2.3 ALTERNATIVES

2.3.1 Introduction

2.3.1.1 Alternative Sites

Kittitas Valley and Wild Horse Project Sites not Alternatives to One Another
As described in Section 1.2, 'Purpose and Need for the Project and Associated Facilities', the objective of the Wild Horse Wind Power Project is to construct and operate a wind energy generation resource to meet a portion of the projected growing regional demand for new energy resources. The Energy Information Administration projects that total electricity demand would grow between 1.8 and 1.9% per year from 2001 through 2025. The Western Electricity Coordinating Council (WECC) forecasts the 2001-2011 summer peak demand requirement to increase at a compound rate of 2.5% per year (WECC 2002). Based on data published by the Northwest Power and Conservation Council (NWPCC), electricity demand for the Council's four-state Pacific Northwest planning region (Washington, Oregon, Idaho, and Montana) was 20,080 average MW in 2000 (NWPCC 2003).

Washington and the Northwest region face a growing medium and long term demand for power. Many regional utilities are currently seeking to acquire new generating resources to meet their loads. More specifically, several regional utilities, including Avista, Puget Sound Energy (PSE), and Pacificorp (doing business as Pacific Power in Washington) have all completed detailed studies and demand forecasts of their own systems as part of their Integrated Resource Plan (IRP) or Least Cost Plan (LCP) process with oversight from the WUTC (Washington Utilities and Transportation Commission). As a result of their formal IRP or LCP processes, PSE , Pacificorp and Avista have issued Requests for Proposals (RFPs) specifically for wind power and/or other renewable resources. Avista is seeking to acquire 50 MW, PSE is seeking to acquire 150 MW and Pacificorp is seeking to acquire 500 MW. There is thus a regional demand for wind generated energy that far exceeds the existing regional supply.

The proposed Project is intended to help meet this growing regional demand for renewable, wind-generated electricity.

The Kittitas Valley Wind Power Project is not considered a reasonable alternative to the Wild Horse Wind Power Project since, neither project, on its own, can meet the forecasted or immediately requested demand for power in the region. Also, neither project could be increased in size, on its own, to generate the same amount of energy output as can be cost-effectively generated by constructing both projects. Therefore, doubling the size of one project is not a reasonable alternative to constructing both projects.

Site Evaluation Criteria

The Applicant considered a variety of potential sites in the area for a commercial wind power project but none met all of the relevant criteria. The Applicant's screening criteria for the Project included:

- Documented commercially viable wind resource - in excess of 16 mph annual average wind speed
- Access to high voltage transmission lines (115 to 287 kV) within 10 miles that have sufficient available capacity to carry the Project's output
- Absence of significant environmental constraints (i.e. no threats to endangered species, major archeological resources, critical wetlands, etc.)
- Willing landowner(s) with sufficient acreage to support a 150 -200 MW project
- Accessible site with sufficient road access to permit delivery of large wind turbine components and allow construction of Project infrastructure.
- Appropriate zoning designation (i.e. resource use or agriculture zones rather than residential or commercial zones)

Since none of the other potential Project sites considered by Applicant appeared to meet all of the above criteria, they are not deemed to be viable alternatives to the proposed Project. Most of the potential wind power project sites that were investigated outside of Kittitas County have not been used as a comparative analysis in the analysis of alternatives section of this application mainly because none the alternate sites met all of the above criteria. Furthermore, sites inside of Kittitas County are the only ones considered pertinent in the framework of a comparative analysis of alternatives since the Project affects land use planning only in Kittitas County. Potential wind power project sites outside of Kittitas County would not come under the County's land use planning jurisdiction.

2.3.1.2 Alternative Power Generation Technologies

As their names imply, the Applicant, Wind Ridge Power Partners, LLC, and its parent company, Zilkha Renewable Energy, LLC are engaged in the sole business of developing and operating commercial scale wind power projects. Therefore, the only class of electrical generating technology considered for the Project was wind turbine generators. The Applicant has considered a variety of wind turbine designs and technology, which is discussed below under Alternative Wind Turbine Generator Designs.

2.3.1.3 Alternative Wind Turbine Generator Designs

Several types of wind energy conversion technologies were evaluated for the Project. However, for the application of utility scale electrical power generation, the technology that has demonstrated itself as the most reliable and commercially viable is the 3-bladed, upwind, horizontal axis, propeller-type wind turbine as shown in Figure 2.3.1-1 (turbines labeled (c) and (d)). Figure 2.3.1-1 compares various wind turbine technologies on the basis of the relative scale and size of commercially used units and their typical sizes. Although larger versions of all models shown have been produced, the diagram illustrates the average sizes of versions that have been implemented on a substantial scale with hundreds of units installed. The Project contemplates the use of the most successful class of wind turbines which are megawatt-class wind turbines. The choice of this type of turbine also minimizes overall impacts since there are fewer turbines, a smaller overall project footprint, less visual impact, and less avian impacts due to a smaller total Rotor Swept Area and the lower RPM.

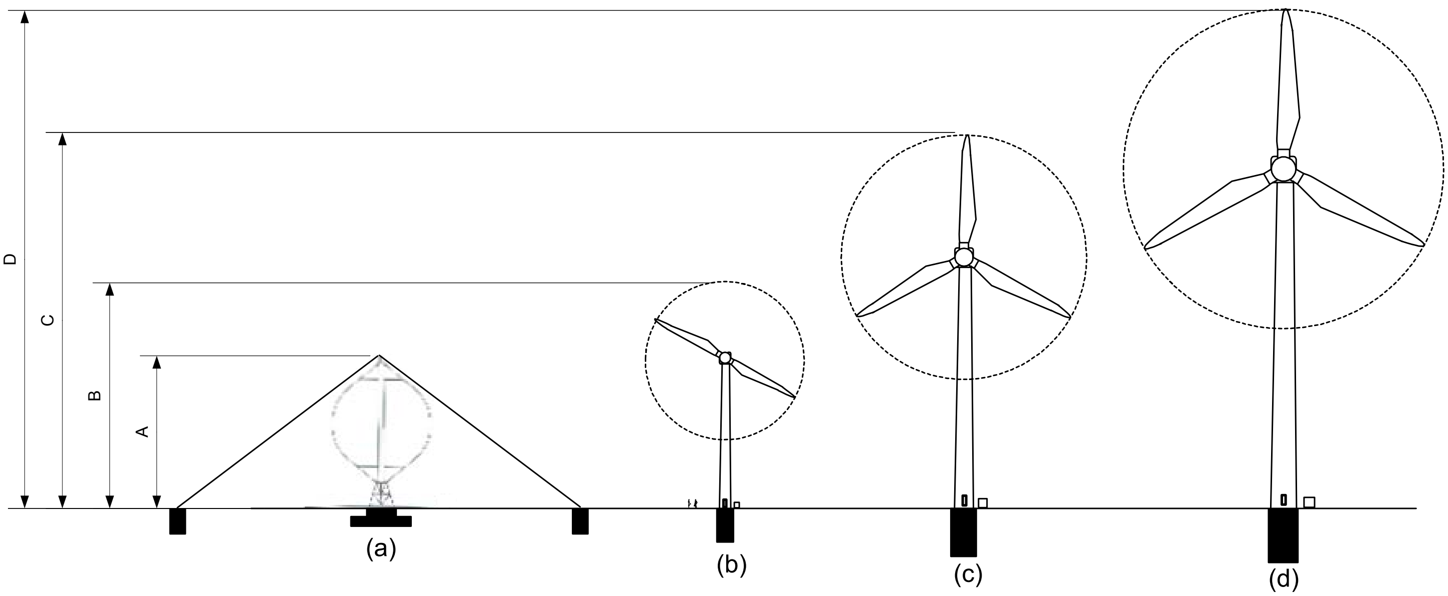

Figure 2.3.1-1: Comparison of Various Wind Turbine Technologies

Table 2.3.1-1 Comparison of Various Wind Turbines					
	Type	**Typical Generator Size**	**Typical Size**	**#. of Units Required for 204 MW**	**Typical Rotational Speed**
a	Darrieus Rotor	50-100 kW	A - 100-150 ft.	2,700-4,000	50-70 RPM
b	2 bladed (downwind)	50-200 kW	B - 150-200 ft.	1,000-4,000	60-90 RPM
c	3 bladed (upwind)	500-750 kW	C - 240-300 ft.	272-408	28-30 RPM
d	3 bladed (upwind)	1,000-3,000 kW	D - 300-400 ft.	158-312	17-25 RPM

Vertical Axis Darrieus Wind Turbines

The most widely used vertical axis wind turbine (VAWT) was that invented in the 1920's by French engineer, DGM Darrieus. It is called the Darrieus Wind Turbine, Darrieus Rotor and commonly dubbed the "eggbeater". Figure 2.3.1-1 illustrates both the eggbeater (vertical axis) and the propeller types (horizontal axis - HAWT) of wind turbines. The Wild Horse Wind Power Project will utilize the horizontal axis type of wind turbines.

Figure 2.3.1-2 FloWind Vertical Axis (Darrieus Wind Turbine Located on Thorp Prairie, near Ellensburg WA

The Darrieus turbine was experimented with and used in a number of wind power projects in the 1970's and 1980's including projects in California and even an experimental machine installed by FloWind on Thorp Prairie located near Ellensburg, WA. Figure 2.3.1-2 illustrates the FloWind turbine near Thorp Prairie.

Despite years of diligent design, experimentation and application, the Darrieus turbine never reached the level of full commercial maturity and success that horizontal axis turbines have due to inherent design disadvantages. Over the years, the 3-bladed horizontal axis wind turbine has proven to be the most reliable, efficient, and commercially viable wind power technology.

A few of the advantages of propeller type wind turbines over the eggbeaters are discussed in further detail below:

Higher Wind Speeds Higher Above the Ground:

Darrieus rotors are generally designed with much of their swept area close to the ground compared to HAWTs. As the wind speed generally increases with the height above ground, HAWTs benefit from having higher wind speeds and higher wind energy incident to their rotor plane that can be extracted.

Cut-in Wind Speed:

VAWTs require a higher level of wind speed to actually start spinning compared to HAWTs. Older VAWT machines were generally "motored-up" by using the generator as a motor to start-up. HAWTs do not require as much wind speed for start-up and most have the advantage of variable pitch blades which allow the turbine to simply change blade pitch to start up. Modern HAWTs do not use the generator to motor-up the rotor.

Variable Pitch:

Most all modern HAWTs have mechanisms which pitch the blades along their axis to change the blade angle to catch the wind. Variable pitch allows the turbine to maximize and control power output. VAWTs generally do not have variable pitching capability and rely on stall regulation. This results in less efficient energy capture by VAWTs.

Avian Hazards – Guy Wires:
VAWTs are generally constructed with guy wires which have been shown to be a greater hazard to birds than turbines themselves, as they are much more difficult for birds to see and avoid. The HAWTs contemplated for the Project use free standing tubular steel towers and do not require guy wires.

Turbine Footprint:
VAWTs are generally fitted with 4 sets of guy wires which span out from the top of the central tower and are anchored in foundations as shown in Figure 2.3.1-2. Including the tower base foundation, VAWTs require a total of 5 foundations all spread apart. The result is that the overall footprint and disturbed area for a VAWT is larger than that for a comparably sized HAWT. HAWTs on free standing towers use only one main foundation and have a relatively small overall footprint in comparison.

Fatigue Life Cycles:
Due to their design, VAWTs have higher fatigue cycles than HAWTs. As the rotor blades rotate through one full revolution, they pass upwind, downwind and through 2 neutral zones (directly up-wind of the tower and directly downwind of the tower). In contrast the rotor blades on a HAWT do not pass through similar up-wind/downwind neutral zones. As a result, VAWTs are subjected to a far higher number of fatigue load cycles compared to HAWTs which, past operating history shows, has resulted in far more frequent mechanical failures and breakdowns on VAWTs.

Two-Bladed, Downwind Wind Turbines
The most widely used vertical two bladed wind turbines were of the downwind variety and were in the size range of 50-200 kW. They are referred to as downwind since the blades are downwind of the supporting tower structure. Although there is continued experimentation with prototype wind turbines of this design of a larger scale (300-500 kW), they have not proven to be reliable and commercially viable units.

The two-bladed turbines require a higher rotational speed to reach optimal aerodynamic efficiency compared to a 3-bladed turbine. Two-bladed rotors are also more difficult to balance and this combined with the downwind tower shadow, results in higher fatigue loads compared to the 3-bladed design. As in the case of Darrieus turbines, two bladed down wind turbines use guy wires, with higher associated avian impacts.

Figure 2.3.1-3 Two-Bladed Downwind Wind Turbine

Smaller Wind Turbines
Over the past 20-30 years, wind turbines have become larger and more efficient. The Applicant considered using smaller turbines in the 600 -750 kW range for the Project,

however, this is both less cost effective and would result in a far higher total number of turbines, a larger project footprint and an overall higher impact to the surrounding environment. Use of 600-750 kW turbines would result in more than twice as many total turbines and a greater total Rotor Swept Area to produce the same amount of energy. For example, the total height of the typical 660 kW turbine is about 73% of the total height of the typical 1500 kW turbine, while its total output is only 44% of the output of the 1500 kW turbine. Using more turbines to produce the same amount of energy also results in more turbine foundations, which results in more land area being disturbed.

As the growth trend of the wind energy industry has continued, smaller machines have become less cost efficient. Use of megawatt-class turbines result in lower energy prices than sub-megawatt-class turbines.

2.3.1.4 Design Alternatives to the Proposed Project

The proposed Project layout, Exhibit 1-B, was designed to minimize environmental impacts while maximizing power generation and minimizing cost. The key criteria used to design the proposed Project layout (including roads, wind turbines, substations, electric collection lines, transmission feeder lines, O&M facility, equipment laydown areas, visitor kiosk, gravel quarries and concrete batch plant locations) are summarized below.

- Maximize use of existing roads to minimize the need to construct new roads
- Maximize the use of underground electric collection lines (vs. overhead collection lines) to minimize visual impacts and potential avian impacts
- Avoid siting any Project infrastructure in or near any sensitive areas, including:
    - Wetlands
    - Streams and riparian areas
    - Documented locations of any threatened or endangered wildlife and/or plant species
    - Documented locations of any archeological or historical sites
    - In close proximity to any residences
- Avoid obstructing any line-of-sight communications paths
- Minimize wake loss effects among wind turbines
- Minimize visual impacts

During the development process, the proposed layout was modified based on the results of the various surveys and studies commissioned by the Applicant, such as cultural resource surveys, telecommunications obstruction analysis, plant and wildlife studies, visual impact assessments, etc.

The proposed layout results in the lowest level of impacts and highest level of energy production at the lowest cost, given the constraints of terrain, technology and existing infrastructure on site (e.g. roads.) All Project infrastructure has been placed to avoid all documented locations of wetlands, streams, cultural resources and other sensitive areas. No construction will take place in any sensitive areas. All possible alternative configurations would result in a greater level of impact or lower level of energy production at a higher cost.

2.3.1.5 Alternatives Initially Considered but Eliminated

As described in the preceding section 'Design Alternatives to the Proposed Project', the proposed Project represents the result of a lengthy and iterative process whereby the Applicant has modified the Project layout in response to the results of various studies commissioned to evaluate environmental resources and potential impacts of the Project. The proposed Project layout optimizes energy production while minimizing environmental impacts and avoiding all impacts to sensitive areas.

2.3.1.6 Alternative Transmission Feeder Line Routes

The Applicant has designed a transmission feeder line route that provides the best combination of safety, environmental protection, site access, economic cost, willing landowners, and appropriate zoning. In evaluating alternative routes, a primary consideration involves the willingness of underlying landowners to participate in the Project. Such participation is difficult to estimate without directly contacting the affected landowners, which is not a practical approach for analyzing hypothetical alternatives.

In general, transmission feeder lines should be located on relatively flat land where possible to avoid potential erosion problems with having construction trails along steep slopes. The routes should avoid environmentally sensitive areas such as major archeological resources and potential or known wetlands and should avoid possible impacts to endangered wildlife species. Feeder line routes should have sufficient access to allow for the safe delivery and construction of the pole structures and lines during construction and for inspection and maintenance during operation. Where practical, the feeder lines can parallel existing roads to facilitate access and minimize ground disturbance impacts, and can run along property lines to avoid segmentation of landowners' property. Where feasible, the lines should not be routed alongside or across existing power lines and should be set back from residences and commercial areas.

The feeder line routes should minimize the overall route length and number of angles or "corners" by building in straight lines where possible. This reduces the number of corner structures which require guy-wires and ground anchors and the resulting amount of temporary and permanent environmental impacts associated with construction is therefore also reduced. Minimizing the number of angles reduces the number of guy-wires and ground anchors required to support transmission towers.

The Applicant examined various transmission feeder line routes and performed a helicopter survey with TriAxis Engineering, as well as with WEST to examine the possible routes. Based on the various factors discussed above, the final route was determined as it is proposed in this Application. The straight line routes that were examined crossed over very steep and unfavorable terrain, required pole construction in potential stream beds and riparian areas, and involved smaller parcels of land and multiple landowners. For these reasons, the Applicant considers the alternative routes to be inferior alternatives to the proposed transmission feeder line routes.

2.3.2 No Action Alternative

Under the No Action Alternative, the Project would not be constructed or operated, and the environmental impacts described in this ASC would not occur. The No Action Alternative assumes that future development would comply with existing zoning requirements for the Project area, which is zoned Commercial Agriculture and Forest and Range. According to the County's zoning code, the Commercial Agriculture zone is dominated by farming, ranching, and rural lifestyles, and permitted uses include residential, green houses and agricultural practices. Permitted uses in the Forest and Range zone include logging, mining, quarrying, and agricultural practices, as well as residential uses (Kittitas County 1991). However, if the proposed Project is not constructed, it is likely that the region's need for power would be addressed by a combination of user-end energy efficiency and conservation measures, existing power generation sources, or by the development of new renewable and non-renewable generation sources. Base load demand would likely be filled through expansion of existing, or development of new, thermal generation such as gas-fired combustion turbine technology. Such development could occur at conducive locations throughout the state of Washington.

A base load natural gas-fired combustion turbine would have to generate 67 average MW of energy to replace an equivalent amount of power generated by the Project (204 MW at 33% net capacity). (An average MW or "aMW" is the average amount of energy supplied over a specified period of time, in contrast to "MW," which indicates the maximum or peak output [capacity] that can be supplied for a short period.) Table 2.3.2-1 presents the basic parameters of a hypothetical 67 aMW natural gas-fired combustion turbine.

Table 2.3.2-1: Potential Annual Environmental Impacts for Hypothetical 67 aMW Gas-Fired Combined Cycle Combustion Turbine Plant			
	On-Shore Gas Extraction	**Transportation**	**Generation**
Air Pollutants			
Sulfur Oxides (tons)	64	0	2
Oxides of Nitrogen (tons)	4	18	389
Particulates (tons)	0.1		2.0
Carbon Dioxide (tons)			261,632
Carbon Monoxide			149
Water Quality Impacts			
Consumption (acre-ft)			228
Discharge	0.4 acre-ft drilling mud		0.5
Other Discharge	0.1		
Biological Oxygen Demand (tons)	0.5		43.6
Chemical Oxygen Demand (tons)	1.5		
Oil and Grease (tons)	0.004		
Chromium (tons)	0.001		
Total Dissolved Solids (tons)	20		71
Total Suspended Solids (tons)			76
Ammonia (tons)			0.01
Chloride (tons)	4		
Sulfate (tons)	3		
Waste Streams			
Solid Wastes (tons)	150 (drill cuttings)		undetermined

Basis: BPA FEIS - Resource Programs, Vol. 1, Table 3-26. February 1993.