PAUL R. LEPAGE
GOVERNOR

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION & FORESTRY
LAND USE PLANNING COMMISSION
106 HOGAN ROAD, SUITE 8
BANGOR, MAINE 04401

Memorandum

To: Interested Persons

From: Stacie R. Beyer, Chief Planner

Date: July 28, 2016

Re: Substantive Review, Milton Removal Petition
Additional Materials for the Public Hearing

LUPC staff has identified or prepared additional materials that may be beneficial to the Commission at the upcoming hearing on the Petition to Remove Milton Township from the Expedited Area for Wind Energy Development. LUPC staff plans to have these materials at the hearing and to enter them into the hearing record. The specific documents are as follows:

1. Milton Twp. Oxford County, Substantive Review. This is a map developed by the Land Use Planning Commission to show existing development and resources in the region, and assist the Commission in understanding testimony at the hearing.
2. Wind Energy Development Projects in Maine, a Combined List of DEP and LUPC Data. The Department of Environmental Protection data was pre-filed by that agency.
3. *Wind Power and Wildlife in Maine: A State-wide Geographic Analysis of High-Value Wildlife Resources and Wind Power Classes*, Susan Gallo, Wildlife Biologist, Maine Audubon, December 2013. Links to the Maine Audubon website and excerpts from the report were pre-filed by the Petition Circulator.

Copies are enclosed for your reference. Any comments that you would like to submit regarding the content of these documents must be submitted to the Land Use Planning Commission by close of business on ***August 4, 2016***.

If you have any questions about the additional materials, please contact me. I can be reached during normal business hours by telephone at 207-941-4593 or e-mail at stacie.r.beyer@maine.gov.

Enclosures

Land Use Planning Commission

Petition to Remove Milton from the
Expedited Permitting Area for Wind Energy Development;
Substantive Review

Attachment 1

Milton Township, Oxford County, Substantive Review Tabloid Map

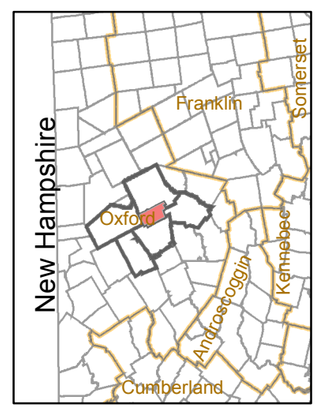
Milton Twp
Oxford County
Sustantive Review

N

0 1 2 4 Miles

- Surrounding Towns
- Towns
- Waterbodies
- County Lines
- Transmission Lines
- BP&L Non-Motorized Trail System
- Appalachian Trail
- ITS Snowmobile
- MEDOT Scenic Byways
- E911 Roads
- U.S. Routes
- State Routes
- Spruce Mountain Wind
- BP & L Campsites
- Public Lands and Parks
- Statewide Conserved Lands
- White Mountain National Forest
- P-MA: Mountain Area
- P-RP: Resource Plan
- P-RR200: Recreation - 200'
- P-RR: Recreation

Sources:
Maine Office of GIS, USGS,
Land Use Planning Commission,
BP&L, DOT, PUC



Locus Map

July 25, 2016

Land Use Planning Commission

Petition to Remove Milton from the
Expedited Permitting Area for Wind Energy Development;
Substantive Review

Attachment 2

Wind Energy Development Projects in Maine, A Combined List of DEP and LUPC Data

Wind Energy Development Projects in Maine, A Combined List of DEP and LUPC Data

Agency	Development Name	Developer/Owner	Town(s) with Generating Facilities	Town(s) with Associated Facilities	Status	Capacity (MW)	Startup Date	Turbine Type	Number of Turbines	Notes
DEP & Cross-jurisdictional Projects	Mars Hill Windpower Project	First Wind	Mars Hill (Aroostook)	Mars Hill, Aroostook County	Operational	42	3/27/2007	GE 1.5MW	28	Predates WEA
	Rollins Wind Project	First Wind	Burlington, Lee, Lincoln, Winn (Penobscot)	Burlington, Lee, Lincoln, Mattawamkeag, Winn (Penobscot)	Operational	60	7/26/2011	GE 1.5MW	40	
	Record Hill Wind	Independence Wind	Roxbury (Oxford)	Roxbury (Oxford)	Operational	50.6	12/1/2011	Seimens 2.3MW	22	
	Spruce Mountain Wind	Patriot Renewables	Woodstock (Oxford)	Woodstock (Oxford)	Operational	20	12/1/2011	Gamesa 2.0MW	10	
	Saddleback Ridge Wind	Saddleback Ridge Wind, LLC (Patriot Renewables)	Carthage (Franklin)	Canton, Carthage, Dixfield (Franklin, Oxford)	Operational	33	12/1/2014	GE 2.75MW	12	
	Oakfield Wind	Evergreen Wind Power II, LLC (First Wind)	Oakfield, T4R3 WELS Twp (Aroostook)	Chester, Glenwood Plt, Linneus, Macwahoc Plt, Mattawamkeag, Molunkus Twp, North Yarmouth Academy Grant Twp, Oakfield, Reed Plt, T3R3 WELS Twp, T4R3 WELS Twp, Woodville (Aroostook, Penobscot)	Operational	148	September, 2015	Vestas 3.0MW	148	Turbine capacity in permit is 3.0MW, development website claims 148MW for 48 turbines.
	Canton Mountain Wind	Canton Mountain Wind, LLC (Patriot Renewables)	Canton (Oxford)	Canton, Dixfield (Oxford)	Permitted	22.8	Target is 2016	GE 2.85MW	8	
	Passadumkeag Windpark	Passadumkeag Windpark LLC (Noble Environmental Power LLC)	Grand Falls Twp (Penobscot)	Grand Falls Twp, Greenbush, Greenfield Twp, Summit Mountain Twp (Penobscot)	Permitted	42	Target unknown	Vestas 3.0MW	14	
	Bingham Wind Project	Blue Sky West, LLC & Blue Sky West II, LLC (First Wind)	Bingham, Kingsbury Plt, Mayfield Twp (Piscataquis, Somerset)	Abbott, Bingham, Kingsbury Plt, Parkman, Mayfield Twp (Piscataquis, Somerset)	Under Construction	186	Fall 2016	Vestas 3.0MW	62	
	Hancock Wind	ancock Wind LLC (First Win	T16 MD Twp, T22 MD Twp (Hancock)	Aurora, Osborn, T16 MD Twp, T22 MD Twp (Hancock)	Under Construction	56.1	Fall 2016	Vestas 3.3MW	17	
	Fox Islands Wind	Fox Islands Wind, LLC	Vinalhaven (Knox)	Vinalhaven (Knox)	Operational	4.5	12/1/2009	GE 1.5MW	3	Small-scale wind certification
	Pisgah Mountain Windpower	Pisgah Mountain LLC	Clifton (Penobscot)	Clifton (Penobscot)	Under Construction	9	Target unknown	Vestas 1.8MW	5	Small-scale wind certification
	Beaver Ridge Wind Project	Beaver Ridge LLC (Patriot Renewables)	Freedom (Waldo)	Freedom (Waldo)	Operational	4.5	11/1/2008	GE 1.5MW	3	Not permitted as a wind project. Stormwater permit only.
				DEP Approved Wind Energy Developments (Number Nine, not included)		678.5				
LUPC Projects	Stetson Wind Power Project	Evergreen Wind V, LLC	T8 R3 NBPP, WA; T8 R4 NBPP, WA	NA	Operating	57	1/22/2009	GE 1.5MW	38	DP4788
	Owl Mnt & Jimmy Mtn Wind Project	Stetson II Wind, LLC	T8 R4 NBPP, WA	NA	Operating	25.5	3/12/2010	GE 1.5MW	17	DP4818
	Kibby Wind Power Project (Kibby I)	TransCanada Maine Wind	Kibby Twp., FR; Skinner Twp., FR	Chain of Ponds Twp., Jim Pond Twp., Coplin Plantation, Wyman T	Operating	132	10/30/2009	Vestas V-90 3.0M	44	DP4794
	Bull Hill Wind Project	Blue Sky East, LLC	T16MD, HA	NA	Operating	34.2	11/12/2012	Vestas V-100 1.8I	19	DP4886
				LUPC Approved Wind Energy Developments		248.7				
TOTAL MW Approved Thu 06/10/2016						**927.2**				

Land Use Planning Commission

Petition to Remove Milton from the
Expedited Permitting Area for Wind Energy Development;
Substantive Review

Attachment 3

Wind Power and Wildlife in Maine: A State-wide Geographic Analysis of High-Value Wildlife Resources and Wind Power Classes

Wind Power and Wildlife in Maine:

A State-wide Geographic Analysis of High-Value Wildlife Resources and Wind Power Classes

Maine Audubon

Susan Gallo, Wildlife Biologist

Maine Audubon, December 2013

Acknowledgements

This work was funded in part by the Orchard Foundation. We thank Chris Kittredge for many hours of help with the geographic analysis and for creating all the maps included in this report. We appreciate the staff at First Wind and Iberdrola for their input on our initial analysis. Dylan Voorhees (Natural Resources Council of Maine) and David Publicover (Appalachian Mountain Club) both provided valuable input on all phases of analysis and reporting. Mike Thompson (Penobscot Environmental) provided helpful editorial suggestions for the final report.

Executive Summary

This report analyzes, on a broad, state-wide scale, how much acreage in Maine has both wind and wildlife resource value, compared to how much acreage has wind without an overlapping natural resource value, in order to evaluate the potential for wind development that minimizes impacts to a broad array of wildlife habitat. This report also evaluates the state's goal of 3,000 MW capacity of wind energy by the 2030 deadline set in the amended Maine Wind Energy Act, and if that level of development can happen with minimal impact to multiple wildlife resources.

This report finds:

- The wind resource in Maine is extensive. There are 1.1 million acres with viable wind (>300 W/m^2) located away from developed areas, established conservation land and excessively steep slopes (>20% grade). As expected, the higher wind power classes are located at higher elevations.

- Most wind projects in Maine have been built where there are relatively low levels of wind (<500 W/m^2). Increasingly longer blades and taller towers have made these sites economically viable.

- Wildlife resources are widely distributed across the state and across the wind resource base. A few wildlife resources, including Rare/Exemplary Natural Communities, Critical Summits and Bicknell's Thrush, have substantial overlap with the higher wind classes.

- Only 16% of the modeled wind base (177,000 acres) overlaps with any of the wildlife resources analyzed in this report. That leaves 84% of the modeled wind base (933,000 acres) with the potential for fewer and less severe impacts on wildlife, though this analysis does not eliminate the need for site specific analysis of impacts.

- Acreage that overlaps with the modeled wind base is disproportionately split between the expedited and non-expedited permitting areas, with almost twice as many acres in the expedited permitting area vs. non-expedited permitting area overlapping with the wildlife resources analyzed here.

- All of the wildlife resources included in this analysis have the potential to overlap with wind developments as they are proposed, though those overlaps could be minimized or avoided

altogether with proactive planning and thoughtful layout and design of wind project developments.

- Coastal areas take up a large part of the modeled wind base, especially in the lowest wind power classes. There are approximately 1.5 million acres within two miles of the coast, which is 7% of the land base but contains 13.5% of the wind resource and just over 41% of the wildlife resources mapped in this analysis.

- Based on this analysis, it appears there is adequate wind in the expedited permitting area that does not overlap with mapped wildlife resources to meet the State goal of 3,000 MW capacity of wind energy.

- For future wind developments in Maine, Maine Audubon recommends :
  - Siting new wind projects in the expedited permitting area away from known and valuable wildlife resources, including but not limited to those analyzed in this report.
  - Siting new wind projects to first **avoid**, then **minimize** impacts, with the last resort to **mitigate** wildlife impacts only if absolutely necessary.
  - Avoiding high elevation sites with Rare/Exemplary Natural Communities, modeled Bicknell's Thrush Habitat, as well as those areas designated as Critical Summits.
  - Careful analysis of any new wind projects within two miles of the coast, due to the high potential for overlap with known wildlife resources.

There are numerous limitations to the analysis used in this report and to the interpretations of the findings presented here. We recognize that the siting of wind development is a complex process, involving, among other things, multiple landowners, meteorological and geophysical assessments, permit applications, biological surveys and studies of visual and other impacts. The value of wildlife and wildlife resources is just one of many concerns that need to be considered as wind development projects move forward.

The wind data used for this analysis, although mapped on a fine scale, is a model based on a much coarser scale. Actual, on-site measurements of wind power may be different. Maps created in this report should not be used for any site-specific analysis of siting. We have analyzed wildlife resources for which there was good information available. Not all wildlife resource values have been adequately mapped and there are wildlife values for which we lack geographical information. These other wildlife resource values will need to be assessed as new wind developments move forward in Maine.

Background & Introduction

Commercial wind power developments on Maine's landscape are relatively new, with more than two dozen projects either operational or under development since 2007 (Appendix A). There are a broad range of drivers behind these developments, including a federal Production Tax Credit for Renewable Energy, state policies that support renewable energy (e.g., Renewable Portfolio Standards), the increasing costs of fossil fuels and innovations in technology that allow for cost-effective wind power generation with fewer turbines at lower wind speeds. The role that each of these drivers will play in the future is not entirely clear, as fossil fuel prices, federal subsidies for renewable energy, global competition, public sentiment and policies at both the federal and state level continue to shift.

Maine passed the first *Wind Energy Act* in 2003 (last amended in 2013) with the broad goal of supporting and promoting wind power development while protecting Maine's quality of place and natural resources, and delivering meaningful benefits to Maine's economy, environment and people.[1] The Act sets several wind generation goals for the state, including at least 2,000 megawatts (MW) of installed capacity by 2015, 3,000 MW by 2020 (including 300 MW or more from coastal waters) and 8,000 MW by 2030, (including 5,000 MW from coastal waters).

A 2011 Legislative Resolve, LD 1366 (*Resolve, To Clarify the Expectation for the 2012 Assessment of Progress on Meeting Wind Energy Development Goals*) requested an early assessment of progress towards meeting these goals, which was completed and submitted by Coastal Enterprises Inc. (CEI) in January 2012.[2] The report states we have approximately 345.5 MW of capacity now operational in Maine, with 183 turbines and an average generation of 1.9 MW/turbine. This is roughly 17% of the way toward the 2,000 MW wind goal for 2015.

Concurrently, the Maine Land Use Regulation Commission (now the Land Use Planning Commission, LUPC) had been discussing how to evaluate and assess cumulative visual impacts as they relate to wind power development over time and space. This discussion has not continued, since as of September 1, 2012, permitting for *all* wind development projects - in both the organized and unorganized territories - is under the Maine Department of Environmental Protection (DEP), with some limited engagement by LUPC. Projects proposed in LUPC jurisdiction will need to seek LUPC certification before getting a DEP permit and those in the non-expedited permitting area will also need to get LUPC rezoning approval. Keeping these processes transparent and open to public input is important to Maine Audubon as it relates to future wind development.

Maine Audubon recognizes the need to include renewable energy as part of a long-term energy strategy that reduces the consumption of fossil fuels, thereby helping to decrease the threats to wildlife and wildlife habitat from global climate change. To that end, we brought diverse stakeholders together to create the first Wildlife Siting Guidelines in 2008 and Methodologies for Evaluating Bird and Bat Interactions with Wind Turbines in Maine in 2006. We also participated in the Governor's Task Force on Wind Power Development in 2007, which ultimately utilized our

[1] Full text of 35-A M.R.S.A, Chapter 34: THE MAINE WIND ENERGY ACT, can be found online at www.mainelegislature.org/legis/statutes/35-a/title35-Ach34.pdf (accessed January 4, 2012).

[2] Maine Wind Assessment 2012, Stephen Cole, Coastal Enterprises, Inc, Stephen Ward, Perkins Point Energy Consulting and Robert Fagan, Synapse Energy Economics, Inc., can be found online at www.maine.gov/oeis/alternativeenergy.html (accessed June 21, 2012)

work in developing its report and created a map that identifies areas of the state that were suitable for an expedited permitting process.

The expedited permitting process eliminated the step of rezoning for commercial wind projects within the expedited area, with the goal of giving all stakeholders, including developers, environmental organizations and local citizens, greater predictability in the permitting process. The map of expedited areas (Appendix B) was drawn on a coarse, state-wide scale, primarily following political rather than ecological boundaries, and was adopted in 2008 in LD 2283, *An Act To Implement Recommendations of the Governor's Task Force on Wind Power Development* (last amended in 2013).[3] The expedited permitting process was never intended to eliminate the need for detailed review of site-specific impacts during the permitting process, but unfortunately, some perceive the expedited areas as unquestionable "go" zones for wind power development. This is not necessarily the case. Four out of the ten projects proposed or permitted since passage of the Act – Sisk, Bingham, Bowers and Highlands (which has been withdrawn – have been particularly contentious despite their location within the expedited permitting area.

Innovative technology that allows viable wind developments at lower elevations with reduced wind speeds has helped reduce some of the conflict. This improvement in technology allows wind developers avoid higher elevation sites that inherently have more contentious issues (limited habitat, higher visibility, steeper slopes, rare species and habitats, etc.). It also opens more areas to potential wind development, theoretically giving wind developers more options for locations with lower natural resource conflicts.

The Wind Energy Act capacity goals and the expedited permitting area map have helped set the stage for how wind development might play out on Maine's landscape. But there are questions about how that development might affect wildlife and wildlife habitat. Of particular concern are impacts (both direct and indirect, and over time and space) to rare, endangered, and threatened species, exemplary natural communities, and Significant Wildlife Habitats. Because these impacts affect values core to Maine Audubon's mission of protecting wildlife and wildlife habitat, and because Maine Audubon also recognizes the need for renewable energy as part of a long-term energy policy, we have focused the current analysis on two compelling questions:

1) Can we identify areas of the state that are most appropriate or least appropriate for commercial wind development, from the perspective of wildlife and wildlife habitat?

2) What does the landscape of Maine look like with a full build-out of 3,000 megawatts of land-based wind power, and is there a way to create a build-out scenario that minimizes impacts to wildlife and wildlife habitat?

[3] Full text of 35-A M.R.S.A Chapter 34-A: EXPEDITED PERMITTING OF GRID-SCALE WIND ENERGY DEVELOPMENT, can be found online at www.mainelegislature.org/legis/statutes/35-a/title35-Ach34-A.pdf (accessed January 4, 2012).

Appalachian Mountain Club Ridgeline Study

Concurrent with Maine Audubon embarking on a project to answer these questions, the Appalachian Mountain Club (AMC) issued a report in early 2011 entitled *Ridgeline Windpower Development in Maine: An Analysis of Potential Natural Resource Conflicts.* The report focuses on ridgeline developments, where the majority of early wind power development had been proposed for the state of Maine, and uses a Geographic Information Systems (GIS) analysis to identify ridgeline locations that are attractive for wind power development proposals, based on wind speed at 50 meters (m) and the length of the ridge. It then assesses the potential for impacts to natural resources and scenic values at each ridge by assigning a composite natural resource score (based on 12 natural resource categories). These scores were then evaluated to determine the relative potential impacts to natural resources across the set of ridgelines.

Briefly, the report identified 670 miles of ridgeline at 267 separate sites. 51% of these sites were either wholly or partially on conservation land. Of sites on private land, 55% were wholly or partially within the expedited permitting area. The analysis found 63 sites, totaling 147 miles of ridgeline, which were in private or mixed ownership, had a natural resource composite score less than two, and had more than half their length within the expedited permitting area.

A build-out analysis starting with these 63 sites (minus six sites that had existing or permitted projects and another four that had factors that would almost certainly exclude them from development) found that, with an average density of 11.5 MW/mile, we could potentially add 1,377 MW of capacity if all of these sites were fully developed. With 473 MW of capacity either operational or in permitted projects, this would bring the total potential for Maine to only 1,850 MW. Wind power development outside of these ridgelines is clearly necessary for the state to reach its goal of 3,000 MW of wind-powered energy by 2030.

Changes in Technology

In recent years, wind turbine technology has advanced with the creation of longer turbine blades and taller towers. The tips of blades on operational turbines in the U.S. can now be over 150 m tall, with capacities of up to 3 MW per turbine. In Europe, Enercon manufactures an on-shore 7.5 MW turbine that is 198 m tall, and the research and development for the production of even larger turbines is underway.[4] These turbines have the potential to make smaller projects at lower elevations more economically viable than they were a decade ago. Although there were low-elevation projects from the beginning of wind development in Maine (Mars Hill and Stetson, for example), we are seeing more low-elevation developments in Maine now (and in the near future, based on meteorological tower locations) compared to higher-elevation, ridgeline projects.

Project Methods

This project builds on AMC's work by expanding an analysis of potential wind sites to lower elevations and to places where lower wind speeds are now economically viable, in order to 1) identify areas of the state that are most (and least) appropriate for wind development, from the perspective of wildlife and wildlife habitat; and 2) develop a model of what the landscape of Maine

[4] See the *2010 Wind Technologies Market Report, p v,* U.S. Department of Energy, Energy Efficiency and Renewable Energy, available online at www1.eere.energy.gov/wind/pdfs/51783.pdf. Accesseed June 11, 2012.

might look like with a full build-out of 3,000 MW of wind power. Ultimately, our goal is to improve the siting and regulatory review of land-based wind power projects in Maine so that we can move more quickly towards meeting the State's goal of 3,000 MW of electricity from terrestrial wind power projects by 2030 (if that goal is indeed achievable), while at the same time protecting the most sensitive habitats and landscapes.

This project uses GIS layers of mapped wind power resources and multiple wildlife resource values to identify the areas of overlap, illustrate areas with both high and low overlap of wind and wildlife resource values and to analyze the potential for wind power development in Maine that avoids high-value wildlife resource areas.

GIS Layers Used in Analysis

Base Wind Layer: The starting point for this analysis is a GIS layer of wind power class at 80m, provided by the Natural Resources Council of Maine and originally created by a team led by Bob Grace of Sustainable Energy Advantage for the Governor's Task Force on Wind Power Development in 2008.[5]

The layer consists of a 200m resolution grid with associated wind power range classes (1=300-400 watts (W)/m^2, 2=400-500 W/m^2, 3=500-600 W/m^2, 4=600-700 W/m^2, 5=700-800 W/m^2, and 6=>800 W/m^2).[6] A preliminary exclusion of conservation land, developed land and land with >20% slopes had already been done on the layer when we received it. We excluded additional conservation land using the state conserved lands layer from the Maine Office of GIS (MEGIS) and also excluded areas overlapping open water (lakes, ponds and ocean).

We wanted to include the lowest wind power class (300-400 W/ m^2) in our analysis, because some wind projects in Maine already use these areas. We also know that wind speed is only one of many factors that interact in a complex fashion to make a site suitable for wind development. In order to account for the multiple factors affecting viability, we wanted to exclude some of the lowest Power Class from our analysis. We expected that including all of that acreage would grossly overestimate the acreage available for potential wind development. To reduce the acreage to a more realistic starting point, we removed all polygons (regardless of size) that were wind power class one (300-400 W/m^2) that were not adjacent to or touching a defined area (polygon) with a higher wind power class rating.

We also wanted to remove isolated areas from the wind base that would be too small to support viable commercial wind development. Based on several discussions with wind developers, we clipped all polygons that were less than 4 ha in size, regardless of wind power class or proximity to other polygons. We also clipped any isolated 4 ha (single pixel) polygons that were more than 400 m away from any other polygons.

[5] See *Report of the Governor's Task Force on Wind Power Development,* Attachment E, available online at www.maine.gov/doc/mfs/windpower/pubs/report/wind_power_task_force_rpt_final_021408.pdf. Accessed January 5, 2012.

[6] Note that these wind power ranges 1-6 correspond to wind power ranges 0-5 in the Task Force report, p. 57.

Expedited and Non-expedited Permitting Areas: These areas were designated in the 2008 Wind Power Siting Law, *An Act To Implement Recommendations of the Governor's Task Force on Wind Power Development* (Appendix B).

Coastal Zone: We created a GIS layer extending two miles inland from estuaries and the coastline in order to isolate this area for further analysis.

Current Wind Developments: We obtained turbine layouts from FirstWind for their current permitted projects at Mars Hill, Rollins and Stetson (I and II). We were also able to digitize from aerial photos the turbine layouts for eight other wind developments in Maine. Together, these 12 projects represent all current permitted or operational projects in the state as of October 2011. We added a half-mile radius circle around each turbine to analyze the natural resources and wind power classes for each project.

Natural Resource Layers: The natural resource values for which we have GIS layers were divided into two tiers. Tier I values were based primarily on field surveys of known, mapped and relatively discrete natural resources. These are generally places on the landscape where turbines and their associated roads and structures should be avoided if conserving wildlife and wildlife habitat is a high priority, although in some cases developments could be sited around these locations with best management practices for issues like stream crossings or vegetation management. Tier II values, in contrast, cover larger areas, and are primarily models of important habitat over broader scales. Avoiding Tier II areas to maximize quality wildlife habitat is also preferred, but good management that reduces impacts may again be possible in some cases for siting in or at the edges of Tier II resource blocks. The Tier I and II layers are listed below.

Tier I Natural Resources:

Riparian Buffers: Buffers were placed around riparian areas, similar to those in place for municipal Shoreland Zoning. They included an upland buffer of 250 feet from the edge of lakes, ponds, rivers, coastline and wetlands greater than ten acres, as well as 75 feet around perennial streams. The acreage of actual wetlands and streams was also included in this buffer. These buffers were also analyzed separately from the remaining Tier I layers because they are primarily physical constraints, compared to the remaining Tier I layers which are related to habitat features. (Source: MEGIS 2011)

The Nature Conservancy's Critical Summit Ecosystems: Summits (described as "mountain peaks, hilltops, ridgelines, knolls") are one of six special landform/ecosystem types identified as being of particular importance to the conservation of regional biodiversity in The Nature Conservancy's Northern Appalachian-Acadian Eco-regional Assessment.[7] Critical occurrences are considered "crucial to the conservation of biodiversity in the eco-region" and have passed a screening process that considers size, landscape quality and verification. The GIS layer includes the ridgeline and its 100 m buffer.

[7] Anderson, M. et al., 2006. The Northern Appalachian / Acadian Ecoregion: Ecoregional Assessment, Conservation Status and Resource CD. The Nature Conservancy, Eastern Conservation Science and The Nature Conservancy of Canada: Atlantic and Quebec regions.

Deer Wintering Areas: Polygons for these Significant Wildlife Habitats were included for both organized towns as well as the P-FW zones within LUPC. There is no buffer around Deer Wintering Areas. (Source: Maine Department of Inland Fisheries and Wildlife (MDIFW), 2011)

Inland Waterfowl and Wading Bird Habitat: Polygons for these Significant Wildlife Habitats include moderate and high-value wetlands and a 250-foot upland buffer (Source: MDIFW, 2011).

Endangered, Threatened and Special Concern Species: Locations for 96 rare and special concern species (see Appendix C). Buffers around observed locations or polygons are based on habitat use and vary by species (Source: MDIFW, 2011).

Shorebird Habitat: Polygons for these Significant Wildlife Habitats include a 250-foot area around all designated roosting areas and a 100-foot area around all designated feeding areas (Source: MDIFW, 2011).

Tidal Waterfowl and Wading Bird Habitat: Polygons for these Significant Wildlife Habitats include only the identified tidal wetland habitat (Source: MDIFW, 2011)

Exemplary Natural Communities: Polygons provided by the Maine Natural Areas Program for rare plant and rare or exemplary natural communities include both specific points (or for some species, habitat) where populations of rare, threatened and endangered plants have been documented, as well as both rare natural communities and also those that are common but in exemplary condition (Source: Maine Natural Areas Program, 2011).

Wading Bird Colony Buffers: Buffers of one quarter mile were added to points of Great Blue Heron rookery locations. Herons travel well beyond this distance to feed, but buffers beyond a quarter mile would need to be directional based on observed behavior, so were not included in our analysis (Source: MDIFW, 2011).

Tier II Natural Resources:

Beginning with Habitat Focus Areas: These are natural areas of *statewide* ecological significance that contain unusually rich concentrations of high value and at-risk species and habitats. These areas support rare plants, animals and natural communities; high quality common natural communities; significant wildlife habitats; and their intersections with large blocks of undeveloped habitat. Beginning with Habitat (BwH) Focus Area boundaries are drawn based on the species and natural communities that occur within them and the supporting landscape conditions that contribute to the long-term viability of the species, habitats and community types (Source: BwH, 2011).

Modeled Bicknell's Thrush Habitat: Bicknell's Thrush is the rarest migratory songbird in the east and is endemic to subalpine spruce-fir forest in the northeastern United States and maritime Canada. The layer includes potential Bicknell's Thrush habitat as identified in a model

developed by the Vermont Institute of Natural Sciences in 2005.[8] (Source: Vermont Center for Ecostudies, 2011).

Beginning with Habitat Connectors: BwH connectors were identified by predictive computer modeling that highlights locations where high-value habitat is likely to occur on both sides of a road. The connectors include both Riparian Habitat Connectors (likely crossing locations for wetland- and riparian-dependent species moving between waterways and wetlands divided by roads) with a 35-foot buffer, and Large Block Habitat Connectors (likely habitat areas linking undeveloped habitat blocks greater than 100 acres) with a 500-foot buffer (Source: BwH, 2011).

Limitations

It is important to highlight several limitations that should restrict the interpretation of our results and to reiterate the goals of the project.

1) The wind data used for this analysis, although mapped on a fine scale, is only a model of actual wind power potential. We recognize that the base layer of potential wind power is a model of expected wind based on a suite of geographic variables and modeled on a fairly coarse grid across the state. We recognize that some areas with high wind speeds on the map will not be acceptable sites for wind development due to other factors, such as sheer, turbulence, soils, slopes, etc. We also recognize that some of the areas identified as having low wind resources may in reality have much higher wind, and that developers must collect several years of site-specific meteorological data in order to fully evaluate and assess the potential suitability of a site for development. Any maps created as a result of this project should not be interpreted as pinpointing specific, project-level locations on the ground. The wind power data used in this analysis provides a starting point for the creation of possible scenarios for where viable wind resources might be more or less likely, but we realize that it vastly oversimplifies the process used to identify suitable sites for wind development.

2) The siting of wind developments is a complex process. There are many factors that affect the profitability, and therefore the economic viability, of a wind development project. It is beyond the scope of this project to evaluate the economic viability of different locations within the state, especially in relation to transmission lines, either existing or proposed. Other analyses (e.g., those conducted for the Wind Power Task Force in 2008 and CEI's 2012 report) have evaluated some of those aspects, but that is not the focus of this report.

3) Not all wildlife values have been adequately mapped and there are wildlife values for which we lack geographical information. In addition, not every available mapped wildlife resource was included in this analysis, though many deserve consideration during the wind permit process. For example, locations and suitable habitat for many of our endangered species, like northern bog lemming and Roaring Brook mayfly, are not known and have therefore not been mapped on a state-wide scale, as is the case with Significant Vernal Pools. Some rare habitats are not

[8] Lambert, D. et al., 2005. A practical model of Bicknell's Thrush in the Northeastern United States. The Wilson Bulletin 117(1):1-11.

completely mapped across the state, and some (like subalpine fir/heart-leaved birch communities at Sisk and Black Nubble wind developments) may be "discovered" as new areas are surveyed prior to development. Maps for nesting Bald Eagles, high-value brook trout streams and ponds, occurrences of Golden Eagles and Critical Habitat for Canada lynx and Atlantic salmon were not included in this analysis, though they should be considered during wind permitting. Bats are emerging as a conservation concern due to their plunging numbers and several species are proposed for emergency federal listing as endangered. We have very little information about either bat migration or resident bat populations (locations and numbers) in Maine. Bird migration routes have been poorly studied, and we know very little about migratory pathways through the state. Maine's Important Bird Area project is incomplete, especially in the northern half of the state, but could provide information about areas more likely to have higher concentrations of migratory birds. These examples illustrate the continued need to evaluate wind project proposals on a site-specific basis. Areas that show up in this analysis with little or no potential natural resource conflicts may in fact, once evaluated more closely with site-specific data, be unsuitable for wind development from the perspective of adverse impacts to wildlife resources.

5) There are many values on the landscape beyond wildlife resources that may affect the level of impact of any particular wind development project. Maine Audubon's lens is wildlife and wildlife habitat and that is our focus when evaluating the impact of potential wind developments. This analysis is limited to wildlife-related resources and potential overlap with wind resources. There are many other important values on the landscape, including but not limited to visual and scenic impacts, noise levels, impacts to recreation opportunities, tourism, human health issues, proximity to residential areas and the value of community benefits, which may or may not align with wildlife values. Those values are not necessarily any less meaningful, but simply fall outside of Maine Audubon's wildlife-oriented mission.

6) Impacts from wind development projects may extend far beyond the turbines and pads. Access roads, clearing for maintenance and transmission lines are all necessary components of an industrial scale wind project and can have significant and cumulative impacts on rare and endangered species, high value habitats, wetlands and other water resources, soils, steep slopes and connectivity. We did not fully account for these impacts in our analysis of the overlap of wind and wildlife.

To reiterate the goals of this project, we are assessing, on a broad, state-wide scale, how much acreage has both wind and wildlife resource value, compared to how much acreage has wind without an overlapping wildlife resource value, in order to evaluate the potential for wind development in Maine that minimizes impacts to wildlife and wildlife habitat. We are also using this analysis to evaluate the state's goal of 3,000 MW capacity of wind energy by the 2030 deadline set forth in the amended Maine Wind Energy Act, and if that level of development can happen with minimal impact to multiple wildlife resources.

Results and Discussion

The Wind Base:

Results: The base map of wind resources we started with identified 1,507,060 acres in Maine where wind speeds were projected to be greater than 300 W/m^2. We eliminated 26% of this layer by clipping additional conservation land, polygons that consisted solely of Power Class 1 wind resources, and small, isolated pockets of any wind power (<10 acres in size). The remaining acreage of 1,111,770 acres was used for the next steps of the analysis and is hereafter referred to as the wind base.

Most of this wind base, 800,000 acres, or 72%, is in the lowest Power Class, and acreage in the two lowest Power Classes (1 and 2) make up 92% of the wind base in Maine (Figure 1). The analysis for the Wind Power Task Force in 2007 did not include the lowest power class in their build-out estimates because at the time it didn't appear to be economically viable to develop (designated as Power Class One in this analysis or as Power Class Zero in the Task Force Report).

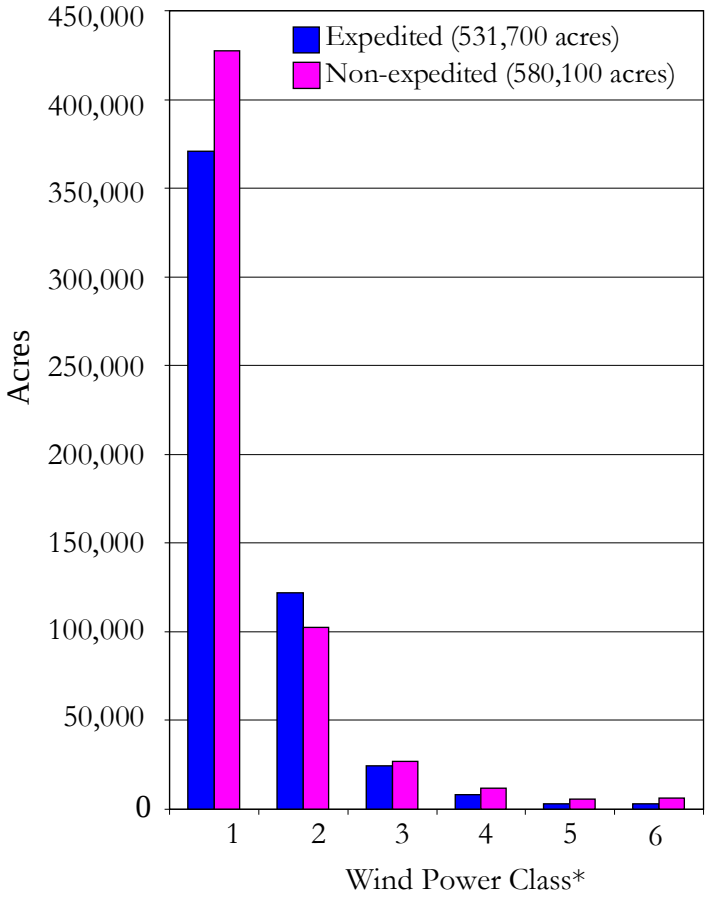


Figure 1. Wind Base Acreage in Expedited and Non-expedited Areas by Wind Power Class.

**1=300-400 W/m^2, 2=400-500 W/m^2, 3=500-600 W/m^2, 4=600-700 W/m^2, 5=700-800 W/m^2, and 6=>800 W/m^2. Note that these same categories are identified as Power Class 0-5 in Appendix E of the Governor's Windpower Task Force Report.*

Discussion: *The growing economic viability of wind power at less "windy" places opens up more acreage on the Maine landscape to potential effects from wind development.*

The Wind Base and the Expedited Permitting Area

Results: About two-thirds of Maine's land base is in the expedited permitting area (13.77 million acres out of 20.68 million total acres), leaving about one third (6.90 million acres) in the non-expedited area (Figure 2). The total wind base is relatively evenly split between the two areas (Figure 1). Because the expedited permitting area is so much larger, this translates to roughly 3% of the total land in the expedited permitting area having the potential for wind development, compared to roughly 8% of the total land in the non-expedited area.

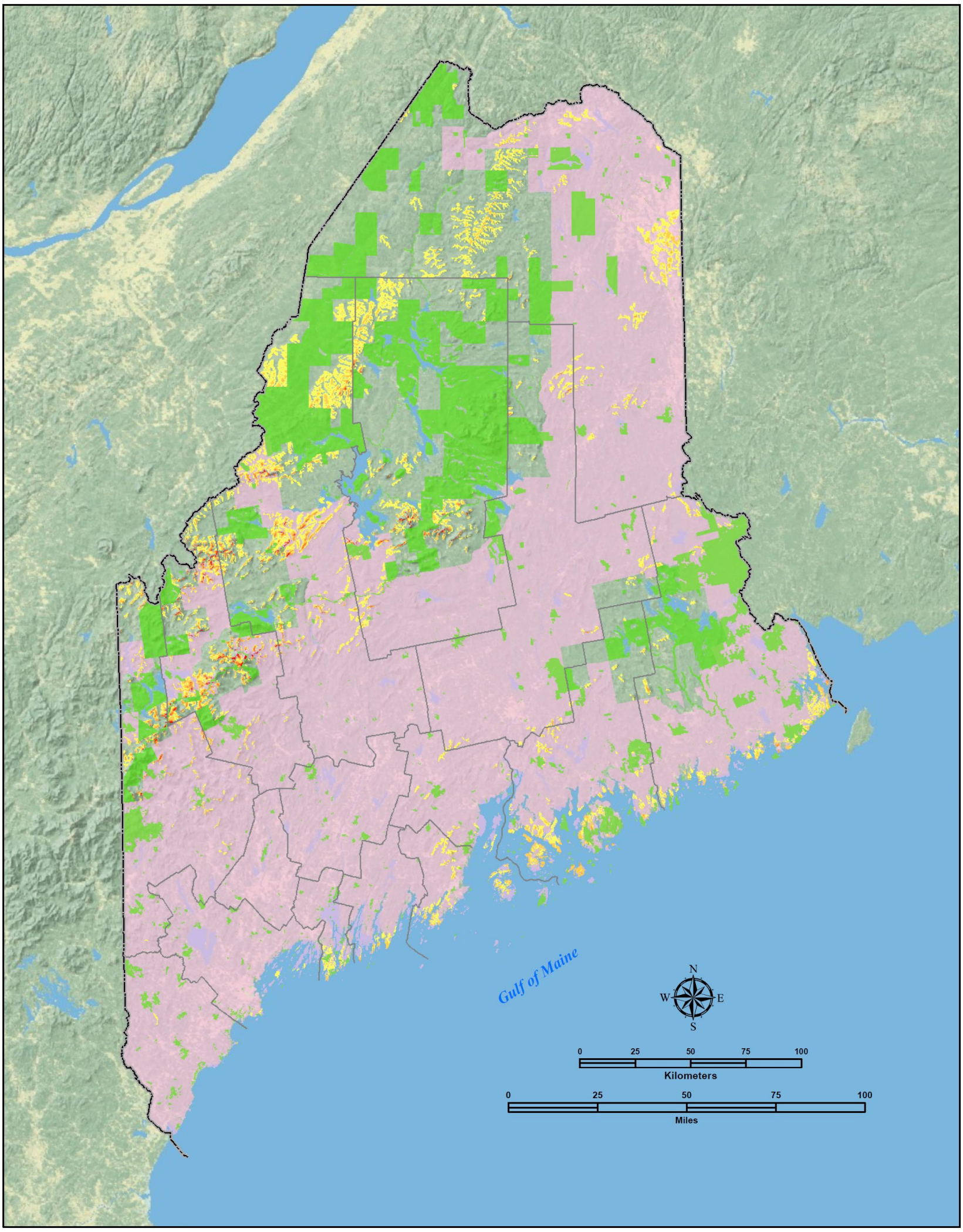
About 65% of the acreage with the highest wind speeds (Power Classes 5 and 6) is located in the non-expedited permitting area, compared to only 35% in the expedited permitting area (Figure 1). This makes sense given the non-expedited area includes more high-elevation areas in the northern

and western part of the state (Figure 2). These high-elevation areas have higher wind speeds and were targeted for the first wind development proposals in Maine. Many wind development proposals in high-elevation areas (Redington, Black Nubble and Sisk) have been highly contentious.

Although the standards for protecting natural resources are the same in both expedited and non-expedited areas, the standards for scenic impacts are higher in the non-expedited Area, and any wind development in the non-expedited Area requires an additional step of rezoning. In addition, wind developments in these high-elevation and high-wind areas may face more public scrutiny due to greater visibility of turbines, the potential for impacts to recreational users and organized local opposition.

The land base within two miles of the coast and estuaries, which is all in the expedited area, stands out as having a high concentration of wind resources, especially from the Sagadahoc County line east (Figure 2). This coastal area makes up about 10% of the total expedited area, but has about 28% of the total expedited wind base. Most of this wind is in the lowest Power Classes (1 and 2), with no wind base acreage greater than Power Class 4. There are a whole suite of factors that may affect how viable wind development is in this area, including higher population densities, complex scenic issues and impacts and organized local opposition.

Discussion: *The wind base is relatively evenly split between the expedited and non-expedited areas. In both areas, the wind base is primarily in the lowest power classes. The non-expedited area has about two-thirds of the acreage with the highest wind power classes. About one-third of the wind base in the expedited area is located within two miles of the coast.*



Legend

80m Wind Power Data

- 300 - 400 W/m2
- 400 - 500 W/m2
- 500 - 600 W/m2
- 600 - 700 W/m2
- 700 - 800 W/m2
- > 800 W/m2
- Conservation Lands
- Expedited Wind Permitting Areas
- State Boundary
- County Boundary

Data Sources: AWS Truewind; First Wind; Maine Governor's Task Force on Wind Power Development; Maine Office of GIS; National Geographic Society; Natural Resource Council of Maine; New York State Energy Research & Development Authority; Sustainable Energy Advantage; US Geological Survey.

Projection: NAD83, UTM Zone 19N, meters.

THIS MAP IS NOT INTENDED FOR SITE-SPECIFIC PLANNING.

MAINE AUDUBON

Maine Wind Analysis Project

Figure 2
Wind Power Data
Expedited Permitting Areas

November 2012

The Modeled Wind Base and Permitted Projects:

Results: We analyzed the modeled wind base within a half-mile radius of existing or proposed turbine locations at 12 permitted wind developments in order to assess what kind of modeled wind they used. More details about the size and capacity of these developments are provided in Appendix A. The "wind footprints" of nine of these developments were highly variable (Figure 3). The two developments on and near Kibby Mountain are the only ones to utilize significant amounts of modeled wind in the highest power classes, though Saddleback Ridge uses a small amount of Power Class 3 and 4 wind. Seven of the nine projects are located where most of the modeled wind is in Power Class 1 and 2, and three of those projects are located in places where only Power Class 1 and 2 winds are present.

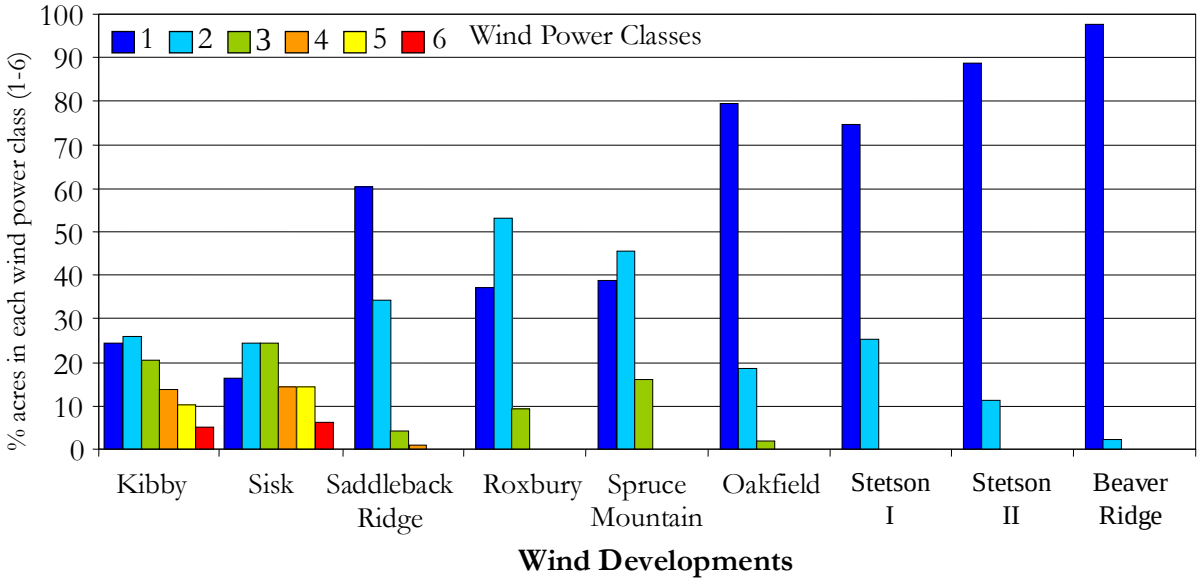


Figure 3. Percent of acres in each wind Power Class (1-6) within a half-mile radius of turbines at permitted and operational wind developments in Maine.

Three wind projects are not represented in Figure 3. Two of the projects (Bull Hill and Rollins) had no modeled wind base within a half-mile of its turbines. Mars Hill had only negligible modeled wind (<2 acres) in Power Class 1. This apparent inconsistency may be tied to the coarse nature of the modeled wind base, which may miss wind resources at smaller, narrower features like the ridgeline at Mars Hill. The lack of "modeled wind" at these three wind developments may also be a result of our eliminating polygons with only Power Class 1 wind in the first step of this analysis (see page 6), as low wind resources are obviously present but some of those were eliminated from the base layer of modeled wind in the first step of our analysis.

There are at least two factors affecting the utilization of wind resources in the lowest power classes at wind developments in Maine. One factor is that actual on-the-ground wind power might be higher than what is modeled, due to the type of topographic features mentioned above. Detailed meteorological and geographical studies on site, over several years, have helped developers locate places where wind speeds are actually higher than what is indicated on maps of modeled wind

speeds. The second factor is that recent developments in technology, including higher towers and longer blades that reach higher wind speeds further from the ground, and increased capacity factors for low-wind-speed technology, have made lower wind areas more economically viable.

Much of the potential for wind power development in Maine lies at these lower elevation sites, at much less "windy" places on the landscape than historically developed for wind power in the northeast. The trend of wind developments moving to these less windy areas was highlighted in a recent presentation from the National Renewable Energy Laboratory,[9] which estimated that the available land area for wind development nationally has grown exponentially, by as much as 2 million acres.

Discussion: *The analysis of the wind base at current developments in Maine affirms the recent trend toward new development at "low wind" sites. This trend has many implications for natural resource conservation. The greater breadth of habitat types across increased acreage gives the industry more options for locating wind developments, and potentially more opportunities to avoid the most ecologically sensitive habitats. At the same time, more types of wildlife resources may now be vulnerable to impacts from wind developments (including those not previously considered at risk). Proactive planning remains important for siting wind developments to avoid or minimize natural resource impacts across a broad range of habitats.*

Tier I Wildlife Resource Values

Results: Evaluating Tier I (TI) resources individually (Figure 4), the largest resource (wetland buffers) overlaps with only 2.5% of the total wind base, roughly 28,000 acres. Most of the remaining TI resources (8 out of 14) each take up less than 1% of the total wind base. If you overlap all these resources, one on top of another, the total acreage for all TI resources combined is 95,230 acres, or roughly 9% of the total wind base.

Physical vs. Habitat Aspects of T1 and the Wind Base

Results: For further analysis, TI resources were divided into physical and habitat values. Although there is certainly some overlap, in general the physical TI resources are relatively fixed in space and are associated with water (blue bars in Figure 4). Habitat TI resources, on the other hand, tend to be focused on the ecological aspects of wildlife habitat (green bars in Figure 4).

An illustration of the TI values present in one randomly chosen township (Sandy River Plantation) is illustrated at a fine scale in Figure 5. It shows how the different Physical and Habitat layers line up with the wind base and is shown simply to illustrate the scale of these features on the landscape.

Physical values together account for most of the acreage of TI resources overlapping with the wind base (72,432 acres), compared to just 31,411 acres of habitat values (Figure 4). The overlap of where physical and habitat T1 values occur at the same location is 8,563 acres (Figure 6), which is 1% of the total wind base.

[9] Wiser, R., E. Lantz, M. Bolinger and M. Hand, February 2012, "Recent Developments in the Levelized Cost of Energy from U.S. Wind Power Projects," accessed 2/2012 online at eetd.lbl.gov/ea/ems/reports/wind-energy-costs-2-2012.

Discussion: *Physical wildlife resource values around wetlands, lakes and streams make up the majority of acreage considered a valuable wildlife resource, potentially at risk to some level of impact during wind development. Keeping strong shoreland protection in place during wind development will be key to maintaining this wildlife resource as wind developments move forward. Habitat wildlife resource values, like those identified as Rare/Exemplary Natural Communities and those associated with high and moderate-value waterfowl and wading bird habitat, cover more than 17,000 acres of the wind base. These resources should be avoided whenever possible or impacts should be minimized by altering the project design and/or using Best Management Practices.*

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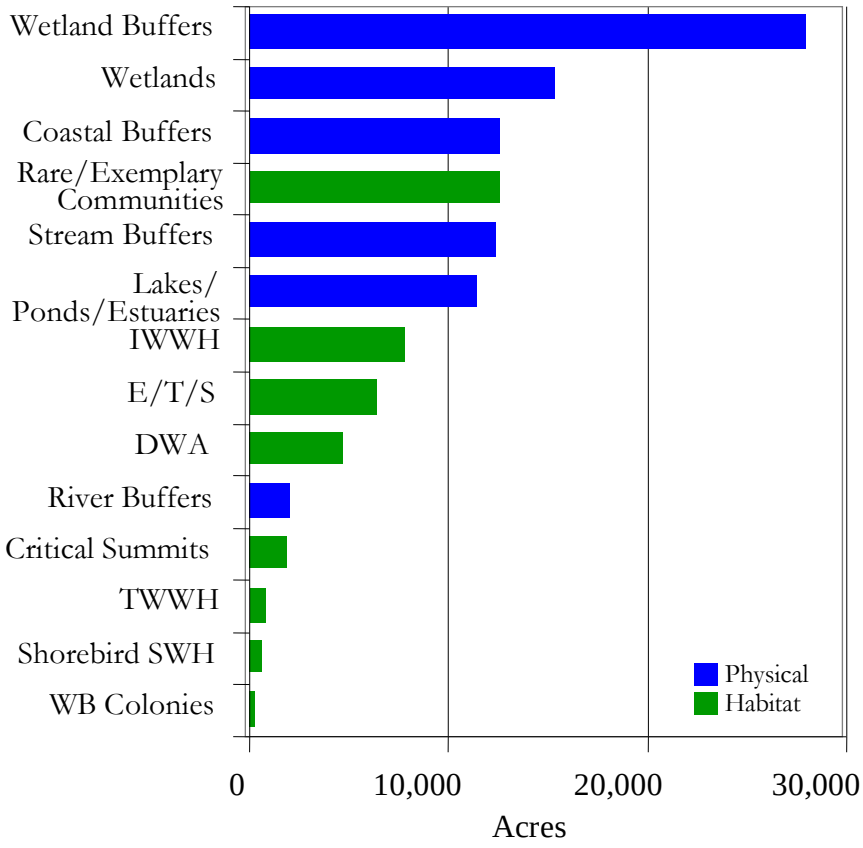
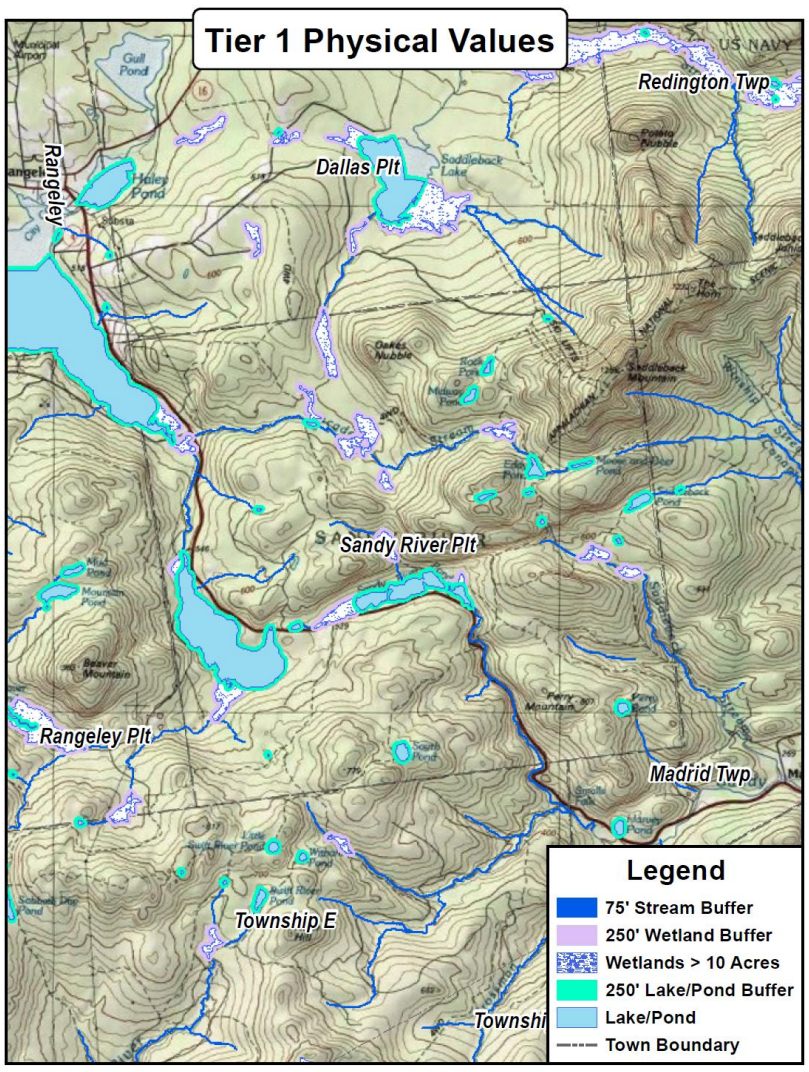
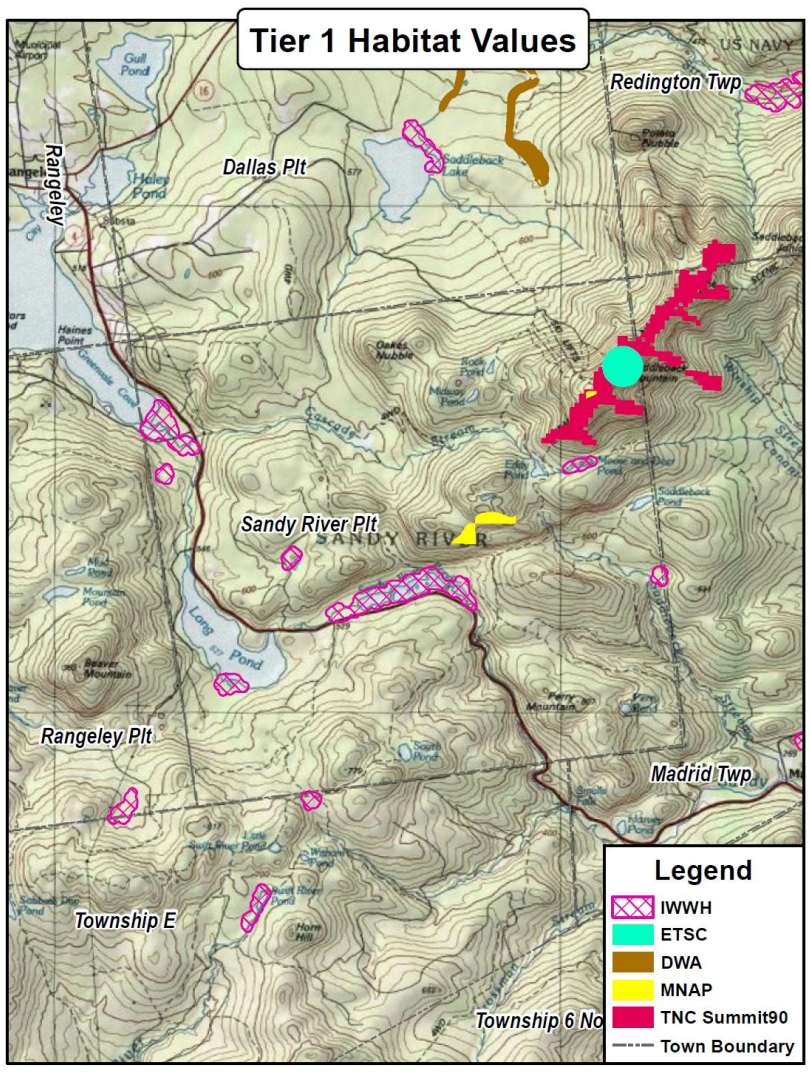


Figure 4. Acres of overlap with the wind base for each Tier I mapped wildlife resource value.

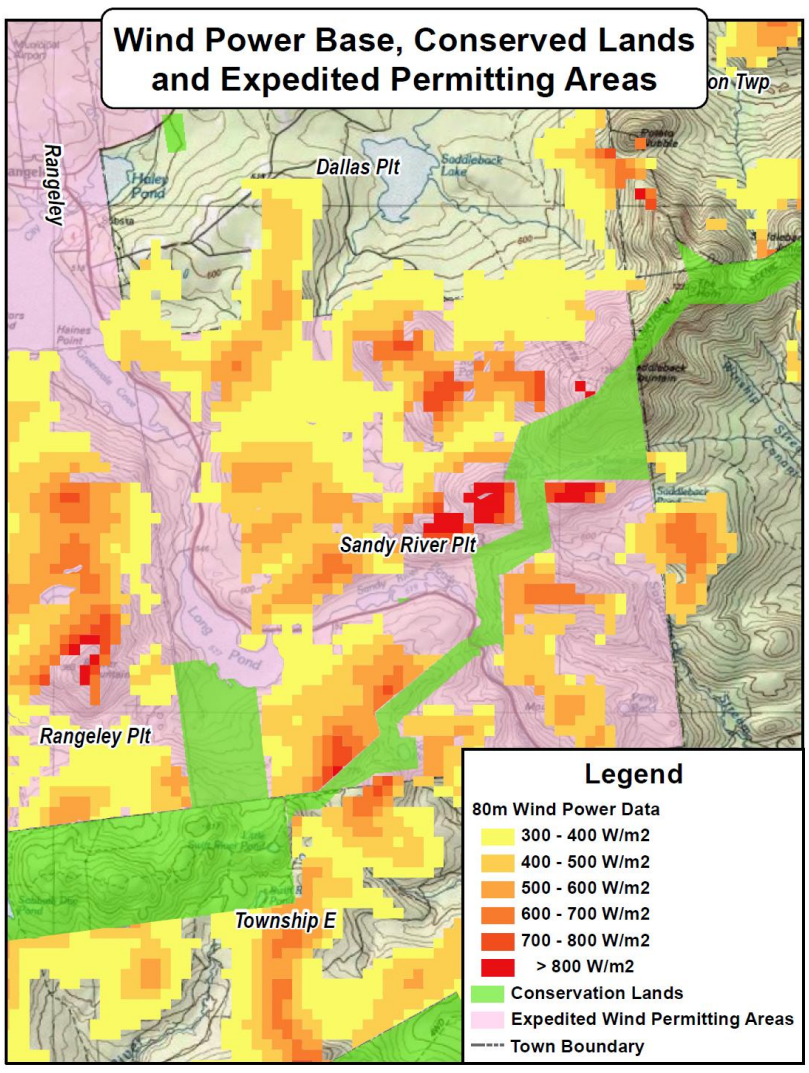
Tier 1 Physical Values



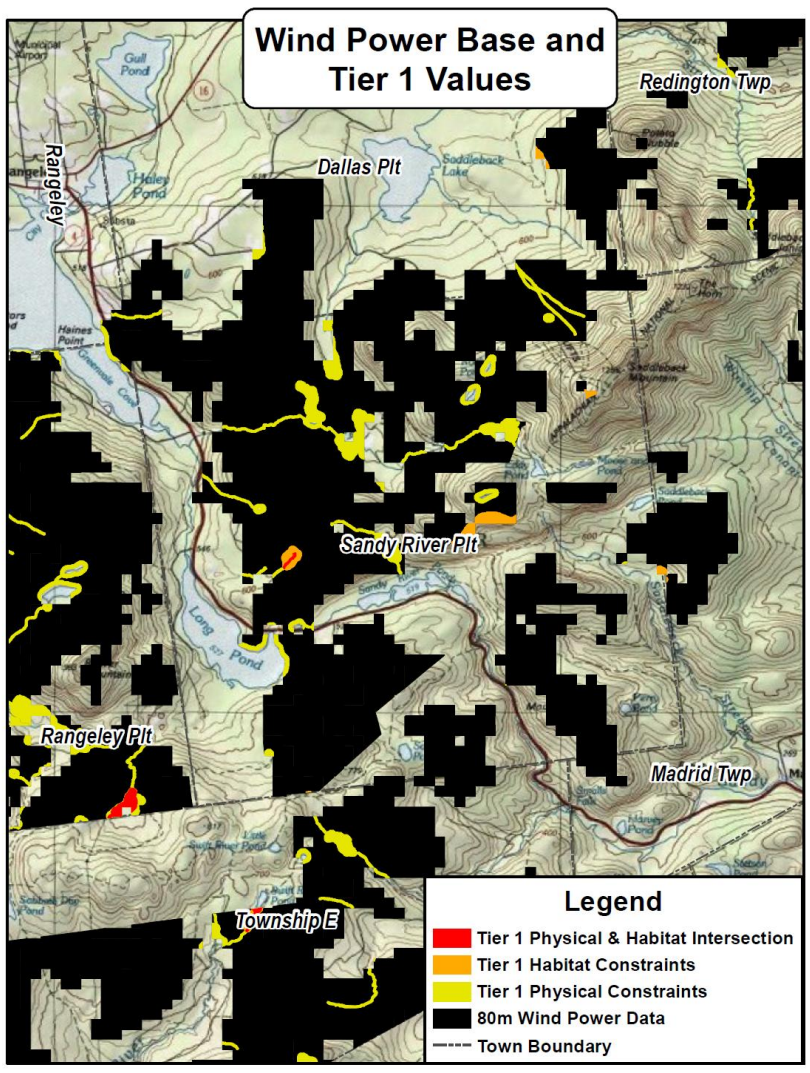
Tier 1 Habitat Values



Wind Power Base, Conserved Lands and Expedited Permitting Areas



Wind Power Base and Tier 1 Values



N
W E
S

0 1 2 3 4
Kilometers

0 1 2 3 4
Miles

Data Sources: Appalachian Mountain Club; AWS Truewind; First Wind; Maine Department of Inland Fisheries and Wildlife - Beginning With Habitat Program and Natural Areas Program; Maine Governor's Task Force on Wind Power Development; Maine Office of GIS; National Geographic Society; Natural Resource Council of Maine; New York State Energy Research & Development Authority; Sustainable Energy Advantage; US Department of Inland Fisheries and Wildlife; US Geological Survey.

Projection: NAD83, UTM Zone 19N, meters.

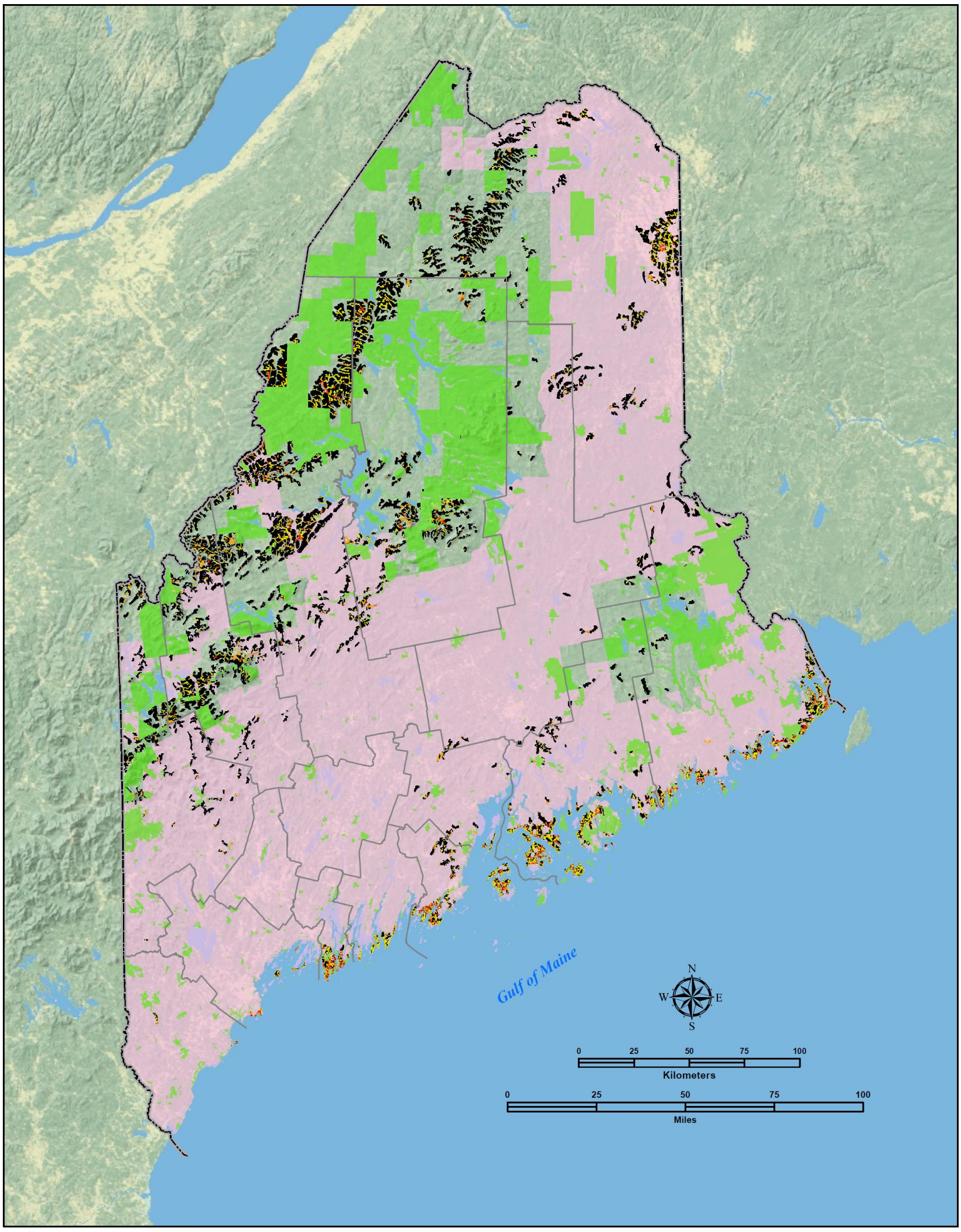
THIS MAP IS NOT INTENDED FOR SITE-SPECIFIC PLANNING.

MAINE AUDUBON

Maine Wind Analysis Project

Figure 5
Wind Power Data
Tier 1 Resources Breakdown
Sandy River Plantation

November 2012



Legend

- Tier 1 Physical & Habitat Intersection
- Tier 1 Habitat Values
- Tier 1 Physical Values
- 80m Wind Power Data
- Conservation Lands
- Expedited Wind Permitting Areas
- State Boundary
- County Boundary

Data Sources: Appalachian Mountain Club; AWS Truewind; First Wind; Maine Department of Inland Fisheries and Wildlife - Beginning With Habitat Program and Natural Areas Program; Maine Governor's Task Force on Wind Power Development; Maine Office of GIS; National Geographic Society; Natural Resource Council of Maine; New York State Energy Research & Development Authority; Sustainable Energy Advantage; US Department of Inland Fisheries and Wildlife; US Geological Survey.

Projection: NAD83, UTM Zone 19N, meters.

THIS MAP IS NOT INTENDED FOR SITE-SPECIFIC PLANNING.

MAINE AUDUBON

Maine Wind Analysis Project

Figure 6
Wind Power Data, Tier 1 Physical and Habitat Resources Overlay

November 2012

TI Wildlife Resources and Wind Power Class

Results: Looking at how the different TI values fall across the wind base in terms of different wind power classes (Figure 7), the only TI values that overlap significantly with the highest wind (Power Classes 5 and 6) are Rare/Exemplary Communities (due primarily to the presence of rare subalpine fir forest communities at higher elevations) and Critical Summits (by nature at higher elevations), with smaller overlaps with Endangered/Threatened/Special Concern Species and Lakes/Ponds/Estuaries. The remaining ten resources have the bulk of their overlapping acreage in the lowest wind classes, with very little acreage (<5%) in the middle wind classes (3 and 4).

Discussion: *As we move forward with wind developments at lower wind speeds across a broader range of habitats, the focus of potential impacts is likely to shift from specific habitats at high elevations to different resource values like the ones included in this analysis that are found more widely across the landscape at lower elevations (e.g. streams, IWWH).*

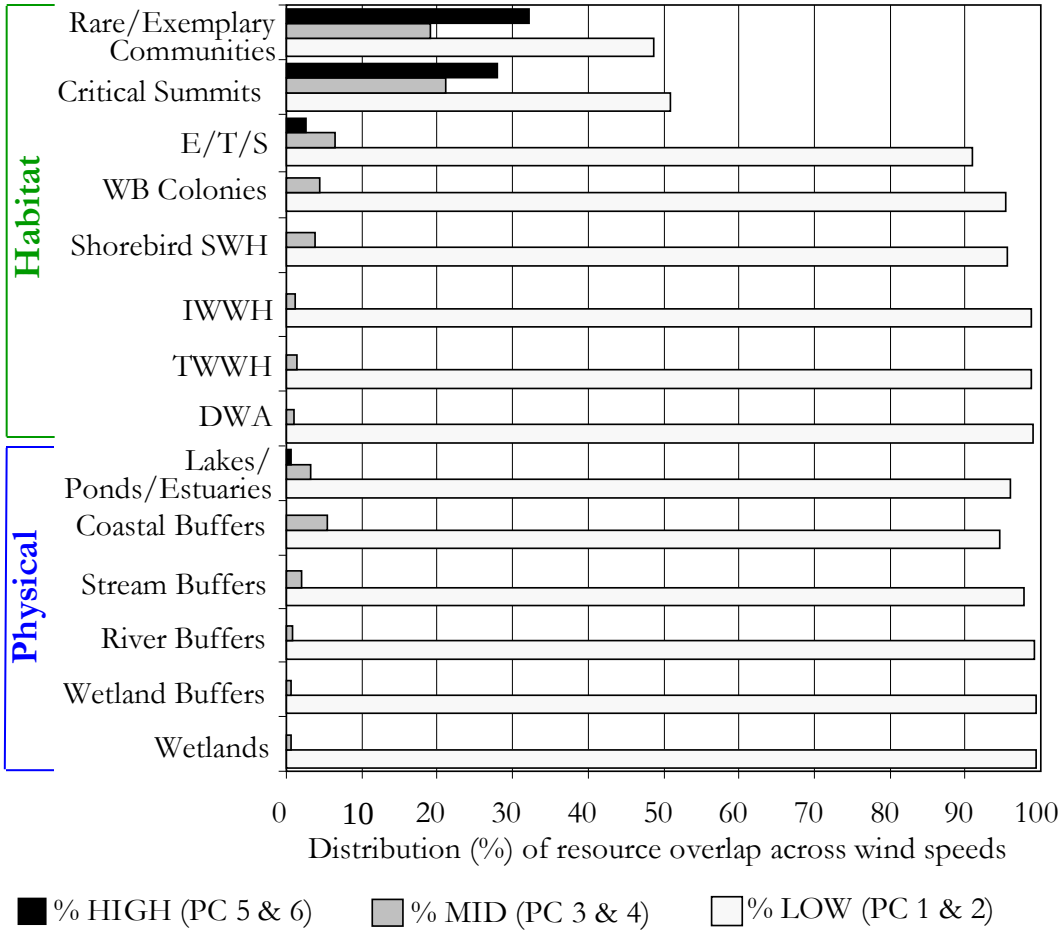


Figure 7. Percent of acres of TI wildlife resource values overlapping the modeled wind base across different wind power classes.

TI Wildlife Resources and Expedited/ Non-expedited Areas

Results: TI acreage that overlaps the modeled wind base is disproportionately split between the expedited and non-expedited areas, with 11% of the expedited area overlapping TI values compared to only 6% of the non-expedited area. This means that almost twice as many acres in the expedited area overlap with TI values compared to the Non-expedited Area (60,380 acres vs. 34, 850 acres).

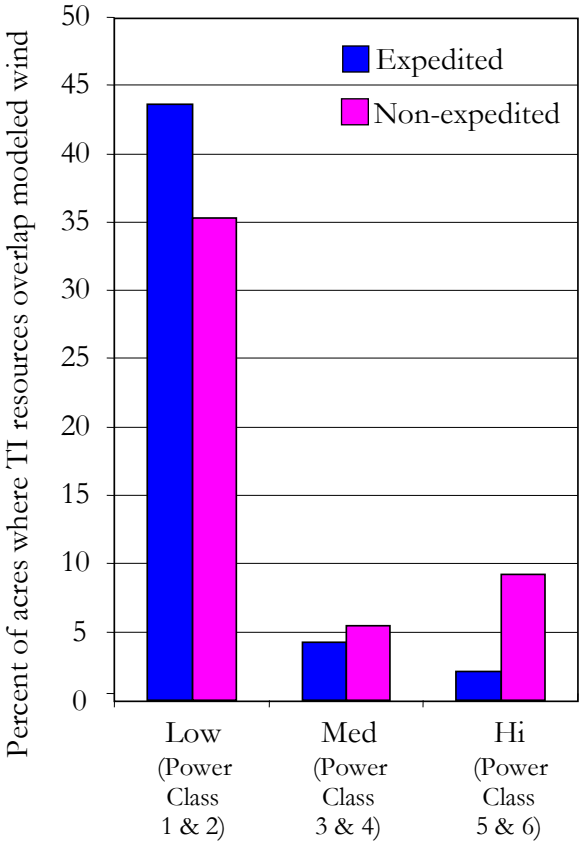


Figure 8. Distribution of TI acreage overlapping the modeled wind base in expedited and non-expedited areas across wind power classes.

Most of the wind base overlapping TI wildlife resources in both expedited and non-expedited areas is in the lowest wind speeds (Power Class 1 and 2) (Figure 8). However, the majority of overlap at higher wind speeds (Power Class 5 and 6) is in the non-expedited Area, likely due to more land at higher elevation compared to the expedited area.

Looking at each TI natural resource value in the two areas (Figure 9), six have a much larger percentage of their acreage in the expedited area (more than 80%). Seven others have between 50-70% of total overlap in the non-expedited area. The wind base overlapping Rare/Exemplary Communities is the only wildlife resource with a higher percentage of its acreage (57%) in the non-expedited area.

Discussion: *All of the TI resources included in this analysis have the potential to intersect with wind developments in both the expedited and non-expedited areas, in all categories from low to high elevation and low to high wind speeds. As might be expected, coastal resources, certain water resources and water-based habitat resources overlap more extensively with wind resource in the lower elevation expedited area, while Rare/Exemplary Communities are more common in the non-expedited area. Each of these resources will need special care to ensure wind projects do not cause site-specific or cumulative adverse impacts.*

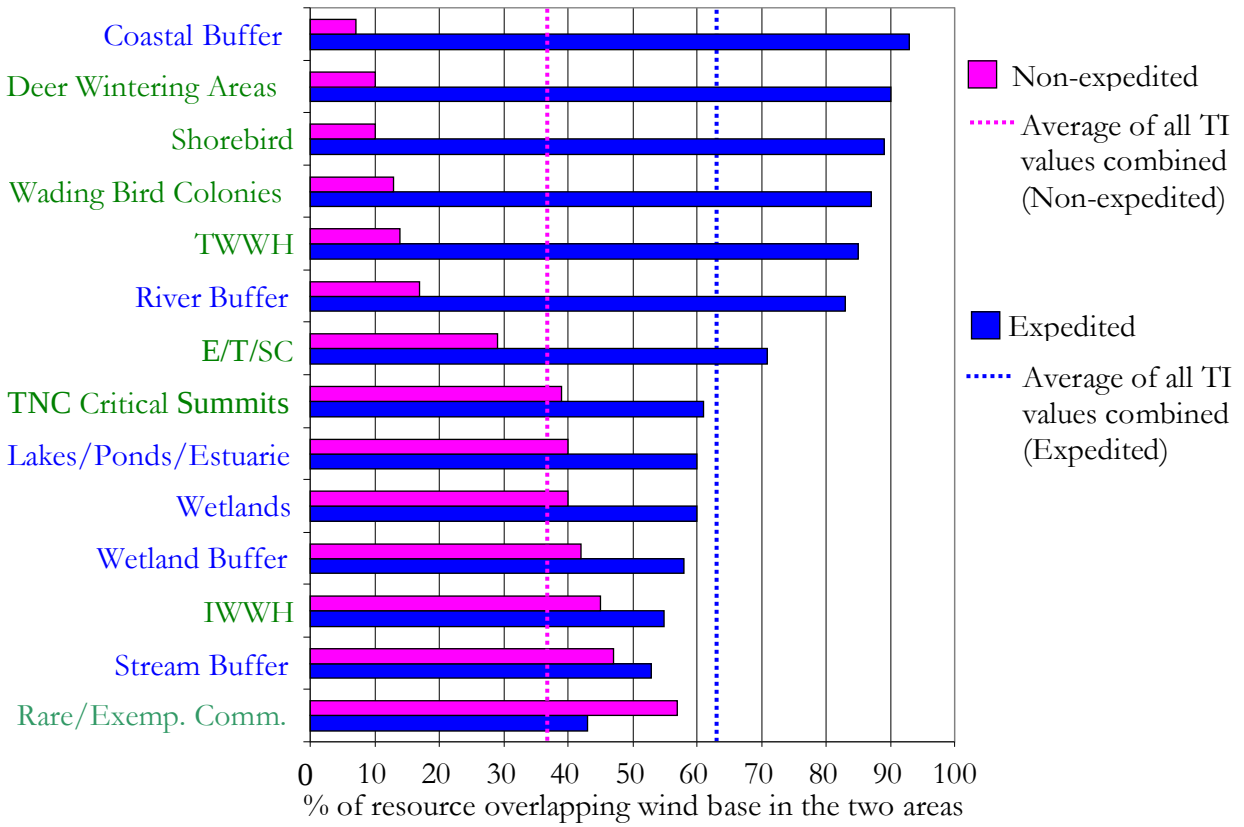


Figure 9. Comparison of TI Natural Resources overlap with the wind base in expedited and non-expedited areas.

Tier II Wildlife Resource Values

Results: Tier II wildlife resource values cover larger areas than TI values, have been mapped on a coarser scale and are closely linked to both habitat and physical characteristics in the environment. BwH Focus Areas overlap with almost 80,000 acres (7%) of the wind base (Figure 10) and BwH Connectors add a few thousand more acres to this total (another 0.3% of the wind base). Modeled Bicknell's Thrush (BITH) habitat overlaps with 28,000 acres (about 2.5% of the wind base).

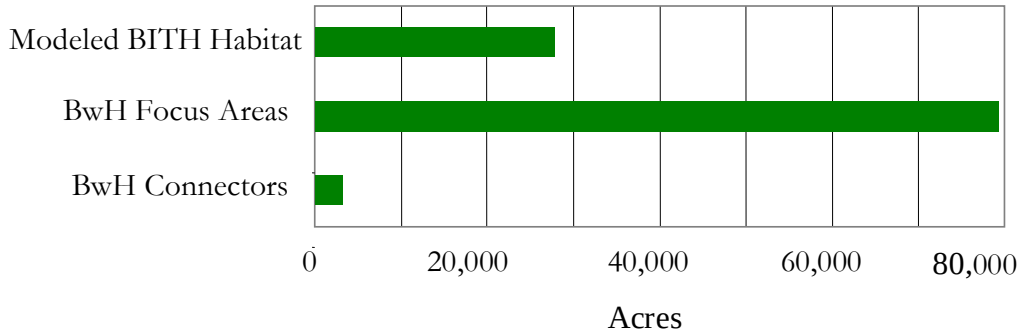


Figure 10. Acres of overlap with the wind base for each of three Tier II mapped wildlife resource values.

An illustration of how the TII values play out in Sandy River Plantation (Figure 11) shows how some of the larger scale blocks of TII habitat overlap with the wind base.

Looking at how the different TII wildlife resource values fall out in terms of overlap with different wind speeds, acreage is again disproportionately weighted in the low wind power classes (Figure 12). Modeled BITH Habitat is the only TII value that has more of its acreage in the highest rather than the lowest wind power classes, which makes sense given that their primary habitat is at higher elevations.

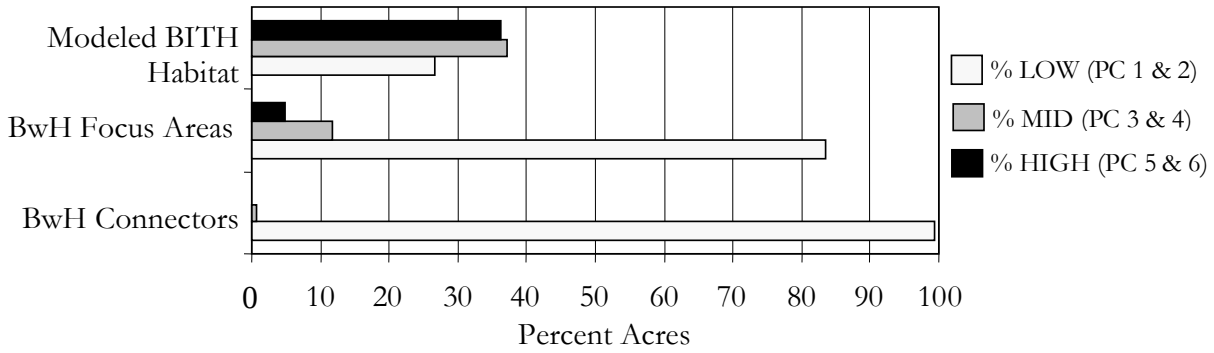


Figure 12. Percent of acres of TII natural resource values overlapping the modeled wind base across different wind power classes.

Comparing the TII wildlife resource values in the expedited and non-expedited areas, modeled BITH Habitat is much more abundant in the non-expedited area, with 68% of its area (19,000 acres) in the wind base in the non-expedited area (Figure 13). Due to the rarity of this species and its limited endemic range in New England, significant acreage of potential habitat could be vulnerable to impacts from wind development in this high elevation habitat.

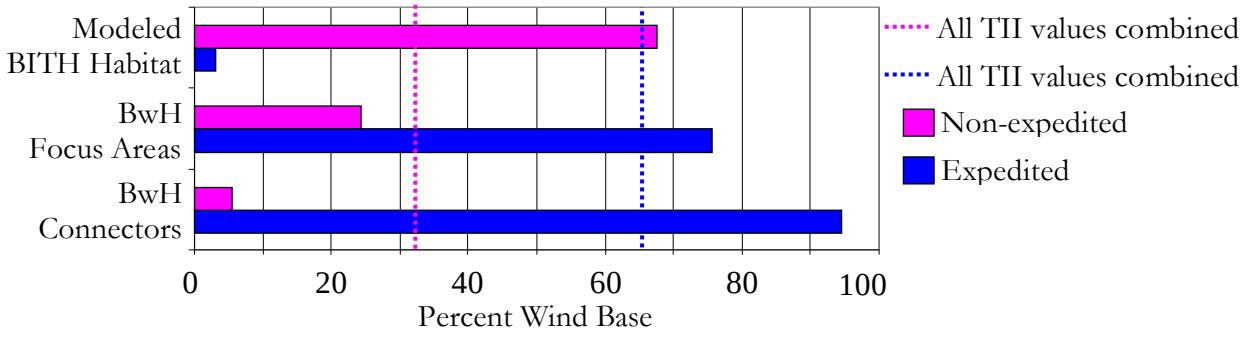
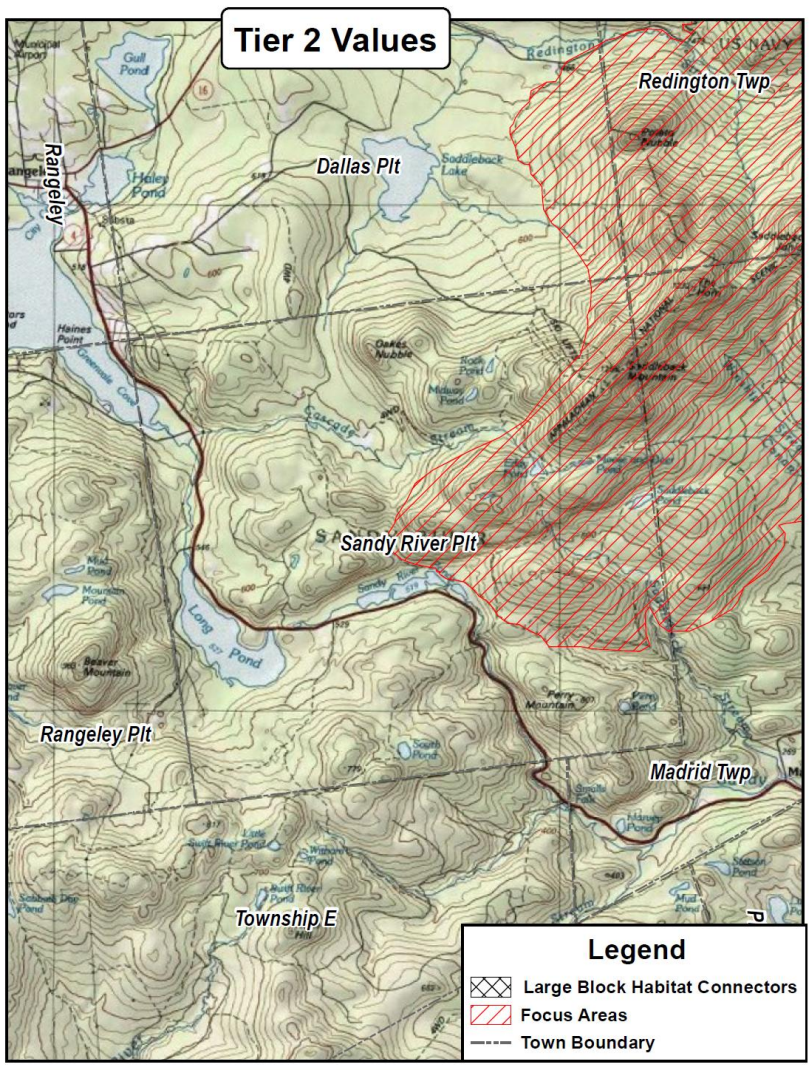
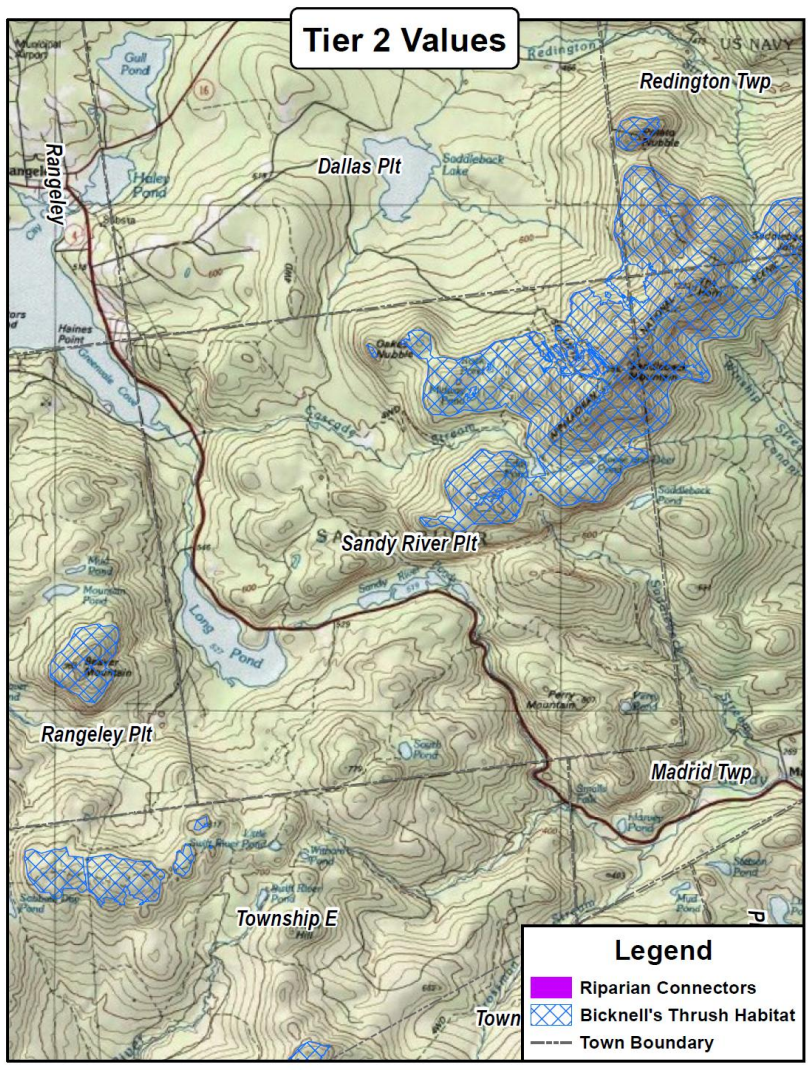
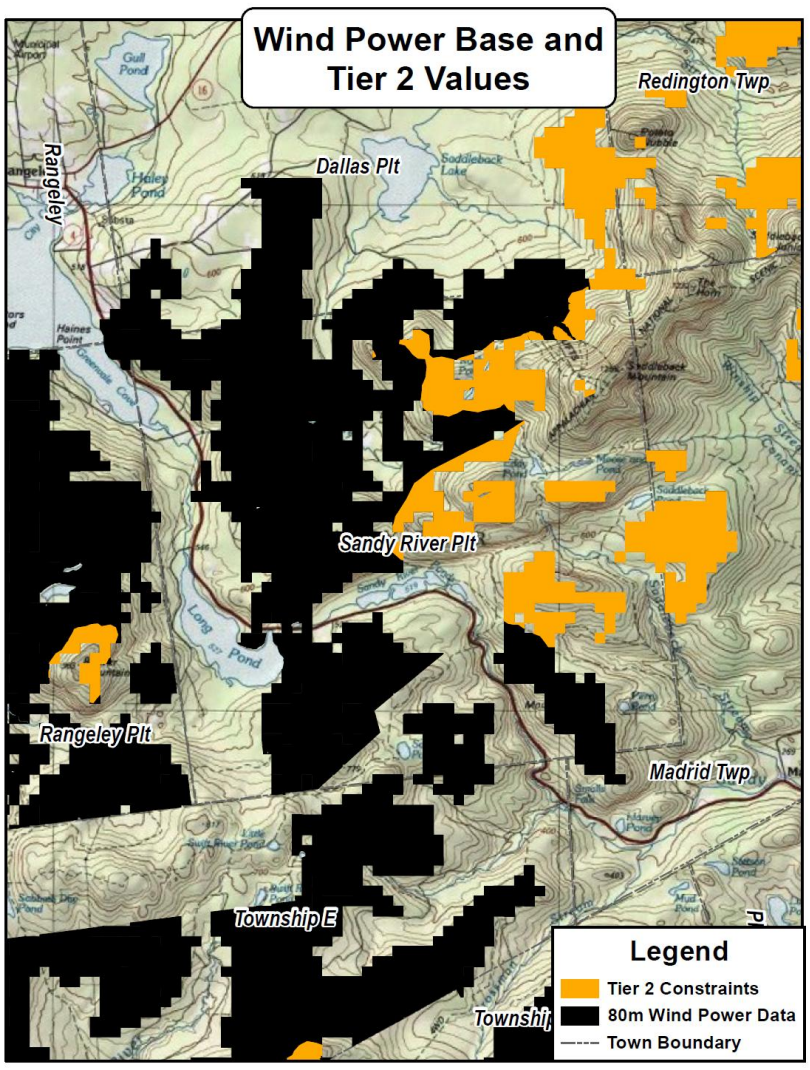
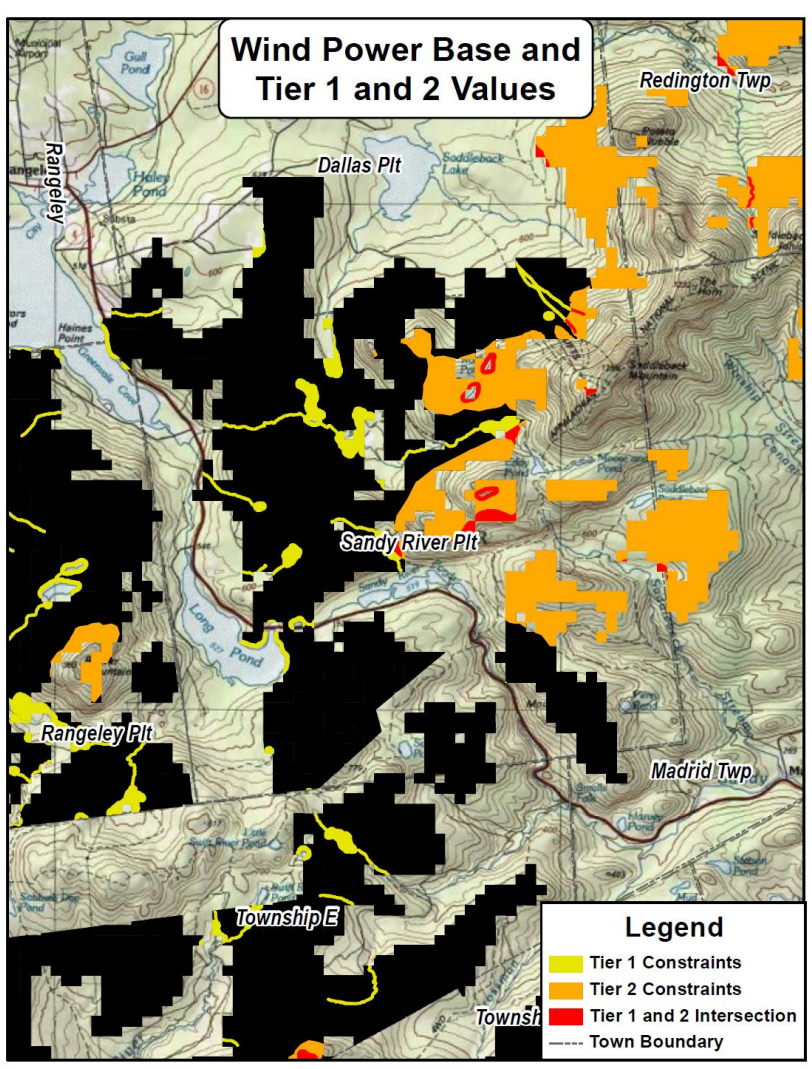


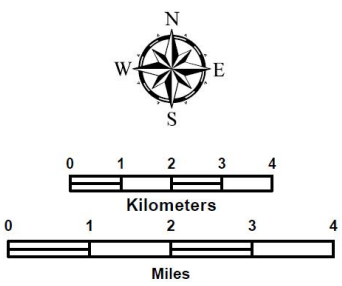
Figure 13. Comparison of % of TII natural resource overlap with the wind base in expedited and non-expedited areas.











Data Sources: Appalachian Mountain Club; AWS Truewind; First Wind; Maine Department of Inland Fisheries and Wildlife - Beginning With Habitat Program and Natural Areas Program; Maine Office of GIS; National Geographic Society; Natural Resource Council of Maine; New York State Energy Research & Development Authority; Sustainable Energy Advantage; US Department of Inland Fisheries and Wildlife; US Geological Survey; Vermont Institute of Natural Sciences.

Projection: NAD83, UTM Zone 19N, meters.

THIS MAP IS NOT INTENDED FOR SITE-SPECIFIC PLANNING.

MAINE AUDUBON

Maine Wind Analysis Project

Figure 11
Wind Power Data
Tier 2 Resources Breakdown
Sandy River Plantation

November 2012

Discussion: *BwH Focus Areas and BwH Connectors may be vulnerable to impacts from development at less windy sites, as has been more common in Maine in recent years. At the same time, because these wildlife resource values are mapped on a broader scale, there may be more flexibility to develop wind in some of these areas but maintain and conserve high value wildlife and wildlife habitat. For example, development could be steered to the edge of a large block of habitat, to existing roads or infrastructure or be designed to bypass key habitat components. However, Maine Audubon remains highly concerned about the potential impacts from wind on Bicknell's Thrush and opposes the development of roads or turbine pads in active BITH breeding habitat due to its rarity and vulnerability. Fortunately, BITH breeding habitat is now presumed to be adversely impacted by wind projects unless proven otherwise (updated Maine Wind Energy Act, 2013), making this habitat much less vulnerable than in the past.*

Combined TI and TII Wildlife Resource Values and the Remaining Wind Base

Results: One goal of the current analysis is to see how much of the modeled wind resource did *not* overlap with mapped wildlife resource values. To assess this, we did one final overlay of TI and TII wildlife resource values. The resulting map (Figure 14) shows areas with TI wildlife resource values (yellow), TII wildlife resource values (orange) and TI and TII resource values combined (red) overlapping the modeled wind base (black).

The total acreage of the modeled wind base that overlaps TI or TII wildlife resource values (or the two combined) is approximately 177,000 acres (Table 1) or approximately 16% of the total modeled wind base. Almost two thirds of this acreage is located in the expedited area. Only 11% of the wind base in the non-expedited area (64,100 acres) overlaps with high-value wildlife resources in this analysis, compared to 21% of the wind base (112, 800 acres) in the expedited area. This leaves 418,160 acres of wind base without TI or TII overlap in the expedited area, and 515,330 acres without overlap in the non-expedited area.

Table 1. Acreage of the wind base remaining after areas overlapping with TI and TII wildlife resource values have been removed.

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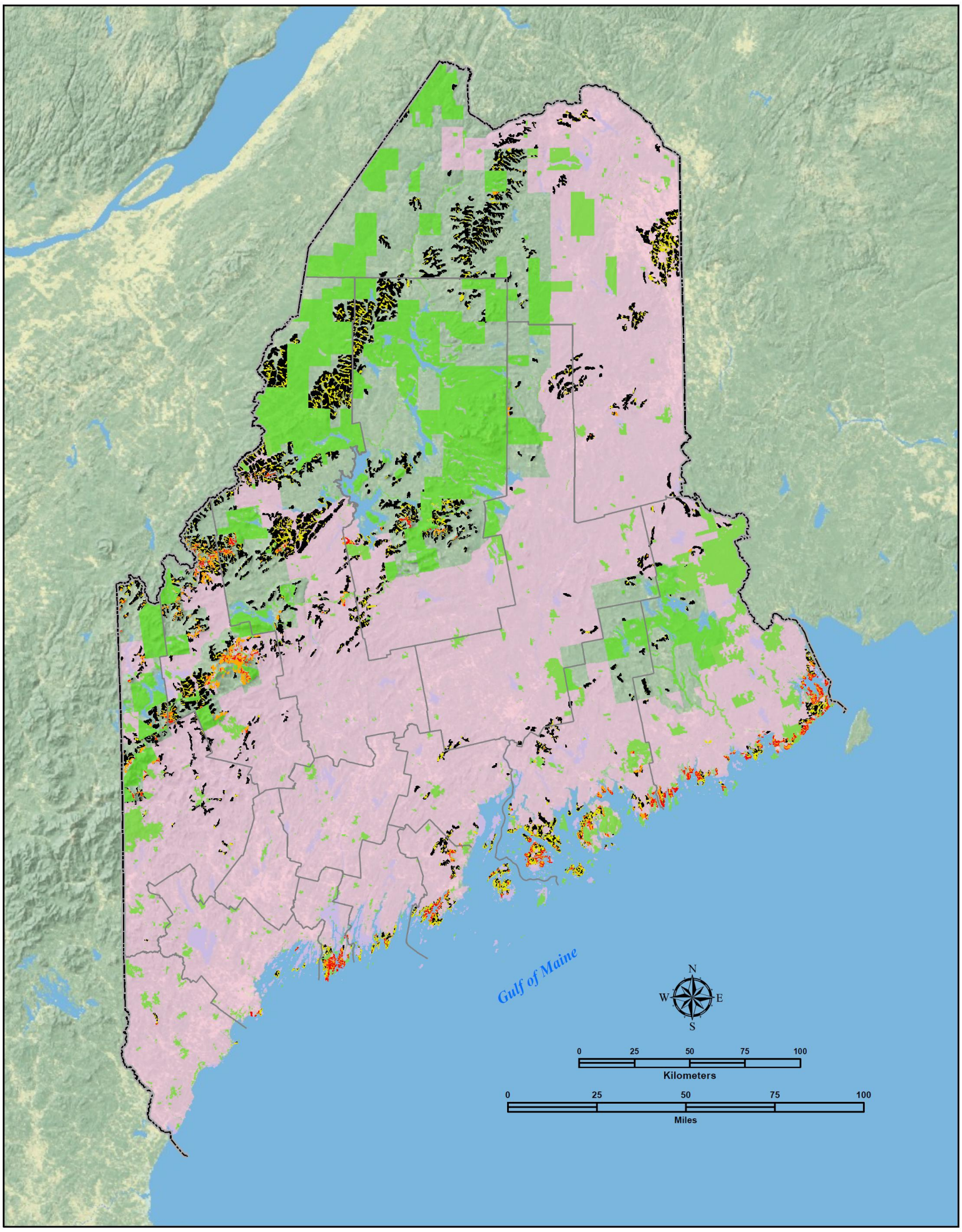
Category	Total	Expedited	Non-expedited
Starting Wind Base (acres)	1,111,780	531,692	580,084
Tier I Acreage (% of wind base)	95,230 (9%)	60,378 (11%)	34,853 (6%)
Tier II Acreage (% of wind base)	102,870 (9%)	68,440 (13%)	34,427 (6%)
Acres of TI and TII Overlap (% of wind base)	21,130 (2%)	15,980 (3%)	5,150 (1%)
TI and TII Total Combined Acreage (% of wind base)	176,970 (16%)	112,800 (21%)	64,100 (11%)
Acres of Wind Base Remaining With No TI or TII Overlap* (% of wind base)	**933,490 (84%)**	**418,160 (79%)**	**515,330 (89%)**

*Note that this acreage is slightly less than the starting wind base acreage minus the TI/TII totals because additional small, isolated polygons of the wind base were removed during analysis. Refer to page 5 for further explanation of methods.



Legend

- Tier 1 Values
- Tier 2 Values
- Tier 1 and 2 Intersection
- 80m Wind Power Data
- Conservation Lands
- Expedited Wind Permitting Areas
- State Boundary
- County Boundary

Data Sources: Appalachian Mountain Club; AWS Truewind; First Wind; Maine Department of Inland Fisheries and Wildlife - Beginning With Habitat Program and Natural Areas Program; Maine Governor's Task Force on Wind Power Development; Maine Office of GIS; National Geographic Society; Natural Resource Council of Maine; New York State Energy Research & Development Authority; Sustainable Energy Advantage; US Department of Inland Fisheries and Wildlife; US Geological Survey; Vermont Institute of Natural Sciences.

Projection: NAD83, UTM Zone 19N, meters.

THIS MAP IS NOT INTENDED FOR SITE-SPECIFIC PLANNING.

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Maine Wind Analysis Project

Figure 14
Wind Power Data
Tier 1 and 2 Resources Overlay

November 2012

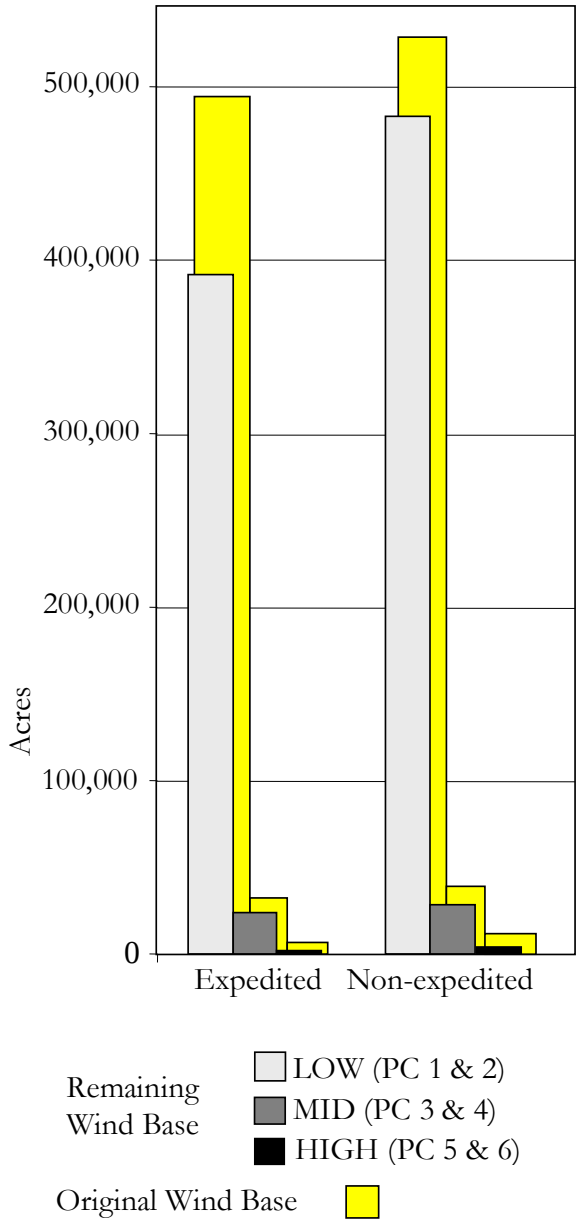


Figure 15. The acreage of wind base remaining in different power classes (grays) after removing TI and TII Natural Resource Acreage from the original wind base (yellow).

Results: Across different wind speeds, the reduction in the wind base was greatest, proportionally, in the highest wind power classes (Fig. 15), with reductions of 64% and 67% in the expedited and non-expedited areas respectively. In other words, the wind base remaining in these two areas was reduced by about two-thirds when TI and TII areas were removed from the starting wind base. In the expedited area, this was a reduction from 6,070 acres to 2,160 acres. In the non-expedited area, this was a reduction from 11,510 acres to 3,790 acres. The highest wind classes have the most overlap with the wildlife resources evaluated in this analysis, in terms of the proportion of acreage overlap.

However, in total acreage, the lowest wind power classes had the greatest total overlap, with just over 100,000 acres in the exedited area and almost 50,000 acres in the non-expedited area. Still, even with those reductions, the wind base remaining in the lowest power classes remains signficantly larger than all the other power classes combined.

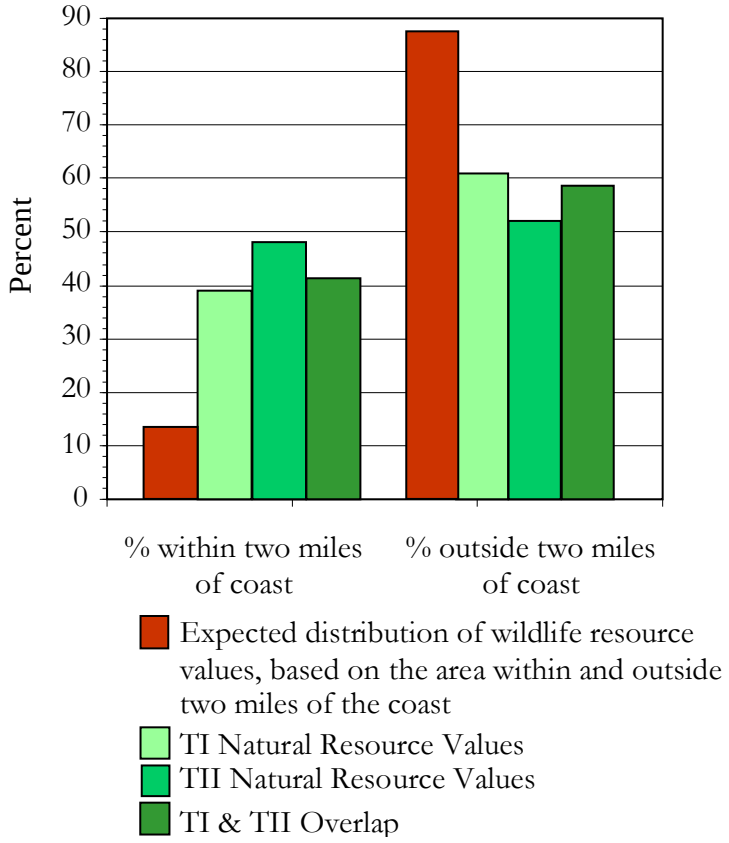
Discussion: There appears to be substantial acreage of the wind base across the state that does not overlap with the high-value wildilfe resources analyzed in this study. Site –specific review in these areas may reveal further wildife issues and potential impacts. Nonetheless, given the relatively small acreage of wind base actually overlapping wildlife resources, the best approach to wind development, from the perspetive of wildlife and wildlife habitat, would be to avoid these areas if at all possible. If areas cannot be avoided, then minimizing impacts will be critical.

The Wind Base and Coastal Areas

Results: Anyone who has spent time on a beach or rocky point in Maine knows that the coast is windy by nature. Approximately 13.5% of the wind base (150,000 acres) is located within two miles of estuaries and the coastline, though this area comprises only 7% of the land base of Maine. Both

TI and TII wildlife resource values are disproportionately high in this coastal area, as illustrated in Figure 14. It is especially notable on this map how much of the red areas (areas where TI and TII resources overlap) occur along the coast. This same information is quantified in Figure 16, which shows the expected distribution of TI and TII values (based on the area within and outside two miles of the coast) compared to the actual distribution of the three different levels of Natural Resource values we analyzed (TI only, TII only, and the two combined).

Figure 16. Distribution of wildlife resource values within and outside of the two mile coastal area.



Discussion: *All of the wind base along the coast falls in the expedited area, but any on-shore wind development in this area will likely face major challenges, based on proximity to more people, impacts to property values, scenic values of coastal land, and possibly more organized opposition. The coastal area stands out as having a high amount of overlap between the wind base and the wildlife resource values we analyzed. In addition, of particular concern is the possibility of wind projects along the coast intersecting with bird migration pathways. Although we do not have good migratory bird data across the state, it is well known that Maine's coastline is a primary pathway. Wind developments in this part of the state will have a higher likelihood of intersecting those resources and should be especially carefully sited.*

Theoretical Build Out

After removing the acreage where the wind base overlaps with the wildlife resources we analyzed, we developed several build-out scenarios illustrating how much capacity we might be able to capture in wind development on the landscape in both the expedited and non-expedited areas (Table 2).

We estimated this by multiplying the acreage remaining in the wind base in the two different areas (expedited and non-expedited) by three different factors of potential wind power generation. The analysis for the Governor's Task Force used an estimate of 7.5 MW/km^2 to estimate capacity within the wind base. We asked several wind developers if there was a way to refine this number based on current wind projects in Maine, but they were either unwilling to comment or advised us to stick with the 7.5 MW/km^2 estimate.

Recognizing that there are many factors, most immeasurable, that may make wind development more or less efficient (in terms of more turbines/acre), we multiplied the acreage of the remaining

wind base (converted to km^2) by 6, 7.5 and 9 in order to include a more liberal and a more conservative estimate of potential capacity. We also analyzed four different scenarios for wind, from the most developed (100% of the remaining wind base developed, a very unlikely scenario) down to more realistic scenarios of 25-15% of the available wind base developed (Table 2).

Estimate of Power Generation	**Total MW Capacity**			
	% of Wind Base Developed			
	100%	50%	25%	15%
Expedited				
6 MW/km^2	10,179	5,090	2,545	1,527
7.5 MW/km^2	12,714	6,357	3,179	**1,907**
9 MW/km^2	15,257	7,629	3,814	2,289
Non-expedited				
6 MW/km^2	12,539	6,269	3,135	1,881
7.5 MW/km^2	15,661	7,831	3,915	2,349
9 MW/km^2	18,794	9,397	4,698	2,819

Table 2. Potential capacity build out scenarios in Expedited and Non-expedited Areas, after areas where the wind base overlaps with analyzed wildlife resource values have been removed. MW capacities based on three different estimates of power generated per square kilometer, and four different levels of development.

The state has set a goal of achieving 3,000 MW of land-based wind power capacity by the year 2030. Part of our objective with this analysis was to see if this goal could theoretically be achieved without overlapping the acreage where major wildlife resource values occur. Currently, we have roughly 650 MW of wind capacity either installed, under construction, or permitted. We have another 64 MW currently under review at DEP, and roughly 500 MW in development and far enough along in the pipeline to have either a corporate field office near the site, met towers in place, or information about the project posted online. Assuming permits are approved for all projects in development or under review, the total capacity is approximately 1,200 MW. We need to find another 1,800 MW of capacity to meet the state's goal for 2030.

For this analysis, if we concentrate all future wind development in the expedited areas away from the wildlife resource values analyzed in this report, it appears we will have to develop roughly 15% of the remaining wind base to meet the 3,000 MW goal the State has set. Assuming the capacity of all future turbines is at least 3 MW, this means we will need another 600 turbines across the landscape, or three times as many as we have in Maine today. That would bring the total developed wind base close to about 25%, with around 900 turbines across Maine.

Given an average project size of 25 turbines, that translates into another 24 wind development projects coming online in the next 18 years to meet the goal of 3,000 MW capacity by 2030, or at least three new projects approved every two years. This analysis shows there is substantial acreage of the wind base in the expedited area alone that could be developed without overlapping with the wildlife resource values we have analyzed in this report, values that are core to Maine Audubon's mission to protect wildlife and wildlife habitat.

Discussion*: Siting wind projects is a long and complex process that requires consistent wind, willing landowners, support of local communities, adequate distance from existing development, roads, infrastructure and feeder lines to the grid, and an assessment of impacts to scenic values, among many other things, to even get started. While we understand this complexity, and the need for flexibility as projects move forward, we also believe the locations of the wildlife resource values analyzed here should be evaluated and avoided during the early stages of project development. Maine Audubon believes it is possible to both protect wildlife and wildlife habitat and develop renewable energy. Siting the latter with the former in mind is critical.*

Summary and Conclusions

This project analyzed the overlap of wildlife resource values with a modeled wind base for the State of Maine, in order to 1) evaluate areas of the state that are most (and least) appropriate for wind development, from the perspective of wildlife and wildlife habitat, and 2) assess what a full build-out of 3,000 MW of wind power capacity on the landscape of Maine might look like as we move forward to meet that goal.

We estimate there are 1,111,770 acres available for wind power development, based on models of viable wind power class. We recognize that the model may identify some land as windy that may in fact not be windy enough for power generation. On the flip side, we know that several existing projects in Maine are built in places with little or no "modeled" wind. We assume for the purpose of this analysis that these two factors will balance each other out.

Most of the wind resource on Maine's landscape (92%) is in the lowest Wind Power Classes (300-500 W/m^2). These areas are now more likely to be developed for wind, due to changes in technology like taller towers and longer blades that make low wind economically viable. Most of the highest Wind Power Classes (65% of the wind base with >700 W/m^2) occur in the non-expedited area, and are comprised largely of high elevation mountain areas in northern and western Maine.

The wildlife resource values we analyzed were scattered across the state, from high to low elevations and from high to low wind power areas. All wildlife resources have some overlap with the wind base, though the physical natural resources values (directly related to water, like coastal buffers and wetland buffers) tend to be more abundant and have more overlap than the habitat-related values. Rare/Exemplary Communities, Critical Summits and Modeled Bicknell's Thrush Habitat all have significant overlap with the highest wind power classes. All other natural resource elements have the majority of overlap with low wind power classes.

It is clear that a broad array of wildlife resource values overlap with the modeled wind base, with 16% of the wind base, or 176,970 acres, overlapping with at least one natural resource value analyzed in this study. Levels of protection vary for each of these natural resource values. About 60% (112,800 acres) of the overlap is in the expedited area. The coastal part of the state also stands out as an area high in both wildlife resource values and wind, mostly in the lowest Power Classes. Although the standards for natural resource protection are the same in both expedited and non-expedited areas, standards for scenic impacts are higher in the non-expedited area, and any wind development in the non-expedited area would require an additional step of rezoning before LUPC.

When siting and permitting wind power projects, Maine Audubon recommends following the same approach that is used when evaluating wetland projects – i.e. first avoid valuable natural resources; it

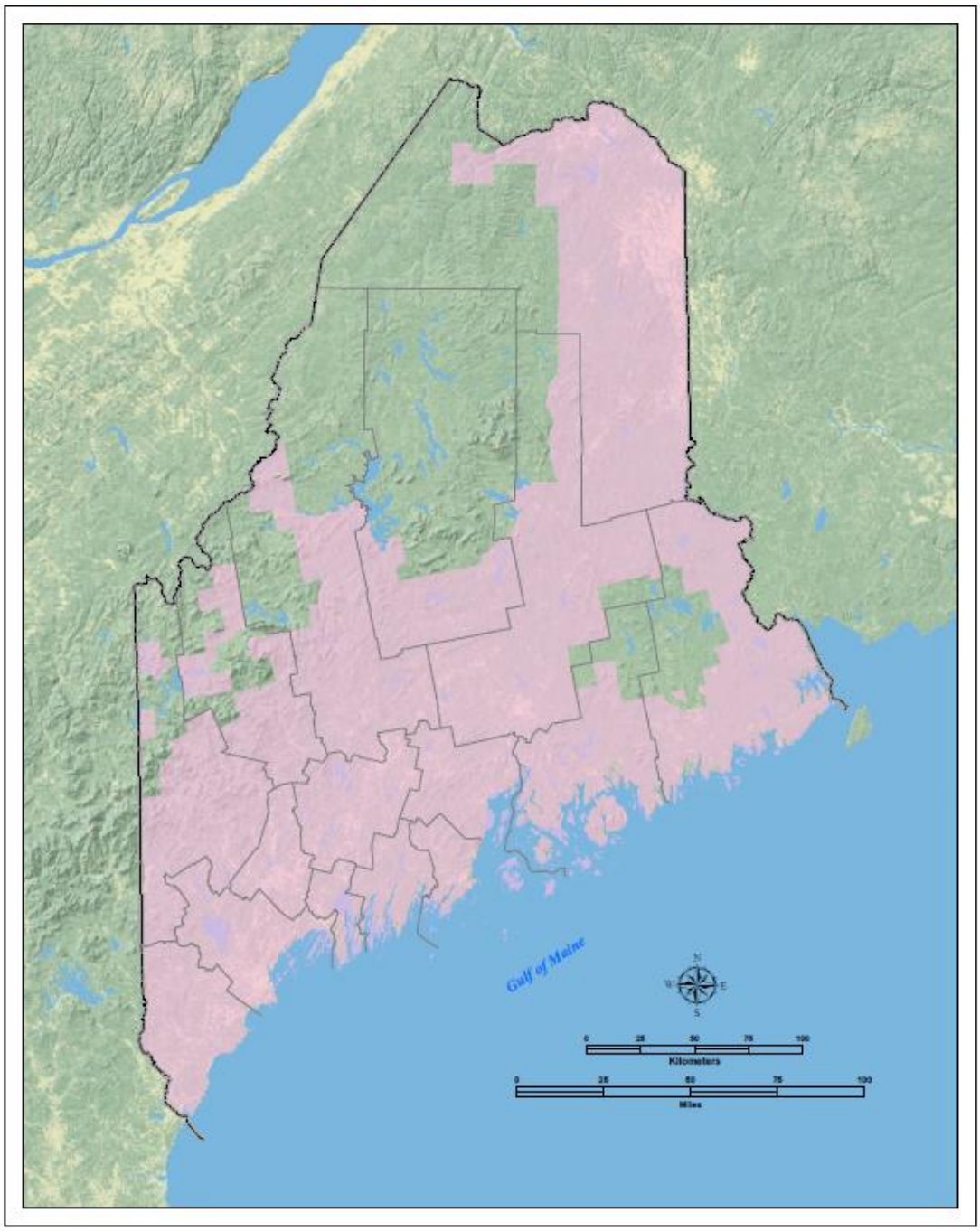
that's not possible, then minimize impacts to natural resources; and finally, if impacts cannot be avoided or minimized, mitigate for all impacts. Based on this analysis, Maine Audubon believes most areas where wind resources overlap with wildlife resources can and should be avoided during wind power development and siting. In some cases, this may mean siting a project on the landscape away from all natural resources; in other cases it may mean moving certain turbine pads or sections of roads and transmission lines to avoid these areas at the development site.

Most of the modeled wind base (84% or 933,490 acres) has no overlap with the wildlife resources analyzed in this study. Although overlap with natural and other resource values not mapped here (like migration corridors, new endangered species locations, scenic values, recreation values, etc.) are likely to occur within these areas, there appears to be adequate wind base on the landscape for potential development with minimal impact to the wildlife values analyzed here. All elements of wind development project impacts still need to be evaluated on an individual basis, but starting with a project that avoids the key wildlife resource values analyzed here is critical to siting that will likely avoid undue adverse impacts to natural resources and move through the permitting process with greater certainty.

We estimate that development of about 15% of the wind base is needed to meet the goal set in the Wind Energy Act. Based on current permitted projects, which now total almost 300 turbines, we expect this would mean another 600 turbines on the landscape, or three times as many as we have in Maine today (based on current technology). Given an average project size of 25 turbines, that translates into another 24 wind development projects coming online in the next 18 years to meet the goal of 3,000 MW capacity by 2030. Ideally new projects would be concentrated in the expedited area, away from high natural resource values.

Appendix A. Wind Projects in Maine as of June 2012

Project	MW	# Turbines	Status	Developer
Mars Hill	42	28	Operational 2007	First Wind
Beaver Ridge	4.5	3	Operational 2008	Beaver Ridge Wind
Stetson Ridge	57	38	Operational 2009	First Wind
Vinalhaven	4.5	3	Operational 2009	Fox Island Wind
Stetson II	25.5	17	Operational 2010	First Wind
Kibby Mountain	132	44	Operational 2010	TransCanada
Rollins	60	40	Operational 2011	First Wind
Spruce Mountain	20	10	Operational 2011	Patriot Renewables
Bull Hill	34.6	19	Operational 2012	First Wind
Record Hill	50.6	22	Operational 2012	Independence Wind
Hancock	54	18	Permitted July 2013	First Wind
Sisk Mountain	33	11	Appeal Unresolved	TransCanada
Saddleback Ridge	33	12	Appeal Unresolved	Patriot Renewables
Oakfield	150	50	Appeal Unresolved	First Wind
Bowers	69.1	27	Appeal Unresolved	First Wind
Canton Mountain	22	7	Under Review by DEP	Patriot Renewables
Passadumkeag	42	14	Under Review by DEP	Noble Environmental Power
Bingham	49.7	32-34	In Development	First Wind
Black Mountain	40	19	In Development	First Wind
Fletcher Mountain	60-80	Unknown	In Development	Iberdrola
Longfellow Windpark	50	Unknown	In Development	First Wind
Number Nine	350	Unknown	In Development	Horizon
TimberWinds - Dixfield	16-33	11-14	In Development	Patriot Renewables



Legend

Expedited Wind Permitting Areas

State Boundary

County Boundary

Data Sources: Maine Governor's Task Force on Wind Power Development; Maine Office of GIS; National Geographic Society; US Geological Survey.

Projection: NAD83, UTM Zone 19N, meters.

THIS MAP IS NOT INTENDED FOR SITE-SPECIFIC PLANNING.

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Appendix B
Expedited Permitting Areas
For Wind Development

November 2012

Appendix C. List of endangered, threatened and rare species in the DIFW GIS layer

Aeshna juncea, Sedge Darner
Alasmidonta varicosa, Brook Floater
Alca torda, Razorbill
Ammodramus caudacutus, Saltmarsh Sharp-tailed Sparrow
Ammodramus savannarum, Grasshopper Sparrow
Anax longipes, Comet Darner
Anthus rubescens, American Pipit
Aquila chrysaetos, Golden Eagle
Arigomphus furcifer, Lilypad Clubtail
Asio flammeus, Short-eared Owl
Bartramia longicauda, Upland Sandpiper
Bat Hibernaculum, Bat Hibernaculum
Boloria chariclea grandis, Purple Lesser Fritillary
Boloria frigga, Frigga Fritillary
Calidris maritima, Purple Sandpiper
Callophrys gryneus, Juniper Hairstreak
Callophrys hesseli, Hessel's Hairstreak
Catharus bicknelli, Bicknell's Thrush
Catocala similis, Similar Underwing
Chaetaglaea tremula, Barrens Chaetaglaea
Charadrius melodus, Piping Plover
Chlidonias niger, Black Tern
Cicindela ancocisconensis, White Mountain Tiger Beetle
Cicindela marginata, Salt Marsh Tiger Beetle
Cicindela marginipennis, Cobblestone Tiger Beetle
Cistothorus platensis, Sedge Wren
Coluber constrictor constrictor, Northern Black Racer
Cordulegaster obliqua, Arrowhead Spiketail
Coturnicops noveboracensis, Yellow Rail
Enallagma carunculatum, Tule Bluet
Enallagma durum, Big Bluet
Enallagma pictum, Scarlet Bluet
Epeorus frisoni, Roaring Brook Mayfly
Erynnis brizo brizo, Sleepy Duskywing
Euphagus carolinus, Rusty Blackbird
Falco peregrinus, Peregrine Falcon
Fratercula arctica, Atlantic Puffin
Fulica americana, American Coot
Gallinula chloropus, Common Moorhen
Gomphus quadricolor, Rapids Clubtail
Gomphus vastus, Cobra Clubtail
Gyrinophilus porphyriticus, Spring Salamander
Haliaeetus leucocephalus, Bald Eagle
Hemileuca maia maia, The Buckmoth
Histrionicus histrionicus, Harlequin Duck
Ischnura hastata, Citrine Forktail
Ischnura ramburii, Rambur's Forktail
Itame sp. 1 nr. inextricata, Barrens Itame
Ixobrychus exilis, Least Bittern
Lampsilis cariosa, Yellow Lampmussel
Lanthus vernalis, Southern Pygmy Clubtail
Lapara coniferarum, Southern Pine Sphinx
Leptodea ochracea, Tidewater Mucket
Leucorrhinia patricia, Canada Whiteface
Libellula needhami, Needham's Skimmer
Lycaena dorcas claytoni, Clayton's Copper
Lycia rachelae, Twilight Moth
Microtus chrotorrhinus, Rock Vole
Myotis leibii, Eastern Small-footed Myotis
Nycticorax nycticorax, Black-crowned Night Heron
Oeneis polixenes katahdin, Katahdin Arctic
Ophiogomphus colubrinus, Boreal Snaketail
Ophiogomphus howei, Pygmy Snaketail
Pantala hymenaea, Spot-winged Glider
Paonias astylus, Huckleberry Sphinx
Papilio troilus, Spicebush Swallowtail
Phalacrocorax carbo, Great Cormorant
Plebejus idas empetri, Crowberry Blue
Progomphus obscurus, Common Sanddragon
Rare Animal, Rare Animal
Rhionaeschna mutata, Spatterdock Darner
Satyrium edwardsii, Edwards' Hairstreak
Siphlonisca aerodromia, Tomah Mayfly
Somatochlora albicincta, Ringed Emerald
Somatochlora brevicincta, Quebec Emerald
Sterna antillarum, Least Tern
Sterna dougallii, Roseate Tern
Sterna paradisaea, Arctic Tern
Strophitus undulatus, Creeper
Stylurus spiniceps, Arrow Clubtail
Sylvilagus transitionalis, New England Cottontail
Synaptomys borealis sphagnicola, Northern Bog Lemming
Thamnophis sauritus, Ribbon Snake
Thorybes bathyllus, Southern Cloudywing
Tramea carolina, Carolina Saddlebags
Tramea lacerata, Black Saddlebags
Vertigo malleata, Malleated Vertigo
Vertigo morsei, Six-whorl Vertigo
Vertigo paradoxa, Mystery Vertigo
Williamsonia lintneri, Ringed Boghaunter
Xylena thoracica, Acadian Swordgrass Moth
Xylotype capax, Broad Sallow
Xystopeplus rufago, Red-winged Sallow
Zale obliqua, Oblique Zale
Zale sp. 1 nr. lunifera, Pine Barrens Zale
Zanclognatha martha, Pine Barrens Zanclognatha