SECTION II-D

K-SFATH-0021549

Site Selection Process

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

D. SITE SELECTION PROCESS

1. Windplant

a. Background

The concept of the NEWES Project has been to develop a utility-scale project that could capture economies of scale and also be expanded over time in response to the changing resource needs of subscribing utilities. Only in this way will wind be a meaningful contributor to the energy mix. Implementing this concept in a fashion that meets the siting challenge requires a site area that can meet four basic criteria:

- favorable and consistent wind resource;
- reasonable access to the regional transmission grid;
- compatibility with current ownership and local environmental resources and land uses; and
- sufficient space to allow expansions of the initial facility.

The site selection effort, which involved almost a year of intensive study, included both an overall assessment of broad areas within New England and a detailed analysis of specific site areas in western Maine. The result of these efforts, USW believes, is the best site area in New England which can realistically support a central-station, utility-scale windplant.

The remainder of this section reviews the site-selection process in three parts:

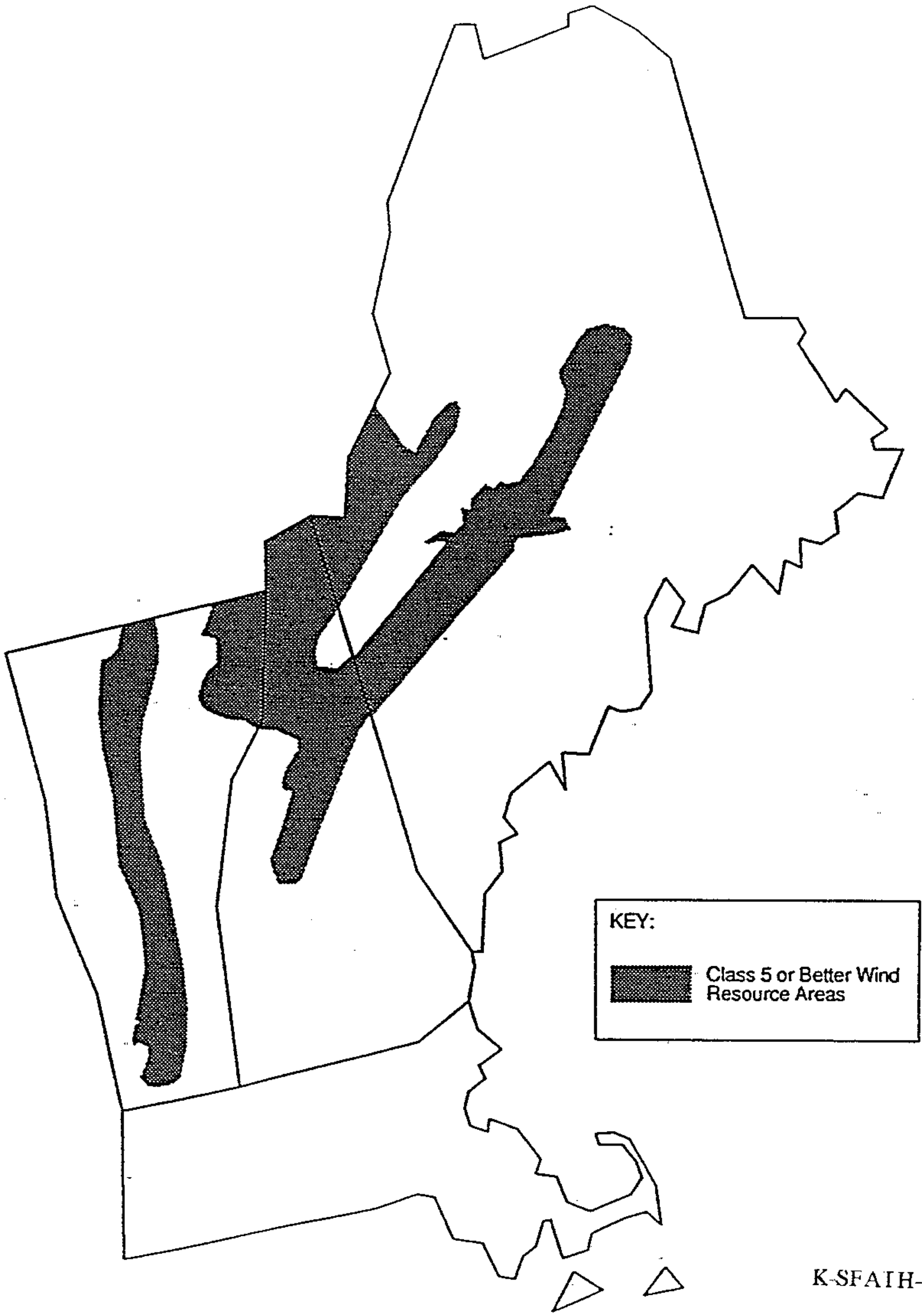
- Macro-Level Process
- Localized Area Process
- Site-Specific Alternative Process

b. Macro-Level Site-Selection Process

Rather than limiting the site-selection process to a single state or utility service area, USW first examined the entire New England region. The broad assessment of the region began with an examination of the overall nature of the wind resource.

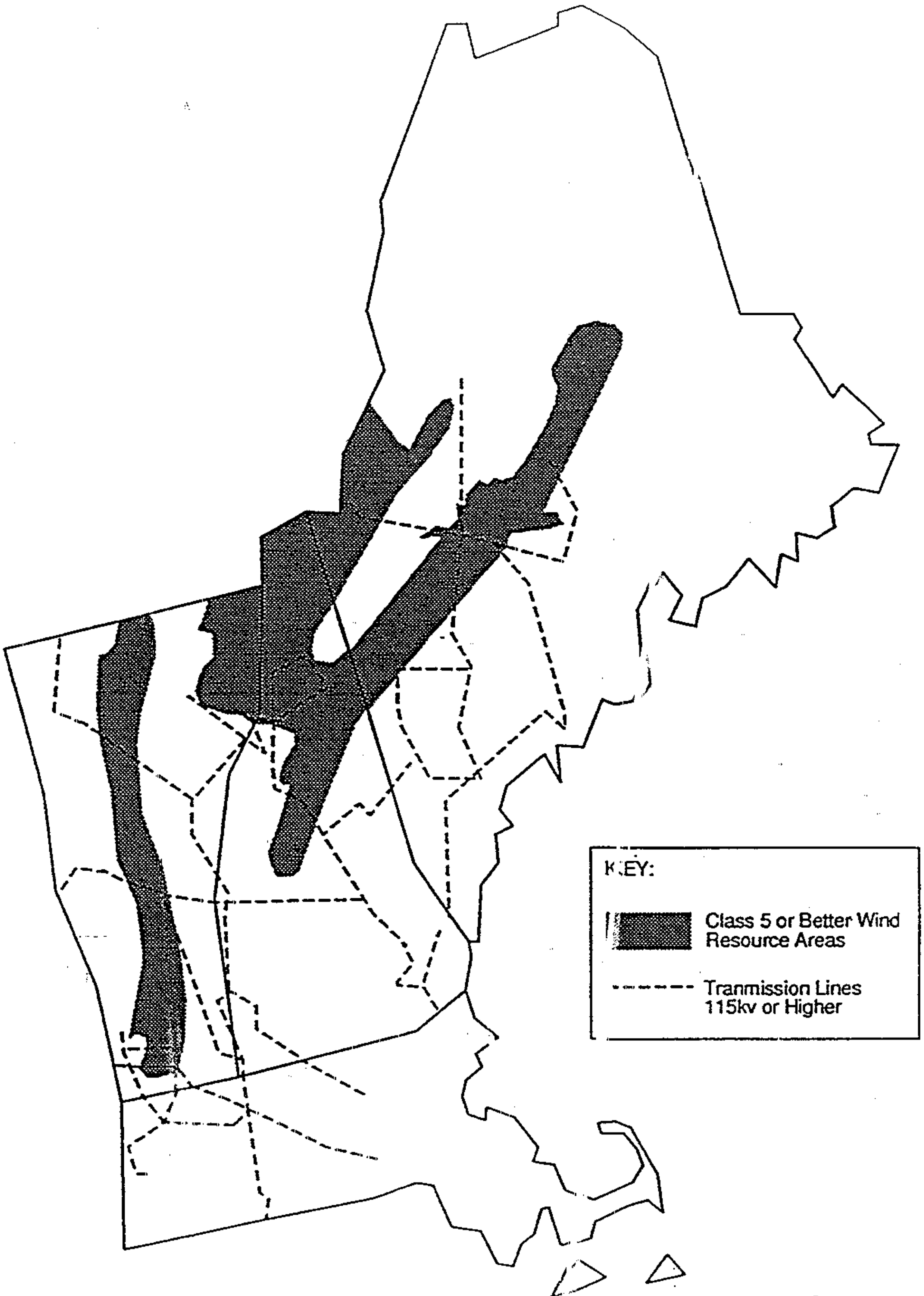
As shown on Figure II.D.-1 of this exhibit, the best wind resource in New England tends to be found in the mountainous areas of Vermont, New Hampshire, and Maine. The wind resource shown on the figure depicts Class 5 and Class 6 winds, as defined by the Pacific Northwest Laboratory of the U.S. Department of Energy (DOE). In general, the higher the Class rating, the better the wind resource, with Class 7 being the highest rating. These DOE Class designations were used as a general guide by USW meteorologists. In addition, they relied on topographical analysis, wind data from local airports and the National Weather Service, and site visits.

Next, strong wind resource areas which could be reached through the regional transmission grid were examined. As shown in Figure II.D.-2 of this exhibit, many of the best wind resource areas can be reached through transmission lines of 115 kV or larger. Perhaps the



K-SFAIH-0021555

FIGURE II.D. – 1
NEW ENGLAND WIND RESOURCE
CLASS 5 OR BETTER



K-SFATH-0021556

FIGURE II.D. – 2
CLASS 5 OR BETTER WIND RESOURCE AREAS AND MAJOR TRANSMISSION LINES

two most notable exceptions are some of the more northern areas of Vermont and New Hampshire and also north-central Maine.

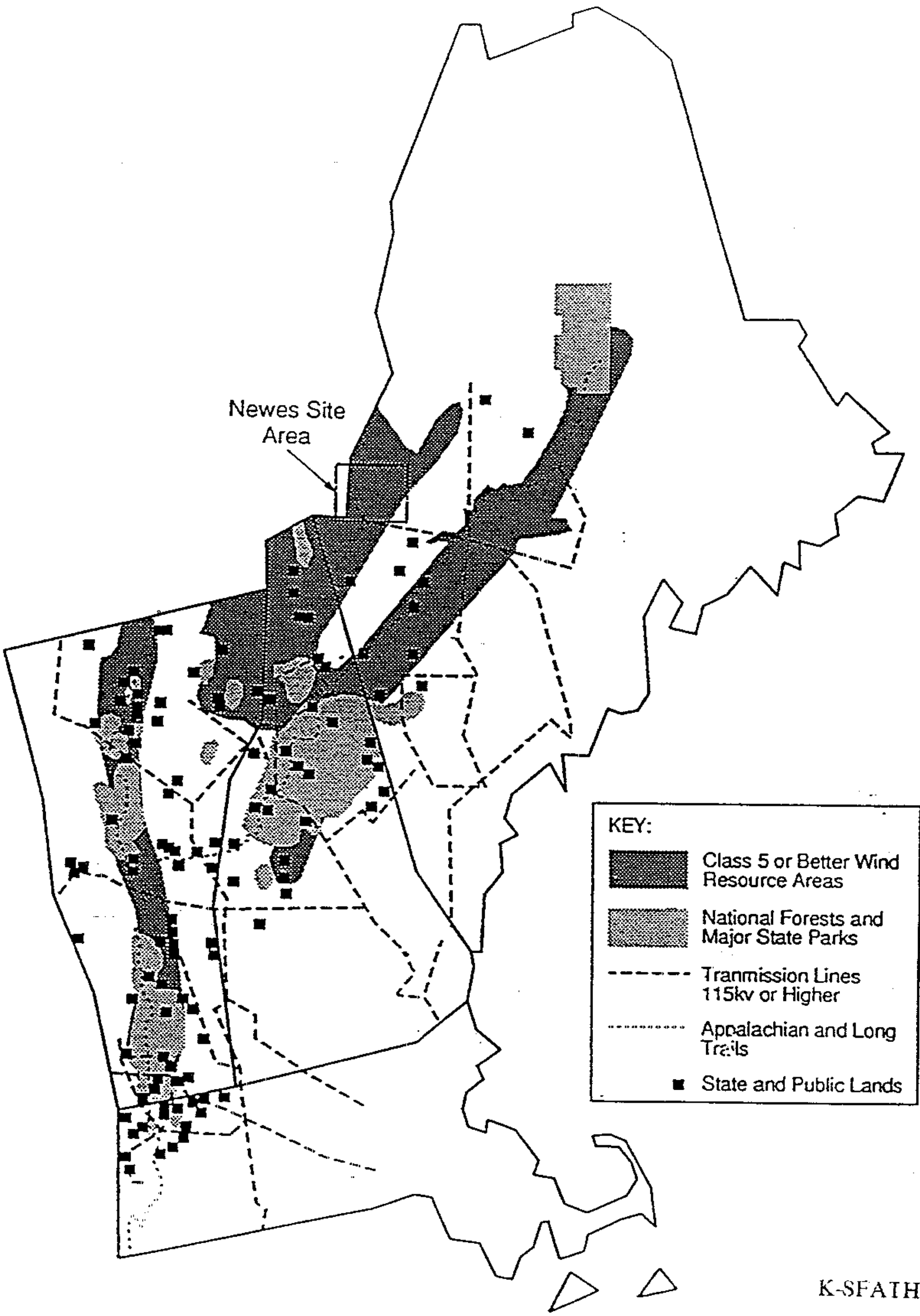
Finally, USW took into account the current land use patterns and general environmental setting of the potential sites as well as of their surrounding areas. Figure II.D.-3 shows an overlay of Figure II.D.-2 with the locations of national and state parks, major hiking trails, and large tracts of public land.

Moreover, the figure suggests a portion of Maine's strong wind resource areas may have land use patterns and environmental settings that may be incompatible with major wind projects. One of the few areas that looked promising was in western Maine, and that is where USW focused its detailed site analysis. Initial estimates placed the potential in this area of western Maine well over 500 MW.

c. Localized Site-Selection Process

There is a substantial body of literature on research and modeling of wind flow over hills, and there are certain basic features of the wind flow about which researchers concur. The Askervein Hill experiments, conducted in 1984 to 1986, sum up these basic characteristics as:

- the speed-up at the crest of the hill is approximately 180% of the undisturbed upstream wind speed, and



K-SFATH-0021558

FIGURE II.D. – 3
WIND RESOURCE, MAJOR TRANSMISSION LINES AND LAND USE CHARACTERISTICS

- a reduced wind speed (negative speed-up) occurs in the front and lee of the hill and is on the order of 20 percent to 40 percent reduction.

Based on these well established wind flow characteristics, it was apparent to USW meteorologists that higher ridgelines should be the focus of the localized site-selection process.

Within western Maine, specific promising ridge lines were identified and potential windplants were conceptualized. For each alternative windplant ridgeline, USW determined:

(1) Quality of Wind Resource

Site visits were conducted by meteorologists to examine evidence of wind potential such as flagging. Capacity and energy estimates were developed using topographical maps, information gathered during the site visits, and available wind data.

(2) Transmission Access

USW examined alternative transmission line routes for grid interconnection and impacts on local communities. Central Maine Power provided USW with estimates of interconnection cost, system upgrades, and line losses for various configurations under consideration.

(3) Site Viability

USW considered visual impacts on the Appalachian Trail, townships, public roads, and recreational areas, assessed potential for environmental impacts, and potential for local and state support by discussing possible sites with many policy makers and opinion leaders including state officials, regulators, environmental advocacy groups (Natural Resource Council of Maine, Maine Audubon, AMC, CLF) and others.

(4) Land Ownership

USW estimated the size of contiguous tracts, number of landowners, present land uses, and land values.

(5) Other Construction Related Costs

USW considered impacts of road access, local terrain, and soil conditions.

Using the above criteria, each site underwent a preliminary review. Some potential windplant areas were quickly excluded from consideration if they impacted the viewsheds of known sensitive recreational areas (such as the Appalachian Trail) or population centers.

Finally, USW developed a supply curve which graphically portrayed the megawatt capacities of individual site areas relative to estimated levelized production costs. This allowed a quantitative evaluation of trading off the benefit of a better wind resource against the cost of a more expensive transmission interconnection, or the reverse. The NEWES site area is the lowest cost site area USW examined that is also likely to be viable from an environmental perspective. It also has over 500 MW of potential wind capacity, more than enough to support the NEWES 250 MW capacity.

At the completion of this analysis, USW conducted field visits to review conditions along selected ridgetops in the area. Meteorologists considered ridge orientation, exposure, and obstructions with the result being a preliminary selection of these ridgelines encompassing the 250 MW NEWES Project.

Immediately following, USW conducted an environmental overview assessment using its consultant team to evaluate the overall suitability of the area and particular ridgelines for the Project. The result of this step was the establishment of an initial configuration for the Project, ready for detailed environmental evaluation and preliminary engineering.

d. Site-Specific Alternatives Assessment

(1) Downslope Placement of Wind Turbines

USW recognized that placement of the wind turbines off the ridgelines might result in their being less open to viewing. In addition, placement of the wind turbines off the ridges at elevations lower than 2,700 ft would move them out of the P-MA subdistricts. Therefore, USW evaluated this possibility. This was done by developing a downslope configuration for K6 through K12 which would develop the same amount of energy as the ridgeline configuration and then comparing the land use requirements and environmental impacts of the two developments which produce the same amount of energy.

(2) General Background

It is recognized that the tops of hills, ridges, and mountains have the highest wind speed and the best potential wind energy production. This is because significant speed-up occurs across the crest due to a concentration of streamlines. When wind turbines are placed along the slope of the hill below the crest, even on what is considered the windward side, the wind speed is much lower than at the crest. Consequently, the energy in the wind, which is a function of the cube of the wind speed, is greatly reduced.

With a complex series of mountains and ridges, such as in Western Maine, the presence of hills and deep valleys causes other significant changes in the wind speed. For example, upwind mountains and ridges will cause shadowing effects on their downwind partners. This shadowing or "wake" effect becomes worse with increasing distance from the top to the bottom of the hill.

Atmospheric stability conditions will also affect the wind. It is not uncommon for cold, stable air to pool in valley areas at night. This very stable pool is characterized by calm winds during the majority of the night and early morning hours.

Wind turbines, placed at elevations where this "pooling" is a common occurrence, will suffer an even greater reduction in energy output.

As part of this evaluation, four tasks were initially completed:

- Determine how many 33M-VS turbines would be needed at 2,600 feet elevation to replace the energy generated by the present layout of turbine strings K6 through K12.

- Determine how many 33M-VS turbines would be needed at 2,300 feet elevation to replace the energy generated by the present layout of turbine strings K6 through K12.

- Provide a specific alternative layout for K9 and K10 for an elevation of 2,600 feet and 2,300 feet.

- Estimate the minimum spacing needed between parallel strings sited on the same windward slope.

Because there are no site-specific measurements available in the literature to address the technical issues associated with the first two issues, these two areas must be addressed through use of numerical modeling techniques and experienced though subjective judgment.

An alternative layout of turbines was considered for K9 and K10. This layout will produce energy equivalent to the output produced by the 170 turbines in K9 and K10.

The minimum spacing needed between parallel turbine strings on the same windward slope is 15 rotor diameters or approximately 1,620 feet. This minimizes wake effects from turbine to turbine and maximizes the potential energy output.

To assess the variation of windspeed and power at the crest of Kibby Range, upwind at the 2,600 foot level, and upwind at the 2,300 foot elevation, a numerical modeling approach was selected using an industry standard model - Wind Atlas and Siting Program (Troen, Mortensen, and Petersen, 1988).

(3) Numerical Model Description

To best understand the implications of placing turbines at the 2,600 foot elevation and the 2,300 foot elevation on Kibby Range, the Wind Atlas and Siting Program (WASP) was used. Objective estimates of the change in wind speed and wind power at these two elevations versus the top of the hill were developed for wind turbine hub heights of 80 feet, 100 feet, and 120 feet.

To perform this analysis, a digitized terrain file and a histogram of meteorological data was required. The model hill was constructed with the same dimensions as a portion of Kibby Range. The characteristics of the model hill are presented in Table II.D-1.

TABLE II.D.-1

MODEL HILL CHARACTERISTICS

Elevation (above base grade)	330 meters (985 feet)
Half Height	700 meters (2,300 feet)
Horizontal Axis	360 to 180 degrees
Surface Roughness (Z_o)	0.01 (clearcut)

A histogram of meteorological data for the site, representative of the wind resource at the crest of the Kibby Range was created and used. This histogram was developed based on an assumed annual average wind speed of 20 mps (at 60 feet).

As part of this analysis, it was also assumed that sufficient trees are removed at both the hill crest and elevations of 2,600 feet and 2,300 feet to allow unimpeded wind flow. A minimum number of trees must be cleared at the hill crest to allow the wind turbines to operate properly. For the turbines installed at the 2,600 foot elevation and 2,300 foot level, the distance from any turbine to the edge of the clearing must be 10 to 15H, where H is the height of the trees.

(4) Modeling Results

The predicted annual average wind speed and available power for three different turbine hub heights as derived from the WASP model are presented in Table II D.-2.

These estimates are for hub heights of 80 feet (24.5 m), 100 feet (30.5 m), and 120 feet (36.6 m) at the crest of the hill, and at simulated elevations of 2,600 (Elevation 1) and 2,300 feet (Elevation 2).

The proposed Kibby Range turbine strings sited along the ridge crests are presented in Table II D.-3. There are approximately 170 USW 33M-VS turbines arranged in seven strings or groups. Using the maximum rating of

TABLE II.D.-2

WASP MODEL ESTIMATES OF ANNUAL AVERAGE WIND SPEED AND POWER

LOCATION	HUB HEIGHT (m)	WIND SPEED (mps)	WIND POWER (watts/Sq. Meter
HILL CREST	24.5 30.5 36.6	9.0 9.4 9.7	858 953 1033
2,600 FT. ELEVATION 1	24.5 30.5 36.6	4.9 5.6 6.2	217 263 316
2,300 FT. ELEVATION 2	24.5 30.5 36.6	5.3 5.9 6.4	235 286 341

TABLE II.D.-3

KIBBY RANGE TURBINE STRINGS

STRING NUMBER	NUMBER OF WIND TURBINES	CAPACITY (MW)
K6	17	5.6
K7	17	5.6
K8	4	1.3
K9	34	11.2
K10	13	4.3
K11	57	18.8
K12	28	9.2
TOTAL	**170**	**56.0**

K-SFATH-0021568

330 kW per turbine, this wind power plant has a capacity of 56 MW (170 x .330 MW). Assuming a conservative annual capacity factor of 28%, this 56 MW windplant will produce 137,356,800 kWh of energy each year with the available wind power at the crest of the hill. As presented in Table II D.-2, the available wind power at an 80-foot hub height at the ridge crest is 858 watts/sq m.

To produce the same amount of energy, but with less available wind power, will require the installation of additional turbines. As a first estimate of the number of additional turbines required, a simple power ratio between the crest of the hill and the required location is used.

In general, the available wind power at both Elevation 1 and Elevation 2 is only 25 percent to 33 percent of the power available at the ridge crest.

The available wind power is 2.7 times greater at the hill crest than at the 2,600 foot level and 2.5 times greater than at the 2,300 foot level. The present seven strings of turbines along the ridge crest will produce 137,356,800 kWh of energy each year. To achieve the same amount of energy for turbines sited at Elevation 1 foot level and Elevation 2 foot level, it will require approximately 2.7 and 2.5 times as many turbines. The numbers of turbines are presented in Table II D.-4. More than 400 turbines will be required to produce the same amount of energy as is obtained at the crest of the hill with 170 turbines.

TABLE II.D.-4

NUMBER OF TURBINES REQUIRED AT ELEVATION 1 AND ELEVATION 2 FOR EQUIVALENT ENERGY OUTPUT

Ridge Crest Turbine String Number	Ridge Crest Turbine String Count	Power Rate (Ridge Crest) vs Elevation 1[1]	Equivalent Number of Turbines	Power Ratio (Ridge Crest vs Elevation 2)[2]	Equivalent Number of Turbines
K6	17	2.7	46	2.5	43
K7	17	2.7	46	2.5	43
K8	4	2.7	11	2.5	10
K9	34	2.7	92	2.5	85
K10	13	2.7	35	2.5	33
K11	57	2.7	154	2.5	143
k12	28	2.7	76	2.5	70
	170		**460**		**427**

----

1. The ratio is calculated by dividing 316 W/sq m (wind power available at Elevation 1 at 120 ft) into 858 W/sq m (wind power available at the ridge crest at 80 ft).

2. The ratio is calculated by dividing 341 W/sq m (wind power available at Elevation 2 at 120 ft) into 858 W/sq m (wind power available at the ridge crest at 80 ft).

is increased to 141 MW for 427 r 460 turbines. These turbines ower capacity factor than the e ridge crest.

se Requirements and

effect of placement of the turbine er slopes can be afforded by a required for generation of the

K10 require the use of 75 acres power and 38,000 MWh of energy, rbance per GWh, when located

sely define how many trees must elopment off the crest of the mate of the order of magnitude Strings K9 and K10. Based on Table II D.-4, assume an area installation of a single line ng criteria are as follows:

e placed in a single north - e crosswind spacing (i.e., adjacent turbines) is 220 rotor diameter).

- On the upwind side (west), the distance from the tree line to the center of the turbine string is 15H, where H is the height of the trees. Assuming the trees are 40 feet tall, this distance is 600 feet.

- On the north, east, and south sides, the distance from the tree line to the center of the turbine string is 10H. With 40 foot trees, this distance is 400 feet.

These dimensions define a rectangle with a length of 26,540 feet (117 x 220 feet) + (2 x 400 feet) and a width of 1,000 feet (600 feet + 400 feet). This is approximately 609 acres of forest which must be cleared to allow installation of the 118 turbines.

Using the above yields a disturbance ratio of 16.0 acres of disturbance per GWH, or 800 percent increase in disturbance and land use commitment would be required if the turbines were located below the P-MA zone. The additional acreage affected would qualify as an undue adverse impact because it can readily be avoided by proper site selection.

Further, the Project would not be economically viable. Costs would more than double, yielding Project energy rates to above 12 to 13 cents per kilowatt hour. It is also unlikely that the landowners would be desirous of leasing such large tracts of land.

More importantly, even beyond the land use requirements, the adverse environmental impacts of the Project would be much greater for the following reasons:

- Lower elevations have more diverse vegetative communities with better vertical layering which is beneficial to song bird species.

- The tree growth and density is improved at the lower elevations; therefore, forests with greater commercial value would be displaced.

- The lower elevations have more streams and wetlands and a greater diversity of wildlife, i.e., several beaver flowages exist at the lower elevations which create real diversity in the forest.

- Visual impacts may in fact be greater because of the greater clearing and greater number of wind turbines to develop the same energy output.

(6) Placement of Wind Turbines Perpendicular to Ridgelines

Similar results would be obtained when considering the option of placing turbines in parallel rows perpendicular to the ridge line. In addition, the areas just off the ridges tend to have steeper slopes than either along the ridges or at the lower elevations. Placement of turbines along these areas would be more likely to cause erosion problems. Many more acres of clearing would be required and it would give the appearance of a large ski area with the slopes full of wind turbines.

2. 115 kV Transmission Line Route

Selection of a preferred route for a transmission line is a highly iterative process which continually balances the three fundamental parameters of avoidance of environmental impact, compatibility with landowner desires, and engineering/cost factors. Unlike other linear type projects, transmission lines have considerable flexibility in their routing.

The iterative route selection process started by identification of the beginning and termination of the line, in this case, the Project substation located south of Kibby Stream off Wind Road and the interconnection with the existing 115 kV line at the base of Hedgehog Hill.

The next step was to identify prominent natural resource and cultural constraints through literature review, map analyses, and initial site visits by environmental scientists and engineers. For the Project 115 kV line, the prominent constraints identified are:

1. Little Jim Pond and Jim Pond and the extensive wetlands associated with the Northwest Inlet;

2. Flagstaff Lake and its regulated buffer zones;

3. Kibby Range;

4. Minimize crossings of the North Branch Dead River;

5. Route 27, in that high voltage lines should not closely parallel major transportation routes, and that the limited residential and commercial development in the area occurs along Route 27;

6. Tea Pond;

7. Village of Eustis and development surrounding development Jim Pond and Porter Nadeau Roads;

8. Wetlands around Reed Pond, Reed Brook, and Trout Brook;

9. Eustis Ridge picnic area with open views to the east towards Flagstaff Lake; and

10. Cathedral Pines area.

11. Avoidance of protected natural resources.

Given these constraints, six alternative routes were plotted out that avoided the constraint acres to the maximum extent practicable. These are shown on the 1"=2,000' maps in Figure I.D.-19 at the end of Volume I.

The next step is to begin to directly compare the routes for equivalency. This exercise requires the development of certain preliminary design information and review of aerial photography for environmental characterization.

For example, alternative routes 1,2, and 3 were only different in their path around Kibby Range. Land use, ownership, and natural resource characteristics were all similar. However, Route 3 had less rugged terrain, a more extensive existing access road network, and could not be viewed from Route 27. Therefore, it was judged to be superior to Routes 1 and 2.

Landowner concerns were also considered. Route 4 extended towards Jim Pond and crossed the King and Bartlett Road twice, and this was undesirable to the landowner. Also, this route could be viewed from the overlook on the King and Bartlett Road at Jim Pond and crossed through areas of high value timber. Therefore, line 3 was judged to be superior.

Routes to the west of Eustis Ridge and the developed areas on Porter Nadeau and Jim Pond Road were preferred because they avoided visual intrusion and residential neighborhoods. As the route selection process proceeded, a number of site visits were made to confirm the results of the map analyses.

When the selection process was narrowed to three remaining routes (Route 3, 5, and 6), teams of environmental scientists and engineers began walking the possible routes to collect detailed field data on terrain, land use, roads, wetlands, wildlife habitat, visual significance, recreation, etc.

The engineers and scientists considered cost, design, and resource factors such as access, number of bends, subsurface conditions, topography, spans to avoid environmental impacts, and route changes to avoid impacts.

In this fashion, the preferred route was developed. Route 3 has these favorable features:

1. Avoids the entire Jim Pond and King and Bartlett Road areas completely;

2. Results in no structures in wetland or waterway buffers and only one pole structure in a wetland;

3. Maximizes use of existing road networks;

4. Avoids visually sensitive areas;

5. Avoids all residential, commercial, and significant recreation areas;

6. Minimizes the number of landowners impacted; and

7. Avoids high value stands and offers minimum interference with traditional land uses.

A complete description of the specific environmental characteristics of the preferred route are provided in the various resource analyses presented in Section II.

E. Soils