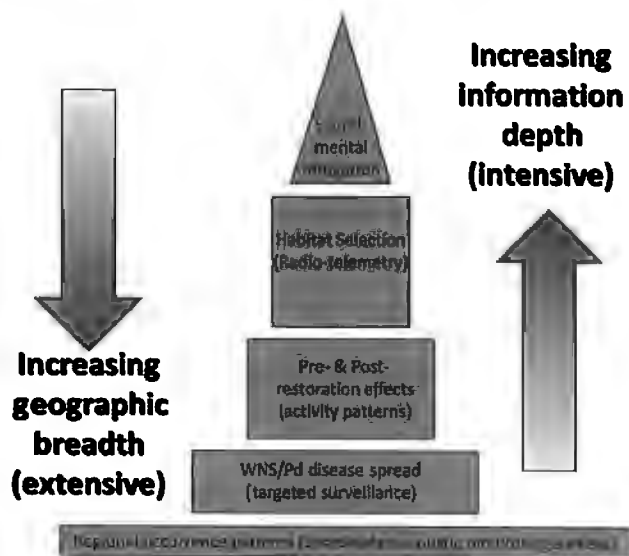


FIGURE 6 Conceptual diagram of an information pyramid that describes the inherent trade-off between geographic extent and informational intensity of monitoring and supporting research that can be integrated into a rich model-based information system for guiding evidence-based bat conservation. Our geographically extensive monitoring from coordinated acoustic surveys and modeling of those data provides a robust "base" of the pyramid that can help identify when and where targeted and more informationally deep studies can be effective. Intensive local-scale studies have been integrated into our grid-based monitoring framework to simultaneously pursue local and regional objectives

integration. For example, with respect to apparent hoary bat decline, our study, as a fundamental baseline, could be a catalyst for increased mitigation of wind turbine collisions via curtailment at low wind speed (Arnett, Huso, Schirmacher, & Hayes, 2011) and other actions (e.g., acoustic deterrence, Arnett, Hein, Schirmacher, Huso, & Szwczak, 2013). If done in a strategic manner (e.g., using experimental design), this can become a way to inform collective learning and adaptive management (Hayes et al., 2019). As another example, studies of the effects of forest thinning for forest fire fuels reduction on bats in the region's national parks (A. Chung-MacCoubrey and S. Mohren, National Park Service, personal communication) have been nested within NABat grid cells, creating an opportunity for data collected during more-informative but geographically less-extensive focal studies to contribute simultaneously to our periodic region-wide trend assessments. It is in this way that the coarse-grained grid-based NABat monitoring can become relevant at local-scales, building bottom-up engagement for a regional conservation program that requires top-down coordination.

For the present study, region-wide net hoary bat decline was hypothesized to be the result of fatalities at wind energy facilities outside the study region and during autumn (see Figure 4 in Hayes et al., 2015) unobserved by our study. We did not consider whether hoary bat occurrence trend over time might also co-vary over space along, for example, forest cover or elevation gradients, but our framework could support pursuit of these questions, particularly if the energy

facility footprint expands in the region along these environmental gradients (e.g., if predominantly in open agricultural and steppe landscapes) and compelling hypotheses about spatial variation in hoary bat decline are articulated. However, we find it more tangible at present that if WNS impacts on the little brown bat population become more widespread (i.e., from carcass recoveries throughout the region), a plausible hypothesis of an interaction between precipitation and little brown bat decline could be proposed because the disease has been reported to occur along precipitation and humidity gradients in eastern North America (Langwig et al., 2012) and our region has strong moisture gradients that may strongly influence disease spread and morbidity. This hypothesis could be evaluated with our empirical monitoring-data-model framework via inclusion of an interaction between the precipitation covariate (and other relevant covariates) and the dynamics of colonization and survival as $b_i * z(i, t-1) + \beta_3 \text{Precipitation}_i + \beta_5 \text{Precipitation}_i * z(i, t-1)$ (Royle & Dorazio, 2008).

In conclusion, empirically informed Bayesian modeling, fueled by large monitoring datasets that accumulate over time and that are underpinned by a robust survey design (e.g., our NABat spatially balanced master sample) provides a powerful and flexible foundation for building an adaptive, evidence-based conservation information system. The long-standing logistical challenges associated with studying bats that preclude directly estimating bat population sizes and demographic rates require the kinds of solutions that we demonstrate and discuss. Multiple lines of evidence, even if indirect, will be required to triangulate toward answers about the status and trends of bat populations.

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CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

TJR, RMR, PCO, JB, and KMI designed and implemented the study. RMR coordinated region-wide data acquisition. TJR conducted the modeling and KMB and KMI reviewed statistical procedures. TJR drafted the manuscript. All authors contributed to and edited the manuscript.

DATA AVAILABILITY STATEMENT

The dataset and corresponding BUGS modeling code are archived on the National Park Service Integrated Resource Management Applications (IRMA) portal at: <https://irma.nps.gov/DataStore/Reference/Profile/2264920>.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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From: Denise Sweaney
Sent: Thursday, June 13, 2019 4:05 PM
To: Ford, John
Subject: wind farm project

When I started reading about this project I thought it was a great idea, right up until I began to hear from many sources about the degradation this project will cause to this area. It far surpasses what it is layed out to 'fix'. I could go into details as noted in the City of Rio Dell letter, along with Mr. Baciks' letter from the Town of Scotia. However, you have their information with concerns noted as significant. I hope you will take into consideration how this project will reflect on this area for our future. Again we are being 'mined' for resources to be used primarily in the south. Do we really want to continues this project, along with the 'mining' of the Eel River water, etc.? Please stop this plan that is simply not good for Humboldt County.

Thank you for letting me voice my concern against this project. MD Sweaney

From: alicia adrian <kudraridge@gmail.com>
Sent: Saturday, September 14, 2019 10:46 AM
To: Ford, John
Subject: Keep Turbines off Bird Migration Pathways

Hello Director Ford,

I agree that wind energy is preferable to fossil fuels but they do not need to be in major animal routes and not when they destroy ecosystems. Bear Ridge is a highly inappropriate location for many different species, some endangered and "protected." This area is so pristine and amazingly healthy. Please do not mar this beautiful place.

Please also work on your plan to minimize impacts to ecosystems and sensitive species. Promise us that you will continue to provide adaptive management while the turbines are in place. Make plans to minimize sediment impacts.

In short, do this the right way. The way that you'd be proud to tell our young people that you are changing the way we treat our Earth. We will not have an Earth if we destroy it and all that lives here. You are in a unique position to make a difference in the area that we live, please do so.

Sincerely,

Alicia Adrian
Blue Lake, CA