KAW NATION
WIND-BIOMASS FEASIBILITY STUDY
Executive Summary

Background: The Kaw Nation is a federally recognized self-governing Indian tribe, located in Kay County, Oklahoma. The Kaw Nation was awarded a Renewable Energy Feasibility Grant subsequent to an application written by Tribal Representatives and Disgen. Disgen is operating at the direction of the tribe under a Consulting Agreement with the tribe.

The study assesses the feasibility of a commercial wind facility on lands selected and owned by the Kaw Nation adjacent to the former Chilocco Indian School campus. Disgen has examined the potential for the integration of the wind facility into a power-generating development plan for the property. Prospective wind power users include:

- **A proposed technical training center;**
- **A machine shop that will support a major aircraft manufacturer located in Wichita, Kansas;**
- **An integrated fuel management system using an innovative low-emission enhanced biomass diesel system provided by the Ho-Chunk Nation of Nebraska;**
- **Additional on-site enterprises, as identified by this study and by the on-going planning of the Kanza Enterprise Development Authority (KEDA).**

A major project goal is to identify a low-cost, sustainable source of renewable energy for tribal housing, services, and enterprises in Newkirk, Oklahoma.

The Kaw Nation selected a tribally-owned parcel of trust land as the subject of the feasibility assessment. The land is located in Kay County, Oklahoma, north of the community of Newkirk. The property contains approximately 815 acres. Four other tribes own adjacent land, individually or in common with the Kaw Nation, creating a total trust land area of approximately 4000 acres.

The Tribe selected Distributed Generation Systems, Inc. (Disgen), of Lakewood, Colorado as its contractor to aid in the preparation of this submittal and to manage and conduct the study under tribal supervision. The Tribe has directed Disgen to conduct or create:

(a) a wind resource assessment sufficient to obtain financing;
(b) a Phase I Avian resource and environmental impact assessment;
(c) a review of a preliminary cultural assessment;
(d) a review of local transmission capabilities;
(e) a preliminary set of project economic projections;
(f) a determination of energy demand requirements and feasible planning horizons for development options;
(g) an integration plan for a wind-hybrid system;

(h) a plan to integrate a diesel fuel supply into the hybrid system;
(i) options for Native American employment and economic development;
(j) an energy-use sales survey to assess local and regional markets.

The Kaw Nation may proceed with project development contingent upon favorable alternatives identified by the Disgen feasibility study.

1. **A wind resource assessment sufficient to obtain financing:** A fifty meter (50m) meteorological (MET) tower was purchased and installed by Disgen in November 2002. The tower is equipment with cellular service capability and the data is downloaded daily to the meteorologist (Ed McCarthy) in Martinez, CA. Mr. McCarthy has tabulated the data in a form suitable for financing and is provided in Tab 8.

   The average annual wind speed of 15.1 miles per hour is equivalent to 6.7 meters per second or a mid Class 3 wind resource. While a Class 3 resource is marginal for an economically competitive wind project in most of the United States, there are several reasons to be encouraged by the wind resource. First, the Department of Energy is funding the development of a low wind speed turbine that will improve the economics of the site. Second, the wind turbine manufacturers continue to increase the size and capability of their turbines which will further enhance the economics. Third, the Chilocco School site represents the best opportunity for development on Tribal Trust Land in Oklahoma and the Kaw Nation will have advantages in marketing the energy as a minority supplier, particularly to Federal Entities.

   This wind direction data supports a turbine layout with strings arranged east and west. A preliminary site layout has been created by Mr. McCarthy and provided in Tab 21.

   Mr. McCarthy has completed an analysis of wind turbines currently available in the United States and, together, he and Disgen have concluded that the GE Wind Energy 1500 kW wind turbine with DVAR capability installed on an 80m tower with a 77m rotor would be the best wind turbine for this site. The estimated Capacity Factor is approximately 34% and the net output per wind turbine is estimated at 4,501,000 kilowatt hours (kWhs) per year. Disgen has not confirmed with GE Wind Energy that the 77 m rotor is suitable for this site. The Kaw Nation must release Disgen to share the detailed wind data with GE in order for this wind turbine to be certified by GE for this site.

2. **A Phase I Avian resource and environmental impact assessment:** Disgen contracted with Western EcoSystems Technology, Inc. (West) of Cheyenne Wyoming to conduct the Phase One Screening Report which was completed in

draft form on March 27, 2003. West is a leading biological research firm with special skills in avian assessments as they related to wind turbines. West recently completed a detailed inventory of endangered eagles in the western Untied States for the US Fish and Wildlife Service (FWS).

The Phase One research focused on identifying any potential environmental impediments to proceeding with the development of a wind project; a "show-stoppers analysis." The research is guided by the Endangered Species Act, the Eagle Protection Act and the Migratory Bird Treaty Act. The biological resources are evaluated through a search of existing data, including communications with local scientists in Oklahoma and Kansas. A site visitation to evaluate habitat, loom for raptor nests, prey populations and other biological resources was conducted on March 13, 2003.

The two largest potential issues facing the Chilocco site are wintering raptors and the potential presence of greater prairie chickens. Should the Kaw Nation decide to proceed with the preconstruction development of a wind facility, these issues will be analyzed through a detailed avian study plan developed by West in cooperation with the Kaw Nation Environmental Department, the FWS and the Oklahoma Fish and Game Department. The studies typically require on site field surveys throughout a year's period and are often the single largest expense in the pre-construction development phase.

3. **A review of a preliminary cultural assessment:** Crystal Douglas, the Kaw Nation staff archaeologist conducted a preliminary cultural assessment of the Chilocco site. Ms. Douglas conducted an in depth review of the literature for the historical record of the site, consulted the Oklahoma State Historical Preservation Office and conducted a field survey of the site. Ms. Douglas' report can be found at Tab 13. . She has reported to tribal officials that there is a limited potential impact; specifically there is a cemetery within the project area, but it is well away from the planned location of wind turbines.

   Kaw Nation has decided to proceed with the pre-construction development of the wind facility and has planned further cultural assessment evaluations including ethnographic studies. These ethnographic studies will be managed by the tribes and no records of what is learned will be published for public consumption.

4. **A review of local transmission capabilities**: There are two potential points of interconnection to the transmission system; (i) the Oklahoma Municipal Power Association (OMPA) at the Newkirk substation and (ii) the Oklahoma Gas and Electric (OG&E) 115kV transmission line about one mile east of the project area. Each of the two potential interconnection points has issues to be studied and resolved prior to finalizing a selection.

   The OMPA interconnection point is approximately seven (7) miles from the project area and will require rights-of-way to construct and three-phase line to the substation. However, a new transformer will not be required for the existing substation which reduces the cost of interconnection substantially. The OMPA will restrict the amount of wind capacity that may be interconnected to its substation based on a technical analysis performed by either their engineers or one's provided by the Kaw Nation. Disgen has just completed such studies on a project in Massachusetts and is well positioned to conduct such studies should OMPA not have the engineering staff to do so. Disgen has budgeted such studies for development grants awarded to its other tribal clients and the budgets have routinely been approved by the funding federal entities. The project, if interconnected to OMPA facilities, will not require expensive analysis by the Southwest Power Pool (SWPP). However, the project size will be limited by the capacity allowed by OMPA.

The interconnection to the OG&E line will require the studies of the SWPP and will also require a new interconnection point, including a new substation. A new substation, depending on its size will cost between $1.8 million and $2.8 million. The size of the project and the substation will be determined by the size of the wind facility, now estimated at thirty megawatts (30mw). In order to analyze such a connection, the SWPP requires a (i) feasibility study, (ii) a system impact study and (iii) a facilities study. Each of these requires substantial deposits payable to SWPP and they are conducted in sequence. Disgen has met with the officials at the SWPP and they will make no exceptions to the procedures and costs of the studies. Disgen is currently managing such studies in Colorado for a non-Indian client and the total costs will not exceed $165,000. By interconnecting to OG&E, the project is likely to be twice as large as compared to an OMPA interconnected facility, but the difficulty is substantially greater. Should the Kaw Nation decide to submit a grant application for the per-construction development phase of the larger project, Disgen recommends including the SWPP costs in the grant application.

5. **A preliminary set of project economic projections:** Disgen has provided two sets of preliminary project economics (see Tab 12) for a 30mw wind facility to be interconnected to OG&E transmission lines. The difference between the two sets is the financing structure and the use of federal tax benefits that accrue to the taxable owners of wind facilities. The tax credits planned to be available, and have been available during the past ten years, equate to 1.8 cents per kWh produced from the project. If the Kaw Nation does not have any federally taxable entities, then the Nation as owner of the project cannot currently utilize the tax credit. Without fully utilizing the tax credit, a tribally owned project will be economically non-competitive with the project using the tax credit. So, the tax credit must be used, if available, for the proposed project.

   The first model provided was a breakeven model assuming a tribally owned project, without using the tax credit, but obtaining low cost federal financing from the Rural Utilities Services (RUS), an agency of the Department of Agriculture. This model assumes no taxes paid to the State of Oklahoma or the US

Government, no landowner payments to the tribe and no income to the tribe. **This is a worst case scenario where the tribe achieves no economic gain.** The breakeven energy sales price is 4.39 cents per kWh.

The second model retains the 4.39 cent per kWh price and utilizes the tax credit. Assuming a 3.5% landowner payment, the tribe receives $138,000 per year for the twenty year period of the hypothetical power contract. In addition, each of these cases assumes tribal employment for the operations and maintenance of the facility.

The lesson learned from comparing these two models is that a taxable entity must own the project for the energy prices to be competitive and for the tribe to earn any income from the project.

Disgen has been in conversations with large institutional investors who seem to be willing to structure an arrangement where the tax credits can be used, but over time the majority ownership reverts to the tribe. In order to capitalize on such a structure, the tribe must be willing to provide a limited waiver of sovereign immunity. Disgen can deliver the necessary language should the tribe decide to proceed down this path.

6. **A determination of energy demand requirements and feasible planning horizons for development options:** The feasibility study plan originally included an option to provide electricity to the Kaw Nation residential and commercial community east of Newkirk, Oklahoma. The community includes a significant residential development of single family homes, the Kaw Nation Casino and several community service facilities including a medical facility.

   The nation has been collecting wind data in this area under the anemometer loan program from the National Renewable Energy Laboratory (NREL). Unfortunately, this particular site is lower in elevation and less exposed to the dominant southern winds that the Chilocco School site and the wind data has indicated that is not a desirable location for a wind turbine. However, there are several other technologies that would likely reduce energy consumption, improve load factors and manage peak demand. Ground source heat pump technology would add efficiency and reduce costs for heating and air conditioning all of the buildings in this area and improve the load factor for the local utility, Newkirk Municipal. Micro-turbine technology has advanced to commercial status and could easily be deployed to manage peak demand and operate on natural gas or diesel fuel. The most economic solution would likely be reciprocating engines operating on diesel fuel, but in most locations there are environmental (air quality) limitations on the number of hours such units can operate. Each of these technologies can easily be evaluated and the economics quantified for this community, although investigation of these technologies is outside the scope of this renewable feasibility study.

7. **An integration plan for a wind-hybrid system:** This plan also focused on the residential/commercial facility east of Newkirk. Given that the wind resource was not sufficient for installation of a wind turbine, the concept of a wind-hybrid system is not feasible for this location. However, the Chilocco School wind site is suitable for a larger scale wind-hybrid system that would utilize gas fired generation to provide capacity support for the wind facility. In most locations, this hybrid system has proven unnecessary due to the ability of the local utilities to provide capacity support, where needed, for the wind facility. At the Chilocco School, the best fuel to provide for generation is natural gas. A gas pipeline exists on the property and could likely be tapped for a simple cycle gas peaking plant that would provide the capacity support. Simple cycle plants are designed to have very low capital cost, but high operating costs so run times are usually limited. The current escalated price of natural gas renders this option as quite unattractive for economic reasons. Disgen examined a biomass facility as capacity support for wind, but determined through several expert interviews that biomass is an uneconomic prospect unless there is a primary need for the waste heat.

8. **Options for Native American employment and economic development:** The contemplated 30Mw wind facility, should it be constructed, will provide Native American jobs during a construction period of about 180 days. After construction, two-four (2-4) full-time operations and maintenance jobs will be required. These are manufacturing quality jobs and will be required for the life of the facility, which is expected for at least twenty-five (25) years. A single administrative person will be required for reporting on project performance and accounting functions. For the first two years or so, there will be a need for post-construction monitoring of environmental impacts, particularly in recording bird strikes, if any.

   In addition to job creation, revenue will accrue to the tribe, depending on the finance structure, from landowner payments, payments in-lieu-of taxes and project profits. There is an opportunity for the tribe to establish a "Wind Farm Tour" operation that would provide a few additional jobs and revenue from the tour admission prices.

9. **An energy-use sales survey to assess local and regional markets**: There are two primary candidates to purchase the energy from the wind facility; (i) OMPA and (ii) OG&E. Each of these utility entities has a wind acquisition program. It is Disgen's view that OMPA is a more receptive buyer due to municipal utilities' societal agenda rather than for-profit utilities like OG&E. However, by selling to OG&E, federal markets like Tinker AFB and Vance AFB and others may be receptive to purchasing from a minority supplier. There is an Executive Order requiring federal facilities to purchase a certain amount of their energy from renewable resources. The Kaw Nation, being a minority contractor may have preferential rights in serving these markets.

Summary: The wind resource studied at the Chilocco Indian School is sufficient to support a commercial wind facility. The interconnection opportunities for such a facility have been identified and there are few, if any, known technical barriers to the interconnection. The Phase One Environmental Assessment identified no "show-stopper" issues. The cultural review also identified no significant impediments. The financial analyses show that the lowest cost of energy will require a taxable entity to own the project to make use of the Production Tax Credit. The market for wind energy exists in Oklahoma and Disgen believes that there will be an incremental market for wind energy from a Native American hosted wind facility.

Recommendation: Disgen recommends that the Kaw Nation prepare solicitation proposals to obtain the necessary funds to conduct the pre-construction development of a 30mw wind facility. In Disgen's experience, the budget, after cost-share will be approximately $500,000. Disgen recently wrote and obtained such development grants for the Northern Cheyenne and Rosebud Sioux Tribes.

"KAW NATION WIND- SOLAR-BIOMASS FEASIBILITY STUDY"
Project Overview

The Kaw Indian TribeNation of Oklahoma (Kaw Nation) is a Federally Recognized Sovereign Nation, located in Kay County in north central Oklahoma. The study assessed the feasibility of a commercial wind facility on lands selected and owned by the Northern Cheyenne Kaw Nation and examined the potential for the development of solar and biomass resources located on tribal lands. The specific land being investigated is part of the Chilocco Indian School grounds north of Newkirk Oklahoma on near the Kansas border. The objectives of the feasibility assessment, and the subsequent wind project development, were to maximize the economic benefits to the Tribe and to identify potential employment for Tribal members through the development of renewable resources.

Distributed Generation Systems, Inc. (Disgen) of Lakewood, Colorado was selected by the Kaw as the contractor for the feasibility study.

The Kaw, in conjunction with Disgen, selected a tribally-owned parcel of trust land for the feasibility study of a commercial wind facility. The property selected is north of Newkirk, Oklahoma on the Kansas border immediately west of US Hwy 77. The area is part of the historic Chilocco Indian School. The Kaw property consists of 800 acres, which is the Kaw share of a total of 4000 acres. The balance of the other parcels are also owned by four Federally Recognized Tribes. A fifty meter (50m) anemometer was installed in November 2002 as part of the Wind Energy Feasibility Grant awarded to the Kaw. A twenty meter (20m) anemometer, provided by the National Renewable Energy Laboratory (NREL), was previously installed near the Kaw Casino which is located approximately eight miles south and east of the project area. The data from the short tower is not pertinent to the wind resource in the project area. Disgen's meteorologist, Ed McCarthy has analyzed the data from the 50m tower and his report is included in Tab #8 of this report.

The electric utility providing service to the project area is Oklahoma Gas and Electric (OG&E), an investor owned utility, through distribution feeders owned by Kay County Rural Electric Cooperative (KCREC), located in Blackwell Oklahoma, about fifteen miles west and south of the project area. KCREC purchases its energy primarily from Western Farmers Generation and Transmission Cooperative, generally delivering the energy through transmission lines owned by OG&E. Disgen met with engineering representatives of KCREC, OG&E and the Oklahoma Municipal Power Administration (OMPA) which serves the community of Newkirk. In these discussions, it was determined that energy from a wind project could be delivered to OMPA through an existing substation at Newkirk, or to OG&E at an interconnect point to a 115 kV line about one mile west of the project area. Interconnection studies are required to determine the feasibility and size of any such projects.

Disgen, at the direction of the Kaw and in compliance with the requirements of the current Wind Energy Feasibility Study grant, arranged for the completion of the Phase I Avian Resource Assessment study. This study was conducted by Western EcoSystems Technology, Inc. (Western) of Cheyenne, Wyoming, a nationally recognized firm in this field and is included in Tab #13. There were no significant impacts identified. However, in order to meet the permitting requirements of NEPA for a future commercial wind project, a year long field study of the project area must be conducted. This study is required for either an Environmental Assessment or an Environmental Impact Statement under NEPA.

The National Historic Preservation Act (NHPA) and NEPA require a comprehensive cultural review, overseen by the Bureau of Indian Affairs (BIA). The customary BIA process is to conduct an on-site inspection of the property and integrate those findings with the catalogued “known significant cultural sites.” The inspection and review of existing data must be done, or overseen by, a “BIA Permitted Contractor.” The Kaw have an experienced archeologist on staff, Crystal Douglas. Ms. Douglass conducted the on site project area examination. The preliminary cultural examination did not discover significant cultural sites that would prohibit future development. A burial site was discovered and the site plans will avoid the sensitive area.

The feasibility assessment of this site supports the further pre-construction development of a 30 MW wind facility.

"KAW NATION
WIND-SOLAR-BIOMASS FEASIBILITY STUDY"
Objectives

Under this grant, the Kaw Nation assessed the feasibility of renewable energy generation projects on Tribal Lands. The assessment included the resource potential of wind, solar and biomass technologies. The specific feasibility study objectives focus on the qualification of the selected site as a candidate for the development, financing, construction and operation of a commercial wind energy generation facility. In order for a wind plant to be developed, the site requires:

(i) a wind resource with an annual average wind speed in excess of thirteen miles per hour (13 mph),
(ii) an environmental assessment indicating no significant impact,
(iii) an electrical transmission capacity capable of accepting the energy from the project,
(iv) business and financing plans that demonstrate economic viability, and
(v) a resulting source of financing. The feasibility assessment will define the facts relative to these issues.

The study assesses the feasibility of a commercial wind facility on lands selected and owned by the Kaw Nation adjacent to the vacant former Chilocco Indian School campus. Disgen has examined the potential for the integration of the wind facility into a power-generating development a redevelopment plan for the property. Prospective wind power users include:

- a proposed technical training center;
- a machine shop that will support a major aircraft manufacturer located in Wichita, Kansas;
- an integrated fuel management system using an innovative low-emission enhanced biomass diesel system provided by the Ho-Chunk Nation of Nebraska;
- additional on-site enterprises, as identified by this study and by the on-going planning of the Kanza Economic Development Authority (KEDA).

A major project goal is to identify a low-cost, sustainable source of renewable energy for tribal housing, services, and enterprises in Newkirk, Oklahoma.

“KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY”
Description of Activities Performed

The Kaw Nation, in conjunction with Disgen, selected a tribally owned parcel of land as the subject of the commercial wind facility feasibility assessment. The property selected will be located on Tribal Lands within the boundaries of the historic Chilocco Indian School in Kay County, Oklahoma immediately west of US Hwy 77 on the Kansas border. The property of the test site consists of approximately 1.4 acres (250 ft. x 250 ft.), on which a 50-meter meteorological tower was installed to gather wind data. Disgen, as the direction of the tribe conducted or created:

- A wind resource assessment sufficient to obtain financing;
  The Wind Resource Assessment Report is included in Tab #8
- A Phase I Avian resource assessment;
  The Phase One Environmental Assessment is included in Tab #813
- A preliminary cultural assessment;
  The Preliminary Cultural Assessment is included in Tab #8 13
- A review of local transmission capabilities;
  A discussion is included in Tab #10
- A preliminary set of project economic projections;
  A preliminary Pro-forma is included in Tab #7
- A quantification of solar and biomass resources on Tribal Lands;
  A discussion is included in Tab #8
- Options for Tribal employment and economic development; and
  A discussion is included in Tab #14
- An assessment of the local market for use or sale of the energy produced.
  A discussion is included in Tab #18

<u>Statement of Work</u>

The tribe will:

1) Assess the transmission capacity, capability and markets for a wind power energy project. Conduct, discussions with power purchasers and the Rural Utilities Service.
2) Provide a complete, in-depth assessment and report on wind resources available.
   a) Briefly assess and provide a brief report on the potential for development of solar and biomass power resources.
3) Assess and report on the potential environmental and cultural impacts of wind power development.
   a) Briefly assess and provide a brief report on the potential environmental and cultural impacts of solar and bbiomass power development.
4) Establish economic models for wind power development for Tribal consideration, including discussion of ownership options.
5) Define and report on economic, cultural and societal impacts on the Tribe of wind power development.

6) Prepare a business plan for wind power development (see description belowAppendix #7).
7) Submit quarterly and final reports on all activities listed herein, including the business plan.

"KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY"
Conclusions and Recommendations

Wind Energy: While there is never certainty as to the market for renewable energy in the future, it is the opinion of the Kaw Nation and Disgen that, based on the information collected from the feasibility study, a commercial wind energy facility contemplated on the grounds of the Chilocco Indian School will be economically competitive with any other wind energy project being developed to serve the Oklahoma market. Such a project has a several advantages; including providing additional revenue for the potential redevelopment of the Chilocco Indian School and creating several long-term manufacturing quality jobs.

The Kaw Nation has two options for interconnection and two utilities that have expressed a willingness to discuss the interconnection and possible purchase any energy produced. In addition, as a Section 8A minority supplier, the Kaw Nation may have preferential marketing rights to several large Department of Defense facilities, primarily Air Force, in Oklahoma. The project location allows the Kaw Nation several opportunities to market the physical energy and the renewable energy credits (environmental attributes) as a bundled sale or as an unbundled sale. Energy produced on Native American lands has public relations benefit to the purchasers and creates for these purchasers an important market differentiator. There already exists a separate market for the environmental attributes which may make the physical energy sale more attractive.

The project effort to date has provided the following significant information:

1. The project location is on Tribal Trust Land; benefiting the Kaw Nation.
2. The wind resource is sufficient for an economic wind project.
3. The preliminary environmental studies identified no significant impacts.
4. The local utilities have indicated cooperativeness for interconnection.
5. Potential renewable energy power purchasers exist in the Oklahoma market.

The Kaw Nation and Disgen recommend a continuing development of this candidate wind energy site and seek a development grant to support the pre-construction development process.

Biomass Energy: The Kaw nation and Disgen examined the availability of wood waste products accumulated primarily from four nearby communities; Ponca City, Newkirk and Tonkawa, all in Oklahoma and Arkansas City, Kansas about seven miles north of the Chilocco Indian School. Most of the wood waste is derived from residential and commercial tree trimming and the occasional winter ice storms that fell trees in very large quantities. The largest landfill for these waste products is south of Tonkawa and the proprietor has indicated he could supply any waste materials required to operate a small biomass power plant. In consultation with experts at the National Renewable Energy Laboratory and commercial entities in the commercial biomass to energy industry, the project has been advised that such projects are not economically competitive unless there is a commercial use for the waste heat derived from the burning of the biomass fuels. Consequently, the project team has decided not to proceed with further investigation of biomass to energy projects for the Chilocco Indian School.

Ethanol Production: During the term of this feasibility study, the Kaw Nation was approached by an ethanol project developer for development at the Chilocco School. Disgen conducted a cursory review of the requirements for the successful development of such a project with the following observations:

1. A commercial ethanol project requires;
   a. A long-term fuel feedstock contract with certainty for supply
   b. A long-term sales agreement (take and pay) for the ethanol produced
   c. A third party financing
2. The Kaw nation does not an existing feedstock crop available for long-term contracting.
3. It appears that one very large company dominates the ethanol market and competition in that market is limited.

Disgen recommended that ethanol is not an attractive opportunity at this time. The Kaw Nation arrived at the same conclusion through its independent evaluation.

"KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY"
Lessons Learned

Native American Cultural Issues: Integrating a commercial wind development process with the cultural values of the Kaw Nation People is an interesting challenge. The Kaw Nation is a business development oriented tribe with several business enterprises including a casino, several smoke shops and a truck stop. However the People are very sensitive to their cultural history. Consequently any additional development effort on the Chilocco Indian School grounds will entail a much more detailed cultural survey and perhaps consultation with tribes owning adjacent lands. While non-Indians hardly ever comprehend adequately the verbal history of the many Native American cultures, it is critical that any tribal development of wind energy include intense study of the verbal history to the satisfaction of the People and their leaders.

Tribal Political IssuesGovernance Structure: The Kaw Nation is governed by Legislative Branch (General Council) consisting of registered tribal members and an executive branch managed by a tribal-wide elected PresidentChairman/CEO, and a Tribal Executive Council elected by the People (General Council) and a Tribal Court. Elections are held every two years for four year terms of office and as much as a third half of the Tribal Council members may change with each election. Consequently, the political process is continuously ongoing; which requires much greater communication with, and education of, tribal leaders. Communications with the body of tribal membership is routine with regularly scheduled General Council meetings quarterly. The communication and education process has been directed by the Tribal Kaw Nation Utility Commission. A decision to advance the pre-construction development of a commercial wind facility must be approved by a vote of the People at a General Council meeting.

Federal Government Oversight: The Kaw Nation has stated objectives of self-determination and sustainability. The Bureau of Indian Affairs has "Trust Responsibility." These two sets of criteria may conflict from time to time on procedural issues and must be considered when planning for wind energy development.

Financing Barriers: Native American Tribes are disadvantaged in financing of wind facilities because (a) they are non-tax paying entities that cannot utilize the Production Tax Credit (PTC) for wind energy and (b) they do not qualify for the alternative Renewable Energy Production Incentive (REPI) provided to other tax-exempt entities. In the 1992 National Energy Policy Act, the tribes simply seem to have been ignored.

Due to the political structure of the tribes and the justifiable focus on tribal sovereignty, non-Indian entities are concerned about investing in some tribal ventures. A limited waiver of tribal sovereignty will likely be required for third-party investment in tribal wind facilities. The waiver will probably focus on dispute resolution in federal courts.

Economic Development: The Kaw Nation has selected leaders that are focused on economic development for the benefit of the People. These efforts, combined with the objective of preserving tribal identities are consistent with the cultural values of the tribal membership.

Preliminary Wind Resource and Theoretical Energy Estimates

Kaw Nation, of Oklahoma

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June, 2004

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What is the difference between Table 16 & 17?

What is the difference between capacity factor shown in eachtable and the "net" capacity factor shown in Table 20?

1.0 Introduction and Summary

A preliminary wind resource assessment is was prepared for the Chilocco Indian School on Tribal Trust Land owned by the Kaw Nation. The Chilocco Indian School is located in Kay County in north central Oklahoma, north of Ponca City. A 50-meter meteorological tower was installed on the reservation Kaw Trust land in November 2002 and over 18 months of data are were collected.

The average wind speed measured at 50-meters above ground level is for the period was 15.6 mph; the projected (calculated) annual average wind speed at 65-meters above ground level is 16.5 mph; and the projected annual average wind speed at 80 meters above ground level is 17.3 mph. A theoretical energy estimate, made for four turbines: the GE 1.5MW turbine with a 70.5m rotor diameter and a 77m rotor diameter, the Vestas V-80 turbine, and the NEG Micon NM82, and two turbine hub heights, 65 meters and 80 meters, are presented in Table 1. Assuming a gross to net ratio of 0.85, or 15% energy losses, the net capacity factor for the site ranges from 30.2% for the GE 1.5MW (70.5m) turbine on a 65m tower to 36.7% for a NEG Micon NM82 on an 80m tower.

Table 1 – Theoretical Energy Estimates and Net Capacity Factors for the GE 1.5MW Turbine, the Vestas V-8- Turbine, and the NEG Micon NM82 Turbine at the Chilocco Indian School.

Supplier	Rating (MW)	Rotor Diameter (m)	Hub Height (m)	Theoretical Gross Output (kWh)	Theoretical Net Output (kWh)	Net Capacity Factor
GE	1.5	70.5	65	4,662,000	3,963,000	30.2%
GE	1.5	70.5	80	5,127,000	4,358,000	33.2%
GE	1.5	77	65	5,114,000	4,347,000	33.1%
GE	1.5	77	80	5,571,000	4,736,000	36.0%
Vestas	1.8	80	65	5,671,000	4,820,000	30.6%
Vestas	1.8	80	80	6,224,000	5,290,000	33.5%
NEG Micon	1.65	82	65	5,741,000	4,880,000	33.8%
NEG Micon	1.65	82	80	6,238,000	5,303,000	36.7%

2.0 Wind Resource

The wind resource map of Oklahoma, prepared by staff from the National Renewable Energy Laboratory (NREL), and published in the Wind Resource Atlas of the United States, is presented in Figure 1. The Chilocco Indian School in Kay County is classified as Wind Power Class 3. Annual average wind speeds at 50 meters above ground level are estimated to fall into the range of 14.3 mph to 15.7 mph.

An updated wind resource map from the Oklahoma Wind Project Initiative (OWPI) is presented in Figure 2. This map also places the Chilocco Indian School in Wind Power Class 3.

Figure 1 – Wind Resource Map for Oklahoma

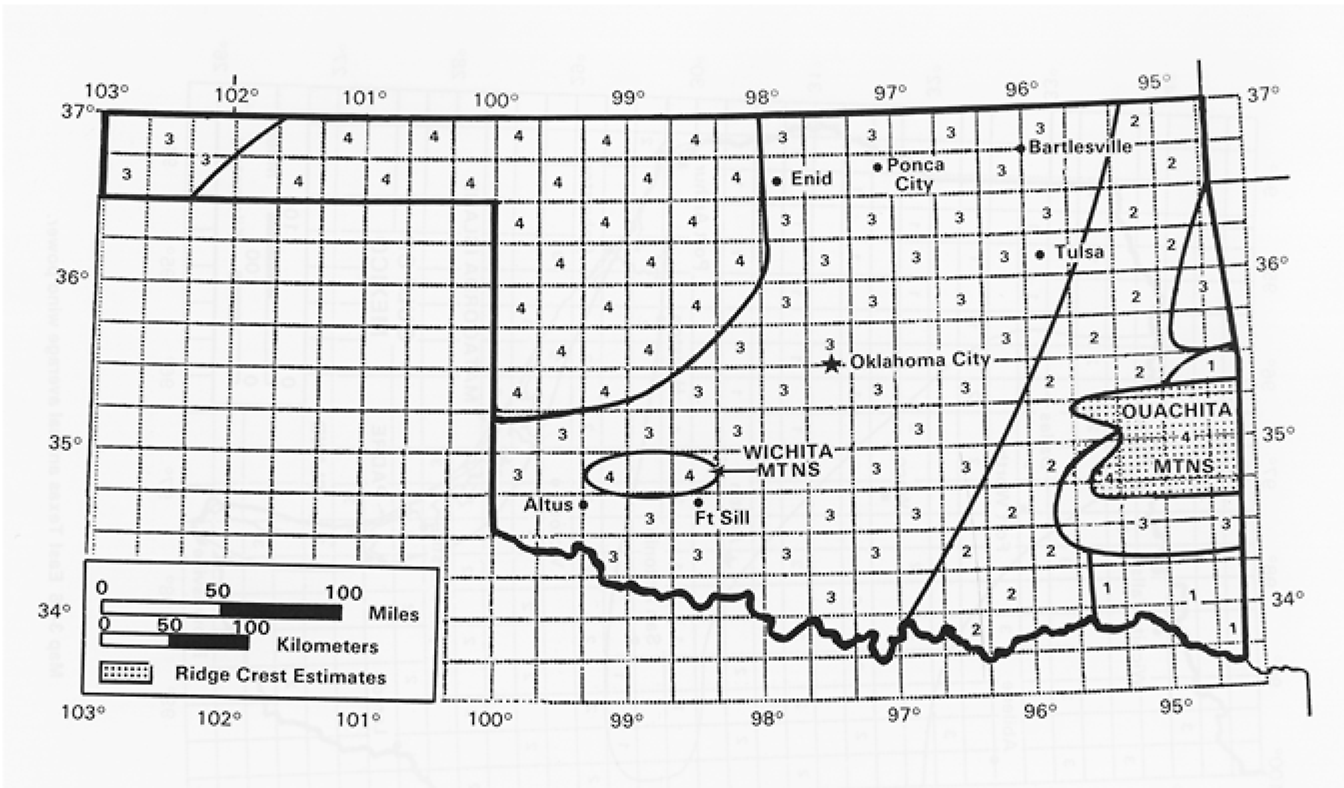
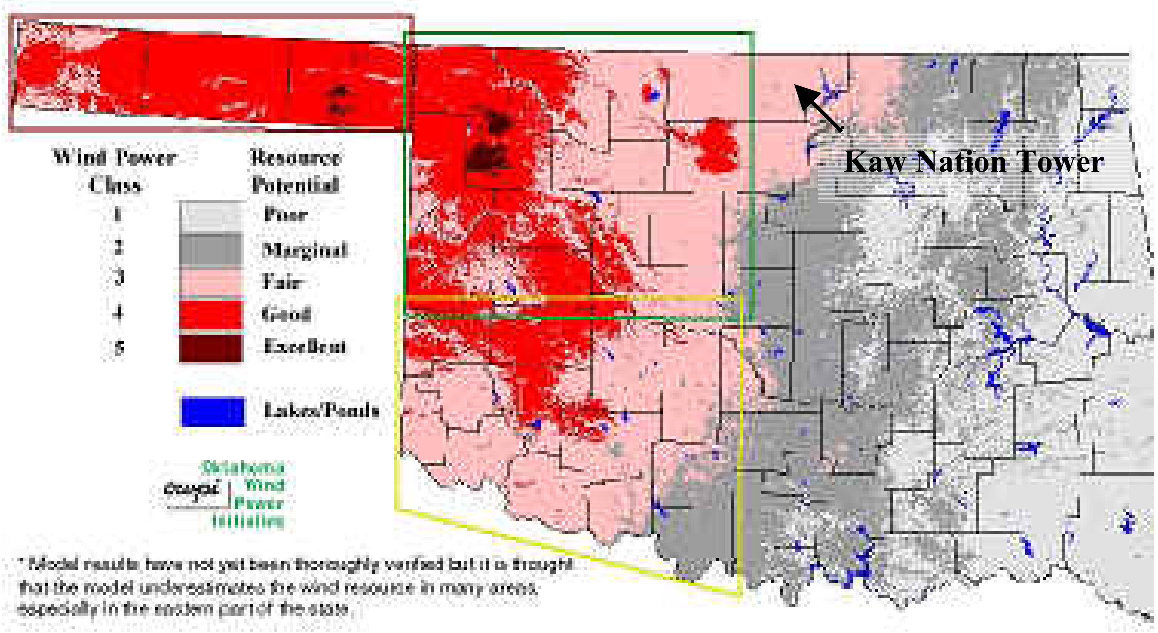


Figure 2 – Oklahoma Wind Resource Map Prepared by the Oklahoma Wind Power Initiative (OWPI)



3.0 Meteorological Data

3.1 On-Site Meteorological Monitoring Program

The meteorological tower was installed on the Chilocco Indian School in November 2002. This 50-meter NRG Talltowers is instrumented with three levels of wind speed and two levels of wind direction. One wind speed sensor is installed at 30-meter above ground level (agl), two wind speed sensors are installed at 40 meters agl, and two wind speed sensors are installed at 50-meters agl. One wind direction sensor is installed at 30-meters agl and one wind direction sensor is installed at 50-meters agl. Ambient air temperature is also collected at 2 meters above ground level. Maximum #40 anemometers and #200P wind directions sensors are used. A multiplier and offset of 1.711 and +0.8 is applied to convert the pulse counts from the Maximum #40 sensor to engineering units (miles per hour). The sensors are sampled once per second and hourly averages calculated using a NRG Systems Symphonie datalogger. The data is collected through use of a cellular telephone. Data recovery is excellent, exceeding 90% for all parameters.

3.2 Average Wind Speed

The average wind speed at the site over the period from November 2002 until May 2004 is 13.9 mph at 30-meters above ground level, 14.7 mph at 40 meters agl (both 40-meter parameters), and 15.6 mph at 50-meters agl (15.5 mph at the second sensor). Mean hourly summaries of the wind speed data are presented in Table 2 (30-meter data) to Table 6. The monthly average wind speeds reflect a spring season peak in the winds with a summer – fall minimum. The diurnal pattern of the hourly wind speeds at 50-meters agl (Tables 5 and 6) do not show a pronounced peak in the average wind speeds during the day or at night. However, examining the diurnal pattern of the 30-meter, 40-meter, and 50-meter average wind speeds, it is evident that at elevations above 50-meters, there most likely will be a pronounced nocturnal peak in the hourly average wind speeds which is typical for sites on the Southern Great Plains.

3.3 Wind Direction

The prevailing wind direction at the Chilocco Indian School is from the south. This is shown in a wind rose for the site (Figure 3). The wind rose is a graphical presentation of the joint frequency of wind speed (six wind speed categories) and wind direction (sixteen 22.5 degree sectors). The wind direction sectors with the highest frequency of occurrence are from 157.5 degrees to 202.5 degrees, or south- – southeast to south-southwest. The joint frequency of wind speed and wind direction is presented in a tabular format in Table 10 and Table 11.

Table 2 - Mean Hourly Wind Speed (mph) at 30 Meters

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
30M WIND SPEED (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	13.8	13.1	14.5	15.7	14.2	11.5	13.8	11.7	11.6	13.0	14.2	15.0	13.8
02	13.7	12.8	14.8	15.3	14.0	11.2	12.9	11.8	12.3	12.6	13.5	14.8	13.6
03	13.1	12.8	14.2	15.1	13.5	11.4	12.4	11.4	12.6	11.8	12.7	15.2	13.3
04	13.4	13.2	15.0	14.8	14.2	11.3	13.0	11.5	12.5	11.6	12.7	14.4	13.5
05	13.6	13.1	15.2	14.8	13.6	9.7	13.3	9.9	12.6	11.5	13.3	14.6	13.3
06	13.4	12.9	15.0	14.6	13.6	9.4	12.7	10.1	13.4	11.3	13.3	14.8	13.3
07	14.4	13.3	14.7	14.1	13.9	9.8	12.7	8.4	12.6	11.0	13.1	14.4	13.2
08	13.9	13.1	14.9	14.6	15.2	11.1	13.4	9.7	12.3	10.0	12.8	14.1	13.3
09	14.6	13.3	16.1	16.5	15.6	11.6	13.5	9.2	13.8	11.5	13.3	13.6	14.0
10	14.6	13.5	16.5	16.9	15.0	11.8	13.0	9.9	14.6	11.8	14.5	14.1	14.3
11	15.2	13.6	16.2	17.1	15.2	12.2	13.8	10.4	13.6	11.8	14.5	14.3	14.4
12	14.5	13.5	15.7	17.3	16.2	12.2	13.9	10.9	14.1	10.5	14.9	14.4	14.4
13	14.7	14.0	15.7	17.4	15.8	13.1	14.5	10.7	14.8	11.9	15.8	14.4	14.7
14	14.5	13.5	15.8	16.5	15.8	13.4	15.3	11.1	14.2	11.9	16.1	14.9	14.7
15	14.4	14.8	15.9	16.7	16.4	13.3	15.5	11.2	13.9	11.4	16.0	15.1	14.9
16	13.8	14.2	15.5	16.9	16.2	13.9	16.3	12.0	14.2	12.0	15.8	14.1	14.8
17	12.5	13.7	15.0	16.1	16.6	13.2	16.3	12.5	13.4	10.8	13.5	13.0	14.1
18	12.9	12.6	13.4	15.3	15.7	13.3	16.8	11.6	13.0	11.0	12.7	13.6	13.6
19	13.3	12.9	12.7	14.2	14.7	12.4	14.7	11.1	12.0	13.1	13.3	14.4	13.4

20	13.5	12.9	13.5	14.5	14.3	11.0	13.9	11.3	12.0	12.8	13.0	14.7	13.4
21	13.3	12.3	13.6	15.0	14.3	10.8	14.1	11.8	11.7	13.3	13.4	15.3	13.5
22	13.5	12.4	13.9	16.0	14.6	10.7	14.7	11.8	11.7	13.4	14.1	15.2	13.8
23	13.7	13.3	14.3	15.7	14.1	11.2	14.3	12.5	12.1	12.6	13.9	15.3	13.9
24	13.5	13.4	14.0	15.5	13.6	11.6	13.9	11.8	12.0	12.3	13.5	15.1	13.6
Mean	13.8	13.3	14.8	15.7	14.8	11.7	14.1	11.0	13.0	11.9	13.9	14.5	13.9
Good Hours	1454	1330	1488	1440	1358	720	711	744	720	734	1157	1433	
Missing Hours	34	38	0	0	130	0	33	0	0	10	283	55	

13,289 Hours of Good Data   583 Hours Missing   95.8% Data Recovery

Table 3 – Mean Hourly Wind Speed (mph) at 40 Meters (Logger Channel 3)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
40M WIND SPEED (CH3) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	15.2	14.4	15.7	17.0	14.3	12.6	15.3	13.1	13.2	14.8	15.6	16.5	15.1
02	14.9	14.1	16.1	16.9	14.7	12.5	14.4	13.1	13.6	14.3	14.9	16.3	14.9
03	14.2	14.2	15.6	16.8	14.3	12.4	13.9	12.5	13.8	13.4	14.2	16.6	14.6
04	14.5	14.6	16.4	16.2	15.2	12.7	14.5	12.5	13.9	13.4	14.4	16.0	14.8
05	14.9	14.5	16.7	16.5	14.2	10.8	14.7	11.0	13.8	13.3	14.8	16.2	14.7
06	14.5	14.4	16.4	16.3	14.3	10.5	14.1	10.9	15.0	13.1	14.7	16.4	14.6
07	15.5	14.8	16.1	15.6	13.8	10.4	13.5	9.3	14.1	12.8	14.5	16.2	14.4
08	15.5	14.3	15.9	15.7	15.0	11.3	13.7	9.6	13.1	11.1	14.1	15.4	14.2
09	15.6	14.2	16.8	17.3	15.3	11.7	13.8	9.2	14.3	12.1	14.1	14.9	14.5
10	15.0	14.4	17.2	17.4	14.5	12.1	13.2	9.9	15.1	12.3	15.3	15.0	14.7
11	15.7	14.3	16.8	17.7	14.7	12.3	13.9	10.3	14.2	12.1	15.2	15.2	14.8
12	15.1	14.0	16.2	18.0	15.5	12.1	14.3	10.8	14.8	10.8	15.8	15.0	14.8
13	15.2	14.6	16.3	18.0	14.8	13.1	14.7	10.6	15.3	12.3	16.6	14.9	15.0
14	15.1	14.3	16.4	16.8	14.6	13.5	15.5	11.0	14.7	12.3	17.0	15.8	15.1
15	15.0	15.5	16.6	17.1	15.3	13.6	15.8	10.9	14.4	11.7	17.0	15.8	15.2
16	14.4	14.9	16.1	17.3	15.7	14.0	16.6	12.1	14.8	12.5	16.8	14.8	15.2
17	13.3	14.4	15.8	16.8	16.0	13.3	16.5	12.5	14.0	11.5	14.6	14.1	14.5
18	14.0	13.3	14.4	16.1	15.2	13.6	17.2	11.7	13.7	12.0	14.2	14.9	14.3
19	14.4	14.0	13.9	15.5	14.5	12.7	15.1	11.6	13.0	14.7	14.8	15.8	14.3
20	14.7	14.0	14.7	16.0	14.2	11.5	14.8	12.2	13.0	14.4	14.7	16.3	14.5

21	14.7	13.2	14.9	16.2	14.2	11.7	15.5	13.0	12.8	15.1	15.0	16.9	14.7
22	14.9	13.5	15.2	17.4	14.7	11.6	16.2	12.9	12.8	15.0	15.7	16.9	15.0
23	15.3	14.6	15.5	17.0	14.6	12.0	15.9	13.7	13.3	14.2	15.5	16.9	15.1
24	14.7	14.8	15.4	16.8	13.8	12.7	15.4	13.1	13.2	14.3	15.0	16.7	14.9
Mean	14.8	14.3	15.9	16.8	14.7	12.3	14.9	11.6	13.9	13.1	15.2	15.8	14.7
Good Hours	1454	1331	1488	1265	945	720	711	744	720	734	1157	1409	
Missing Hours	34	37	0	175	543	0	33	0	0	10	283	79	

12,678 Hours of Good Data   1,194 Hours Missing   91.4% Data Recovery

Table 4 – Mean Hourly Wind Speeds (mph) at 40 Meters (Logger Channel 4)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
40M WIND SPEED (CH4) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	14.8	14.1	15.7	17.6	15.3	12.7	15.2	12.4	13.4	16.8	15.4	16.2	15.2
02	14.6	13.8	16.1	17.1	15.0	12.3	14.4	12.7	13.7	15.6	14.6	16.0	14.9
03	13.8	13.8	15.5	16.9	14.6	12.5	13.7	12.4	13.8	14.8	13.9	16.4	14.6
04	14.3	14.1	16.5	16.6	15.2	12.3	14.3	12.5	13.5	14.4	13.8	15.7	14.7
05	14.5	14.1	16.6	16.6	14.6	10.6	14.6	10.9	14.1	14.0	14.5	15.8	14.6
06	14.3	13.7	16.4	16.2	14.6	10.3	13.9	10.8	14.7	13.5	14.4	15.9	14.4
07	15.4	14.1	16.1	15.8	14.7	10.3	13.3	9.0	13.6	13.3	14.2	15.5	14.3
08	15.2	13.9	15.9	15.2	15.2	11.3	13.5	9.4	12.1	12.8	13.7	15.3	14.2
09	15.4	13.8	16.7	16.4	15.8	11.8	13.7	9.0	14.3	14.0	13.6	14.6	14.5
10	14.8	14.0	16.9	17.8	15.1	12.1	13.1	9.9	15.6	14.0	14.8	14.7	14.7
11	15.2	14.4	16.7	17.6	15.4	12.4	13.9	10.5	14.2	13.8	14.7	14.8	14.8
12	14.6	13.5	16.2	18.0	16.5	12.3	14.1	10.9	14.3	12.0	15.0	14.6	14.7
13	14.9	13.4	16.1	18.0	16.1	13.3	14.6	10.4	15.4	13.6	16.1	14.7	15.0
14	14.3	13.7	16.1	17.0	16.1	13.6	15.5	10.8	15.3	13.9	16.4	15.4	15.1
15	14.5	14.7	16.3	17.4	16.6	13.6	15.7	9.9	15.6	13.6	16.2	15.3	15.2
16	14.0	14.5	15.8	17.9	16.4	14.2	16.5	11.7	15.7	13.6	16.2	14.7	15.3
17	13.1	14.1	15.5	16.9	16.6	13.4	16.6	12.4	14.6	12.5	14.1	13.8	14.6
18	13.7	13.2	14.2	15.8	16.2	13.7	17.2	11.6	13.3	12.2	13.5	14.6	14.3
19	14.3	13.6	13.8	15.5	15.3	12.9	15.4	11.7	13.5	15.9	14.4	15.5	14.4
20	14.4	13.9	14.6	15.8	15.4	11.9	15.1	12.3	14.2	14.9	14.2	15.9	14.6

21	14.3	13.1	14.6	16.6	15.3	11.7	15.5	12.9	13.4	15.6	14.3	16.5	14.7
22	14.6	13.1	15.3	17.6	15.8	11.9	16.1	12.9	13.1	16.1	15.1	16.5	15.1
23	14.7	13.7	15.7	17.2	15.3	12.2	15.6	13.4	13.9	15.6	15.1	16.5	15.1
24	14.5	14.3	15.4	16.9	14.5	12.7	15.2	12.5	13.8	15.8	14.8	16.3	14.9
Mean	14.5	13.9	15.8	16.9	15.5	12.3	14.9	11.4	14.1	14.3	14.7	15.5	14.7
Good Hours	1454	1321	1455	1265	1358	720	711	744	552	547	1157	1444	
Missing Hours	34	47	33	175	130	0	33	0	168	197	283	44	

12,728 Hours of Good Data   1,144 Hours Missing   91.8% Data Recovery

Table 5 - Mean Hourly Wind Speed (mph) at 50 Meters (Logger Channel 1)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
50M WIND SPEED (CH1) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	16.1	15.4	16.8	17.9	16.6	13.7	16.6	14.1	14.1	16.0	16.7	17.6	16.2
02	15.8	15.1	17.1	17.7	16.6	13.6	15.7	14.1	14.8	15.6	16.0	17.3	16.1
03	15.1	15.2	16.7	17.7	16.1	13.4	15.1	13.6	14.7	14.5	15.6	17.7	15.8
04	15.3	15.6	17.6	17.2	16.5	13.9	15.7	13.6	15.0	14.4	15.5	17.0	15.9
05	15.7	15.4	17.7	17.4	15.8	11.8	16.0	11.9	15.0	14.3	15.9	17.4	15.8
06	15.4	15.2	17.3	17.1	16.0	11.3	15.2	11.8	16.1	14.1	15.7	17.4	15.6
07	16.4	15.7	17.1	16.3	15.8	11.0	14.1	10.1	15.4	13.9	15.4	17.1	15.4
08	16.4	15.2	16.6	15.8	16.1	11.5	13.9	9.8	13.8	12.0	15.0	16.8	15.0
09	16.3	14.6	17.0	17.2	16.4	12.0	13.9	9.3	14.5	12.4	14.5	15.8	15.0
10	15.3	14.5	17.4	17.6	15.7	12.3	13.3	10.0	15.5	12.4	15.6	15.4	15.0
11	15.9	14.7	17.0	17.8	16.0	12.6	14.1	10.5	14.4	12.4	15.4	15.5	15.2
12	15.3	14.2	16.4	18.2	17.1	12.3	14.5	10.9	15.0	11.1	16.0	15.3	15.2
13	15.5	14.9	16.5	18.3	16.7	13.4	14.9	10.8	15.4	12.5	16.9	15.3	15.5
14	15.3	14.6	16.7	17.3	16.8	13.8	15.6	11.1	15.0	12.6	17.2	16.1	15.5
15	15.3	15.8	16.9	17.7	17.3	13.8	16.0	11.1	14.7	12.0	17.3	16.2	15.8
16	14.7	15.2	16.4	17.9	17.3	14.4	16.8	12.3	15.0	12.8	17.2	15.2	15.7
17	13.9	14.5	16.2	17.3	17.7	13.6	16.8	12.7	14.2	11.9	15.2	14.7	15.1
18	14.8	14.1	14.9	16.8	17.2	14.1	17.6	12.0	14.3	12.7	15.1	15.7	15.1
19	15.4	14.7	14.7	16.0	16.8	13.3	16.0	12.1	13.7	15.5	15.7	16.8	15.3
20	15.7	14.9	15.7	16.7	16.7	12.5	16.2	13.2	13.9	15.3	15.8	17.3	15.6

21	15.7	14.2	16.1	17.2	16.7	12.6	16.9	14.1	13.8	16.2	16.1	18.0	15.9
22	16.0	14.3	16.3	18.1	17.0	12.6	17.4	14.0	13.9	16.1	16.7	18.0	16.1
23	16.3	15.4	16.5	17.9	16.6	13.0	17.2	14.9	14.2	15.3	16.7	17.9	16.3
24	15.7	15.6	16.4	17.7	15.9	13.7	16.6	14.3	14.1	15.6	16.1	17.6	16.0
Mean	15.6	15.0	16.6	17.4	16.6	12.9	15.7	12.2	14.6	13.8	16.0	16.6	15.6
Good Hours	1454	1342	1488	1440	1358	720	711	744	720	734	1157	1422	
Missing Hours	34	26	0	0	130	0	33	0	0	10	283	66	

13,290 Hours of Good Data   582 Hours Missing   95.8% Data Recovery

Table 6 – Mean Hourly Wind Speed (mph) at 50 Meters (Logger Channel 2)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
50M WIND SPEED (CH2) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	16.1	15.3	16.7	18.0	15.8	13.2	16.6	14.0	14.1	15.9	16.5	17.3	16.1
02	15.8	15.1	17.1	17.7	16.1	13.2	15.7	13.9	14.6	15.4	15.9	17.2	15.9
03	15.1	15.2	16.7	17.6	15.3	12.5	15.1	13.5	14.6	14.3	15.4	17.6	15.6
04	15.4	15.5	17.5	17.3	15.7	12.7	15.6	13.5	15.0	14.3	15.3	17.0	15.7
05	15.6	15.3	17.6	17.3	15.7	11.8	15.8	11.8	15.1	14.1	15.7	17.2	15.7
06	15.4	15.1	17.3	17.0	15.9	11.3	15.0	11.8	16.1	13.9	15.5	17.2	15.5
07	16.4	15.5	17.0	16.3	15.8	11.0	13.9	10.0	15.3	13.7	15.3	16.9	15.3
08	16.4	15.1	16.5	15.8	16.0	11.5	13.7	9.7	13.7	11.9	14.8	16.6	14.9
09	16.3	14.5	16.9	17.2	16.4	11.9	13.8	9.2	14.5	12.2	14.4	15.5	14.9
10	15.2	14.5	17.3	17.5	15.6	12.2	13.2	10.0	15.3	12.3	15.4	15.2	14.9
11	15.8	14.8	16.9	17.7	15.7	12.5	14.0	10.5	14.2	12.3	15.2	15.2	15.1
12	15.1	14.1	16.3	18.1	16.8	12.3	14.3	10.9	14.8	11.0	15.7	15.1	15.0
13	15.4	14.7	16.3	18.1	16.5	13.3	14.7	10.8	15.2	12.4	16.6	15.1	15.3
14	15.2	14.3	16.4	17.2	16.5	13.8	15.6	11.1	14.8	12.4	16.9	15.9	15.4
15	15.1	15.6	16.8	17.5	17.0	13.7	15.8	11.2	14.5	11.9	16.9	16.0	15.6
16	14.7	15.1	16.2	17.8	17.0	14.4	16.8	12.2	14.8	12.6	16.8	15.1	15.6
17	13.8	14.6	16.0	17.1	17.5	13.7	16.8	12.8	14.1	11.7	15.0	14.6	15.1
18	14.7	15.4	14.7	16.6	17.0	14.1	17.6	12.0	14.2	12.5	14.8	15.6	15.1
19	15.5	14.5	14.5	15.9	16.5	13.4	16.1	12.3	13.9	15.4	15.5	16.7	15.2
20	15.7	14.9	15.6	16.7	16.6	12.7	16.2	13.4	14.0	15.1	15.6	17.2	15.6

21	15.6	14.2	16.1	17.2	16.8	12.6	16.8	14.1	13.9	16.0	15.9	17.8	15.8
22	15.9	14.3	16.4	18.1	16.9	12.0	17.3	14.0	14.1	16.0	16.5	17.9	16.1
23	16.2	15.3	16.5	17.8	16.1	12.1	17.0	14.9	14.5	15.3	16.4	17.7	16.1
24	15.7	15.6	16.4	17.7	15.1	12.4	16.5	14.3	14.4	15.5	16.0	17.7	15.9
Mean	15.5	14.9	16.5	17.3	16.3	12.7	15.6	12.2	14.6	13.7	15.8	16.5	15.5
Good Hours	1454	1331	1488	1440	1358	720	711	744	720	734	1157	1417	
Missing Hours	34	37	0	0	130	0	33	0	0	10	283	71	

13,274 Hours of Good Data   598 Hours Missing   95.7% Data Recovery

Table 7 – Mean Hourly Wind Direction at 30 Meters

MEAN HOURLY VALUES

Chilocco Indian School
30M WIND DIRECTION (DEG)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	134	144	169	173	129	146	167	155	134	166	169	184	156
02	138	156	174	165	126	152	159	152	154	164	178	193	160
03	139	144	184	162	138	156	159	152	166	176	162	187	160
04	152	139	190	164	134	124	182	150	162	154	163	188	160
05	156	146	175	174	135	147	173	151	181	158	177	176	163
06	154	149	181	177	120	145	173	134	188	133	197	177	162
07	162	138	174	176	144	174	172	144	156	138	172	180	162
08	158	148	177	175	147	173	168	154	170	155	186	191	168
09	156	145	179	180	152	182	175	184	158	151	189	190	170
10	164	166	161	183	139	173	180	171	192	162	189	186	171
11	171	168	189	173	169	169	155	161	172	165	193	186	174
12	166	163	181	177	158	151	146	154	166	193	200	194	173
13	166	183	178	170	169	159	152	150	168	184	204	208	177
14	169	181	170	170	149	160	143	145	161	189	210	199	172
15	165	199	188	172	155	159	140	141	171	198	197	205	177
16	180	177	194	178	153	147	141	137	171	200	196	207	177
17	157	175	188	166	140	158	144	129	149	198	196	197	169
18	155	175	194	173	128	132	143	141	114	165	181	195	163
19	149	176	179	181	118	130	134	139	115	168	200	195	161
20	146	168	181	161	121	127	139	137	121	172	172	172	154

21	136	159	170	167	125	130	139	142	109	139	154	175	149
22	134	143	158	170	137	138	150	130	112	143	163	168	148
23	135	157	174	160	131	141	154	129	116	158	164	171	151
24	141	149	173	172	127	140	162	137	116	171	159	181	154
Mean	153	160	178	172	139	151	156	147	151	167	182	188	164
Good Hours	1417	1290	1446	1440	1358	720	711	744	720	734	1157	1400	
Missing Hours	71	78	42	0	130	0	33	0	0	10	283	88	

13,137 Hours of Good Data   735 Hours Missing   94.7% Data Recovery

Table 8 – Mean Hourly Wind Direction at 50 Meters

MEAN HOURLY VALUES

Chilocco Indian School
50M WIND DIRECTION (DEG)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	137	145	169	174	130	136	164	158	138	171	164	186	157
02	146	152	174	172	128	164	158	157	148	157	165	190	160
03	135	154	184	169	138	151	158	168	159	182	166	189	163
04	167	149	191	160	134	125	182	155	178	164	165	183	163
05	159	158	187	170	136	162	175	157	183	163	187	172	167
06	155	153	183	173	127	154	173	142	191	151	197	185	166
07	157	149	182	178	144	171	172	151	160	131	183	182	165
08	159	159	183	175	146	169	176	157	171	161	200	200	172
09	156	149	178	179	150	178	170	182	159	152	195	197	171
10	162	161	166	187	137	170	176	162	191	161	188	185	170
11	169	167	187	172	173	165	151	162	172	165	198	191	175
12	151	160	184	176	156	146	143	154	165	193	206	201	172
13	159	182	182	175	166	155	148	161	168	182	209	211	178
14	179	178	179	168	153	155	138	146	172	187	216	200	175
15	165	198	186	177	152	155	135	143	182	196	204	207	178
16	167	183	192	176	157	142	136	138	171	199	195	215	176
17	159	177	186	164	157	154	139	130	149	197	202	199	171
18	155	180	192	177	132	127	139	141	116	178	181	199	164
19	155	169	178	185	117	126	130	140	118	159	208	205	163
20	153	168	175	161	127	123	135	139	123	173	181	182	157

21	137	167	176	168	120	127	135	144	112	153	166	177	152
22	136	143	166	169	139	135	147	132	116	156	166	171	151
23	143	150	168	160	125	138	152	132	119	161	174	172	152
24	154	149	174	167	127	139	160	141	132	172	163	171	156
Mean	155	163	180	172	140	149	154	150	154	169	187	190	165
Good Hours	1413	1285	1446	1440	1358	720	711	744	720	734	1157	1400	
Missing Hours	75	83	42	0	130	0	33	0	0	10	283	88	

13,128 Hours of Good Data   744 Hours Missing   94.6% Data Recovery

Table 9 – Mean Hourly Temperature (Degrees F)

MEAN HOURLY VALUES

Chilocco Indian School
TEMPERATURE (DEG)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	27.2	29.0	41.4	50.5	58.6	63.4	73.0	73.0	59.4	51.5	39.3	32.4	46.3
02	26.7	28.1	40.7	49.9	57.9	62.5	72.2	71.7	58.9	50.6	38.9	31.9	45.6
03	26.2	27.6	39.6	48.9	57.1	61.8	71.2	71.3	58.2	50.0	38.1	31.4	44.9
04	25.5	27.2	39.1	48.0	56.7	61.4	70.3	70.3	57.6	49.1	37.7	30.8	44.2
05	25.0	26.8	38.9	47.3	56.4	60.7	69.4	69.3	57.5	48.9	37.6	30.6	43.8
06	24.6	26.6	38.5	47.0	56.5	61.4	70.3	69.0	56.7	48.7	37.3	30.1	43.6
07	24.1	26.5	38.8	48.8	59.3	64.9	73.9	71.9	58.2	48.7	36.2	29.8	44.6
08	24.6	27.4	41.5	52.2	62.2	68.4	78.0	76.0	61.4	52.5	37.7	30.1	46.9
09	27.7	30.2	44.3	55.3	65.0	71.2	81.7	79.6	64.2	57.3	41.5	33.0	50.1
10	30.4	33.0	47.2	58.0	67.3	73.5	84.4	82.8	66.9	61.2	44.7	36.0	52.9
11	33.2	35.7	49.8	60.4	69.3	75.6	87.0	85.4	69.1	64.2	47.4	38.6	55.4
12	35.6	38.0	51.9	62.2	71.1	76.8	89.1	86.8	70.6	66.2	49.6	40.7	57.4
13	37.6	39.9	53.8	63.6	72.3	78.2	90.6	88.1	71.8	67.6	51.0	42.5	59.0
14	39.5	40.5	55.6	64.7	73.3	78.8	91.6	88.7	72.2	68.0	51.8	43.2	60.1
15	40.5	40.8	56.5	65.3	73.8	79.2	92.3	89.3	72.9	68.3	51.9	43.6	60.7
16	40.4	40.7	56.2	65.2	73.7	78.5	92.5	89.0	72.8	67.5	51.0	42.5	60.3
17	38.5	39.6	55.3	64.7	72.8	78.0	91.9	87.8	71.8	64.8	47.9	39.7	58.9
18	34.4	36.8	52.7	62.9	71.2	76.2	90.4	86.6	69.2	60.9	44.6	36.7	56.3
19	32.4	34.3	48.9	59.1	67.8	73.1	86.9	82.9	65.8	57.6	42.8	35.8	53.5
20	31.1	33.0	46.7	56.6	64.5	70.1	82.7	79.3	63.9	56.1	41.9	35.1	51.4

21	30.2	31.9	45.7	55.2	63.0	68.2	79.7	77.1	62.1	54.5	40.7	34.2	50.0
22	29.3	30.9	44.1	53.8	61.7	66.7	77.8	75.9	61.1	53.6	39.8	33.6	48.8
23	28.6	29.8	43.1	52.7	60.8	65.8	76.4	74.7	60.3	52.6	39.6	33.2	47.9
24	27.6	29.3	42.2	51.7	59.6	64.7	75.3	73.5	59.6	52.1	39.3	32.7	46.9
Mean	30.9	32.6	46.4	56.0	64.7	70.0	81.3	79.2	64.3	57.1	42.8	35.3	51.2
Good Hours	1454	1348	1488	1440	1358	720	711	744	720	734	1153	1444	
Missing Hours	34	20	0	0	130	0	33	0	0	10	287	44	

13,314 Hours of Good Data 558 Hours Missing 96.0% Data Recovery

3.4 Wind Shear

Wind shear is the change or increase in wind speed above ground level. The simple wind power law is expressed as:

$$U_2 = U1\ (Z_2/Z_1)^{\text{alpha}}$$

Where U_2 and U_1 are the wind speeds at the upper and lower levels, Z_2 and Z_1 are the upper and lower elevations, and alpha is the wind speed power law exponent. The typical value for the wind speed power law exponent is 0.14 (1/7 power law). Depending on terrain and surface roughness, the value may vary between 0.05 and 0.35. The calculated value based on the 30 meter and 50 meter hourly average wind speeds for the meteorological tower at the Chilocco Indian School is 0.22, or a 12% increase in speed with height.

3.5 Projected Hub Height Wind Speeds

Using the observed 50-meter average wind speed of 15.6 mph and the power law exponent value of 0.22, wind speeds of 16.5 mph and 17.3 mph are projected for hub heights of 65-meters and 80-meters.

3.6 Peak Wind Speed

The highest 3-second gust for the Chilocco Indian School is estimated based on the peak wind speed information from the airport data collected at Oklahoma City, Oklahoma. The peak 5-second gust measured at Oklahoma City, Oklahoma over the period of record is 62 mph. Selecting the highest value, 62 mph, and adjusting it from 7 meters (21 feet) to 80 meters (262 feet) above ground level using the wind speed power law and a power law exponent of 0.22 yields a peak wind speed of 106 mph (47.3 mps).

Figure 3 - Wind Rose for the 50 Meter Level, Chilocco Indian School. The number in the center, 22.2%, is the percentage of time the wind speeds are less than 10 mph.

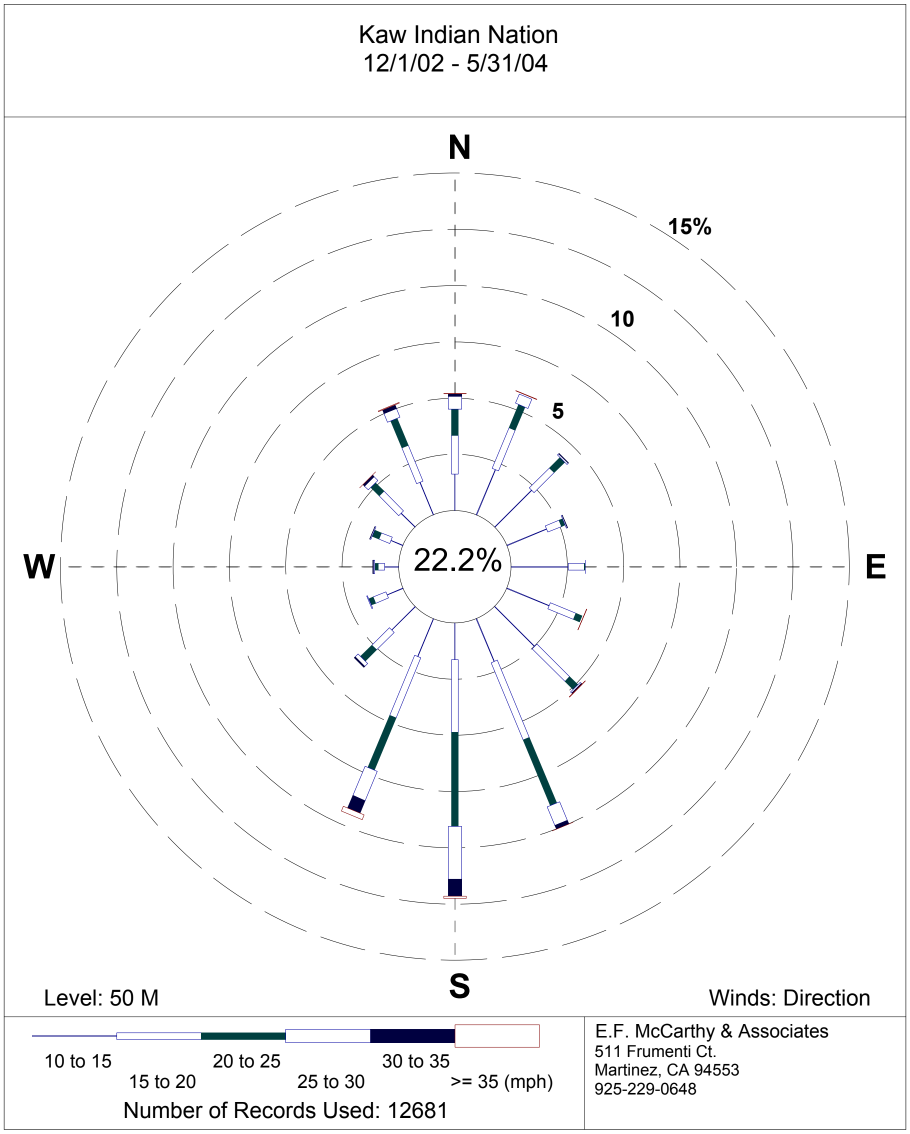


Table 10 – Joint Frequency of Wind Speed and Wind Direction (Hours of Occurrence) at 50 Meters

FREQUENCY DISTRIBUTION - Hours of Occurrence 11/15/02 - 05/26/04

Parameter
1: Chilocco Indian School
50M WIND SPEED (CH1) (MPH)

2: Chilocco Indian School
50M WIND DIRECTION (DEG)

	Parameter 1: MPH							
Parm 2 - DEG	0.0 to 10.0	10.1 to 15.0	15.1 to 20.0	20.1 to 25.0	25.1 to 30.0	30.1 to 35.0	35.1 to 50.0	Total
0.0 to 22.5	212	274	268	186	99	14	2	1055
22.6 to 45.0	228	281	214	119	19	7	1	869
45.1 to 67.5	240	271	103	33	4	0	0	651
67.6 to 90.0	299	279	94	12	4	1	0	689
90.1 to 112.5	289	292	108	20	6	1	0	716
112.6 to 135.0	251	289	199	33	4	1	2	779
135.1 to 157.5	195	297	349	177	26	9	0	1053
157.6 to 180.0	161	244	521	568	269	68	10	1841
180.1 to 202.5	148	201	375	443	231	97	25	1520
202.6 to 225.0	164	253	282	206	71	26	6	1008
225.1 to 247.5	109	139	84	42	12	2	0	388

247.6 to 270.0	119	91	57	18	3	2	0	290
270.1 to 292.5	94	75	37	30	5	1	0	242
292.6 to 315.0	145	92	111	40	19	4	0	411
315.1 to 337.5	153	188	235	131	43	15	3	768
337.6 to 360.1	160	213	194	140	54	20	4	785
Total	2967	3479	3231	2198	869	268	53	13065

13,065 Good Hours 351 Hours Missing 97.4% Net Data Recovery

Table 11 – Joint Frequency of Wind Speed and Wind Direction (Percent Occurrence) at 50 Meters

FREQUENCY DISTRIBUTION - Percent Occurrence 11/15/02 - 05/26/04

Parameter
1: Chilocco Indian School
50M WIND SPEED (CH1) (MPH)

2: Chilocco Indian School
50M WIND DIRECTION (DEG)

	Parameter 1: MPH							
Parm 2 - DEG	0.0 to 10.0	10.1 to 15.0	15.1 to 20.0	20.1 to 25.0	25.1 to 30.0	30.1 to 35.0	35.1 to 50.0	Total
0.0 to 22.5	1.6	2.1	2.1	1.4	.8	.1	.0	8.1
22.6 to 45.0	1.7	2.2	1.6	.9	.1	.1	.0	6.7
45.1 to 67.5	1.8	2.1	.8	.3	.0	.0	.0	5.0
67.6 to 90.0	2.3	2.1	.7	.1	.0	.0	.0	5.3
90.1 to 112.5	2.2	2.2	.8	.2	.0	.0	.0	5.5
112.6 to 135.0	1.9	2.2	1.5	.3	.0	.0	.0	6.0
135.1 to 157.5	1.5	2.3	2.7	1.4	.2	.1	.0	8.1
157.6 to 180.0	1.2	1.9	4.0	4.3	2.1	.5	.1	14.1
180.1 to 202.5	1.1	1.5	2.9	3.4	1.8	.7	.2	11.6
202.6 to 225.0	1.3	1.9	2.2	1.6	.5	.2	.0	7.7
225.1 to 247.5	.8	1.1	.6	.3	.1	.0	.0	3.0

247.6 to 270.0	.9	.7	.4	.1	.0	.0	.0	2.2
270.1 to 292.5	.7	.6	.3	.2	.0	.0	.0	1.9
292.6 to 315.0	1.1	.7	.8	.3	.1	.0	.0	3.1
315.1 to 337.5	1.2	1.4	1.8	1.0	.3	.1	.0	5.9
337.6 to 360.1	1.2	1.6	1.5	1.1	.4	.2	.0	6.0
Total	22.7	26.6	24.7	16.8	6.7	2.1	.4	100.0

13,065 Good Hours   351 Hours Missing   97.4% Net Data Recovery

4.0 Annual Energy Estimate

4.1 Gross Annual Theoretical Energy Estimate

The projected hub height wind speeds at 65-meters and 80-meters are combined with the density adjusted (1.18kg/m^3) power curves of the GE 1.5MW turbine (70.5m rotor and 77m rotor), the Vestas V-80 1.8MW turbine, and the NEG Micon 1.65MW turbine. The gross theoretical energy projections are presented in Tables 12 through 19.

4.2 Net Annual Theoretical Energy Estimate

The gross annual theoretical energy output is adjusted by various loss factors to estimate the actual or net energy delivered to the substation. These losses take into account the wind turbine out-of-service time associated with scheduled and unscheduled downtime, electrical line losses from the turbine to the substation, control system losses, array losses due to wake effects between adjoining turbines, and lost power associated with blade icing and blade soiling.

The annual net energy production for a single turbine is calculated using the following formula:

$$AEP_{net} = AEP_{gross} * (1 - EL)$$

where AEP_{net} is the Annual Net Energy Production of the wind facility;

AEP_{gross} is the Annual Gross Energy Production of the wind facility;

EL is the product of individual energy losses (%);

EL is the product of the individual energy losses and is calculated as follows:

$$EL = 1-(1 - L_{array}) * (1 - L_{blade}) * (1 - L_{collect}) * (1 - L_{control}) * (1-Availability)$$

where L_{array} = Array losses

$L_{soiling}$ = Blade contamination losses

$L_{collect}$ = Collection system from turbine to grid

$L_{control}$ = Control, grid, and miscellaneous losses

Availability = Availability is the percentage of calendar time that the turbines are functional and ready to deliver power to the grid.

Table 12 – Theoretical Energy Estimate – GE 1.5MW Turbine (70.5M Rotor) on 65M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School

Wind Speeds Multiplied By 1.06

Turbine: GE 1.5 SL (1500Kw)70M ROTOR 1.18KG/M**2

Rated at: 1500 kW at 30.0 MPH
Maximum Output: 1500 kW at 30.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	2638	19.8		
Cut-in To Rated	10.1-30.0	10130	76.2	6,289,912	88.9
Rated To Cut-out	30.1-56.0	522	3.9	782,736	11.1
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		10652	80.2		

kW-hrs at Capacity / Total kW-hrs 11.1

hrs at Capacity / hrs of Operation 4.9

Mean Wind Speed 16.5 MPH

Energy Produced 7,072,648 kW-hrs

Annual Production Rate 4,661,881 kW-hrs

Capacity Factor .35

13290 hrs of Good Data 582 hrs Missing 95.8% Data Recovery

Table 13 – Theoretical Energy Estimate for GE 1.5MW Turbine (77M Rotor) on 65M Tower

```
     THEORETICAL WIND TURBINE PRODUCTION            11/01/02 -
05/31/04

     Wind:      50M WIND SPEED (CH1)
              Chilocco Indian School

              Wind Speeds Multiplied By 1.06

     Turbine: GE 1.5 SL (1500Kw) 77M ROTOR 1.18KG/M**2

              Rated at:        1500 kW at 30.0 MPH
              Maximum Output:  1500 kW at 30.0 MPH

                                        Time           Production
         Status             MPH       hrs     %       KW-hrs    %
         ------            -----      ----   ----     ------   ----

       Below Cut-in       Under 10.0   2638   19.8

       Cut-in To Rated     10.1-30.0  10130   76.2  6,975,988   89.9

       Rated To Cut-out    30.1-56.0    522    3.9    781,945   10.1

       Above Cut-out       Over 56.0      0     .0

       Contactor Closed               10652   80.2

     kW-hrs at Capacity / Total kW-hrs    10.1

     hrs at Capacity / hrs of Operation    4.9

     Mean Wind Speed                      16.5 MPH

     Energy Produced                 7,757,933 kW-hrs

     Annual Production Rate          5,113,581 kW-hrs

     Capacity Factor                       .39
```

13290 hrs of Good Data   582 hrs Missing   95.8% Data Recovery

Table 14 – Theoretical Energy Estimate for a GE 1.5MW Turbine on an 80M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School

Wind Speeds Multiplied By 1.11

Turbine: GE 1.5 SL (1500Kw)70M ROTOR 1.18KG/M**2

Rated at: 1500 kW at 30.0 MPH
Maximum Output: 1500 kW at 30.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	2398	18.0		
Cut-in To Rated	10.1-30.0	10161	76.5	6,682,357	85.9
Rated To Cut-out	30.1-56.0	731	5.5	1,096,172	14.1
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		10892	82.0		

kW-hrs at Capacity / Total kW-hrs 14.1

hrs at Capacity / hrs of Operation 6.7

Mean Wind Speed 17.3 MPH

Energy Produced 7,778,529 kW-hrs

Annual Production Rate 5,127,157 kW-hrs

Capacity Factor .39

13290 hrs of Good Data 582 hrs Missing 95.8% Data Recovery

Table 15 – Theoretical Energy Estimate for a Vestas V-80 Turbine on a 65M Tower

```
      THEORETICAL WIND TURBINE PRODUCTION            11/01/02 -
05/31/04

      Wind:      50M WIND SPEED (CH1)
               Chilocco Indian School

               Wind Speeds Multiplied By  1.11

      Turbine: GE 1.5 SL (1500Kw)77M ROTOR 1.18KG/M**2

               Rated at:        1500 kW at 30.0 MPH
               Maximum Output:  1500 kW at 30.0 MPH

                                      Time           Production

          Status              MPH       hrs      %        KW-hrs     %
          ------             -----      ----    ----      ------   ----

        Below Cut-in       Under 10.0   2398    18.0

        Cut-in To Rated     10.1-30.0  10161    76.5   7,357,032   87.0

        Rated To Cut-out    30.1-56.0    731     5.5   1,095,188   13.0

        Above Cut-out       Over 56.0      0      .0

        Contactor Closed               10892    82.0

      kW-hrs at Capacity / Total kW-hrs    13.0

      hrs at Capacity / hrs of Operation    6.7

      Mean Wind Speed                      17.3 MPH

      Energy Produced                 8,452,220 kW-hrs


      Annual Production Rate          5,571,215 kW-hrs

      Capacity Factor                       .42
```

13290 hrs of Good Data   582 hrs Missing   95.8% Data Recovery

Table 16 - Theoretical Energy Estimate for a Vestas V-80 Turbine on 80M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School

Wind Speeds Multiplied By 1.06

Turbine: Vestas 80M(1800kW) POWER CURVE 1.18KG/M

Rated at: 1800 kW at 35.8 MPH
Maximum Output: 1800 kW at 56.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 9.0	2033	15.3		
Cut-in To Rated	9.1-35.8	11168	84.0	8,443,158	98.1
Rated To Cut-out	35.9-56.0	89	.7	160,200	1.9
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11257	84.7		

kW-hrs at Capacity / Total kW-hrs 1.9

hrs at Capacity / hrs of Operation .8

Mean Wind Speed 16.5 MPH

Energy Produced 8,603,358 kW-hrs

Annual Production Rate 5,670,837 kW-hrs

Capacity Factor .36

13290 hrs of Good Data 582 hrs Missing 95.8% Data Recovery

Table 17 – Theoretical Energy Estimate for a Vestas V-80 on 80M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School

Wind Speeds Multiplied By 1.11

Turbine: Vestas 80M(1800kW) POWER CURVE 1.18KG/M

Rated at: 1800 kW at 35.8 MPH
Maximum Output: 1800 kW at 56.0 MPH

		Time		Production	
Status	MPH	hrs	%	KW-hrs	%
Below Cut-in	Under 9.0	1884	14.2		
Cut-in To Rated	9.1-35.8	11253	84.7	9,166,572	97.1
Rated To Cut-out	35.9-56.0	153	1.2	275,400	2.9
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11406	85.8		

kW-hrs at Capacity / Total kW-hrs 2.9

hrs at Capacity / hrs of Operation 1.3

Mean Wind Speed 17.3 MPH

Energy Produced 9,441,972 kW-hrs

Annual Production Rate 6,223,603 kW-hrs

Capacity Factor .39

13290 hrs of Good Data 582 hrs Missing 95.8% Data Recovery

Table 18 – Theoretical Energy Estimate for a Micon NM82 on 65M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School
Wind Speeds Multiplied By 1.06

Turbine: NEG MICON 1.65 1.18KG/M**3 3/04

Rated at: 1650 kW at 31.3 MPH
Maximum Output: 1650 kW at 45.0 MPH

		Time		Production	
Status	MPH	hrs	%	KW-hrs	%
Below Cut-in	Under 8.9	1983	14.9		
Cut-in To Rated	9.0-31.3	10943	82.3	8,110,795	93.1
Rated To Cut-out	31.4-56.0	364	2.7	598,950	6.9
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11307	85.1		

kW-hrs at Capacity / Total kW-hrs 6.9

hrs at Capacity / hrs of Operation 3.2

Mean Wind Speed 16.5 MPH

Energy Produced 8,709,745 kW-hrs

Annual Production Rate 5,740,961 kW-hrs

Capacity Factor .40

13290 hrs of Good Data 582 hrs Missing 95.8% Data Recovery

Table 19 – Theoretical Energy Estimate for Micon NM82 on 80M Tower

```
     THEORETICAL WIND TURBINE PRODUCTION           11/01/02 -
05/31/04

     Wind:      50M WIND SPEED (CH1)
              Chilocco Indian School

              Wind Speeds Multiplied By  1.11

     Turbine: NEG MICON 1.65 1.18KG/M**3 3/04

              Rated at:        1650 kW at 31.3 MPH
              Maximum Output:  1650 kW at 45.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 8.9	1824	13.7		
Cut-in To Rated	9.0-31.3	10914	82.1	8,560,182	90.4
Rated To Cut-out	31.4-56.0	552	4.2	904,200	9.6
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11466	86.3		

```
     kW-hrs at Capacity / Total kW-hrs     9.6

     hrs at Capacity / hrs of Operation    4.8

     Mean Wind Speed                      17.3 MPH

     Energy Produced                 9,464,382 kW-hrs


     Annual Production Rate          6,238,374 kW-hrs

     Capacity Factor                       .43


     13290 hrs of Good Data    582 hrs Missing     95.8% Data Recovery
```

The loss factors for a project on the Chilocco Indian School are estimated to total 15%, so the gross to net ratio is assumed to be 0.85. The projected gross theoretical energy output, net theoretical energy output, and net capacity factors are presented in Table 20.

Table 20 – Theoretical Energy Projections and Net Capacity Factors for The GE 1.5MW Turbine, the Vestas V-80 Turbine, and the NEG Micon 1.65MW Turbine

Supplier	Rating (MW)	Rotor Diameter (m)	Hub Height (m)	Theoretical Gross Output (kWh)	Theoretical Net Output (kWh)	Net Capacity Factor
GE	1.5	70.5	65	4,662,000	3,963,000	30.2%
GE	1.5	70.5	80	5,127,000	4,358,000	33.2%
GE	1.5	77	65	5,114,000	4,347,000	33.1%
GE	1.5	77	80	5,571,000	4,736,000	36.0%
Vestas	1.8	80	65	5,671,000	4,820,000	30.6%
Vestas	1.8	80	80	6,224,000	5,290,000	33.5%
NEG Micon	1.65	82	65	5,741,000	4,880,000	33.8%
NEG Micon	1.65	82	80	6,238,000	5,303,000	36.7%

**“KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY”
Tribal Load Assessment and Export Markets**

The Kaw Nation commercial facilities are served by Kay Electric Cooperative in Kaw City and exclusively by the City of Newkirk Municipal Utility. Other than the Chilocco Indian School, the Kaw Nation does not own large parcels of tribal land in Oklahoma. The community of Newkirk purchases it electricity from the Oklahoma Municipal Power Authority (OMPA), which serves as an aggregator for municipals. The principle loads within the tribe are the casino, the health center and the tribal headquarters. Each of these facilities would benefit from an energy audit and the deployment of demand side management technologies. In addition an analysis of the existing loads of the local utility and the future requirements of that utility should be conducted. The analysis would provide the tribe with the necessary information to select a strategy of self supply and/or export supply. Based on the decisions and direction of the tribe, Disgen will engage the local utility or its wholesale electricity supply in order to discuss the potential of a power purchase agreement.

The Kaw Nation has tentatively decided to proceed with the development of a thirty megawatt (30 MW) wind project which will necessitate the exporting of the energy to a utility buyer. While the Kaw Nation may wish to consume some of the energy locally, the transmission system and the likely purchaser, i.e., a large utility, limit that possibility dramatically. The best method for the Kaw Nation in providing the economic benefit to its members is to sell the energy to either OG&E or OMPA and distribute the proceeds to the members as determined by the General Council. Disgen will continue to define options for tribal consumption of the energy.

Transmission and Interconnection Consideration

The interconnection possibilities for a commercial wind facility at the Chilocco Indian School are twofold; (i) to an existing three-phase distribution feeder that interconnects with the Newkirk Municipal Utility and (ii) a 115 kV transmission line located about one mile west of the project location and owned by OG&E. The transmission line allows for a 30 MW wind facility which fits the project area nicely. The distribution feeder will be the primary limitation followed by the size of transformer in the Newkirk Substation, should the tribe desire to interconnect the wind facility to the local supplier.

The preferred project collection system will consist of a 34.5 kV buried cable, interconnecting to a small substation adjacent to the 115 kV sub-transmission line stepping the voltage up to 115 kV. The interconnection will require a switch, relay, and a meter, transformer and other equipment at the interconnect point.

The Kaw Nation would like to deliver at least some of the energy from a potential wind facility to its commercial facilities. Such a transaction will require the cooperation of the local utilities and result in a loss of revenue for the utilities. It appears unlikely that such cooperation will be achieved.

“KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY”
Technology Analysis

The Kaw Nation and Distributed Generation Systems, Inc. (Disgen) examined three two potential renewable technologies for deployment on the Chilocco Indian School grounds; (i) biomass, and (ii) solar and (iii) wind.

Biomass: Disgen interview community leaders in Tonkawa, Ponca City and Newkirk, Oklahoma and Arkansas City, Kansas. The amount of wood waste biomass available is sufficient to support a small biomass energy generation facility. However, Disgen interviewed scientists at the National Renewable Energy Laboratory and was informed that power plants created solely for the production of electricity from biomass are not currently economically competitive. In order to be competitive, biomass projects must produce electricity and have an economic use for the waste heat or is constructed to supply non-energy related materials such as pulp and paper products. A typical use for the waste heat is a greenhouse. The Kaw Nation is not currently planning on pursuing a biomass facility.

Solar: For the most part, solar technologies have been relegated to special products due the relatively high cost of energy they produce. The only commercially competitive solar technology available currently is solar thermal which usually requires supplemental firing from a fossil fuel source such as natural gas. The Chilocco Indian School does have natural gas pipelines on the property, but the cost of natural gas is currently prohibitive to the development of solar-thermal projects. Disgen continues to explore other emerging solar technologies for the benefit of the Kaw Nation.

Wind energy: The Kaw Nation has collected and analyzed the wind resource at the Chilocco Indian School for one and one-half years. The average annual wind speed is 15.0 6 mph at fifty meters. The Wind Assessment Report prepared by Ed McCarthy indicates the project area is suitable for development (see Tab 8). Further, GE Wind Energy has announced a plan to reduce the cost of its wind turbines by one cent per kilowatt hour over the next two years. Such a cost reduction will improve the economics of the site and will compete with the economics of exiting wind facilities in Oklahoma. The grid access is available at two locations and both the Kaw Nation and Disgen believe the further development of the project area is warranted.

**“KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY”
Economic Analysis**

The economic analysis attached herein is created using the same project pro-forma models used for project financing within the wind industry. The assumptions integral to the models assume a third party taxable owner, not tribal non-taxable ownership. In order to obtain the lowest cost of energy and thereby compete economically in the marketplace, the Production Tax Credit (PTC) for wind energy as defined by the US Congress must be fully applied. That application requires an owner which has a significant federal tax liability and is not subject to the Alternative Minimum Tax (AMT). The PTC is not transferable and must be filed by the owner of the project.

Newly proposed tax legislation for wind energy contains a special provision for Native American owned facilities which allows the transfer of the PTC from the non-taxable tribe to another entity. This has tremendous value for the tribes and will facilitate greater economic development for the tribes.

Phase One Screening Report:

Kaw Nation Site

Kay County, Oklahoma

March 27, 2003

Prepared for:

DISGEN

Prepared by:

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Western **E**co**S**ystems **T**echnology, Inc.
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INTRODUCTION AND METHODS:

Wind energy is one of the fastest growing sources of "green" energy in the U.S. However, wind plants can have negative effects on wildlife. Although studies have shown both the direct and indirect effects on wildlife by most wind plants to be relatively low, state wildlife agencies, the U.S. Fish and Wildlife Service and environmental organizations have concern over the potential short and long term effects of wind plants on wildlife their habitat. State wildlife agencies and environmental organizations are concerned with issues such as impacts to critical wildlife habitat, habitat fragmentation created by development, avian fatalities and the disturbance or loss of unique plants and habitats. The U.S. Fish and Wildlife Service is charged with enforcing the Endangered Species Act, The Eagle Protection Act, and the Migratory Bird Treaty Act, and is concerned about impacts to migratory birds and listed species (candidate, proposed, threatened, or endangered). These concerns often lead to extensive wildlife monitoring studies generally paid for by the wind industry.

When exploring potential wind plant sites, knowledge of potential wildlife issues helps the wind industry identify and avoid possible conflicts with wildlife, state and federal natural resource agencies and private citizens concerned about natural resources. WEST, Inc was asked by DISGEN, Inc. to evaluate potential impacts to wildlife and wildlife habitat at a prospective wind plant site. The area is located within northern Kay County and immediately south of the Kansas – Oklahoma border (Figure 1). The area evaluated for potential wildlife impacts includes the development area and a two-mile buffer. This report focuses on the following wildlife issues:

- Raptor Issues
  1. Identifying areas of potentially high nesting density
  2. Identifying areas of potentially high prey density
  3. Examine topography to determine the potential for high use and nest locations
  4. Determine the species likely to occur in the area
  5. Determine the potential for migratory pathways
- Candidate, Proposed, Threatened, Endangered or State Protected Species
  1. Identify the potential occurrence of federally listed or state protected species through existing literature and database searches
  2. Evaluate the suitability of habitat at the wind plant site for protected species
- State Wildlife Issues (using existing state wildlife agency information)

1. Determine if site is considered a critical winter or parturition area or other highly valuable habitat
2. Determine if area is considered a migratory route for game species
3. Examine habitat during site visits to determine the potential for use by game or state protected species

- Unique Habitat
  1. Evaluate the uniqueness of the site relative to the surrounding area. For example: wildlife might be fatally attracted to a habitat desirable for wind

power development (a rocky bluff) surrounded by undesirable areas (short-grass prairie)
2. Determine the potential for sensitive or protected plants to occur on site through a habitat evaluation and a search of existing information

- Bats
  1. Determine the potential for bat deaths at the wind plant site. Proximity to potential feeding sites and hibernacula will be evaluated
  2. Determine species likely to occur in the area

- Avian Migratory Pathways

METHODS:

Biological resources within the project area were evaluated through a search of existing data and a site visit. The project area was visited on March 13, 2003 to evaluate habitat and look for raptor nests, prey populations and other biological resources.

Several sources were used to identify biological resources within the project area, including requesting data from the Kansas and Oklahoma Natural Heritage Programs. Several local wildlife authorities were also contacted from the Oklahoma Department of Wildlife Conservation (ODWC), Kansas Department of Wildlife and Parks (KDWP), the U.S. Fish and Wildlife Service (USFWS) and the Great Plains Nature Center (Table 1). A search of the existing scientific literature was also made. After biological resources within the project area were identified, the potential for conflicts was analyzed based studies conducted at other wind plants and information gathered during the site visit.

Table 1. A list of personal communications made to gather information on biological resources.

Name	Agency	Position	Date of Contact
Bill Wentroth	ODWC, Ponca City	Wildlife Biologist	3/25/03
Mark Howery	ODWC, Oklahoma City	Non-game Biologist	3/27/03
Charles Cope	KDWP, Wichita	Wildlife Biologist	3/25/03
Bob Gregg	Great Plains Nature Center, Kansas	Naturalist	3/25/03
Randy Rodgers	KDWP, Hays, Kansas	Greater Prairie Chicken Biologist	3/25/03
Dan Mulhern	USFWS, Kansas	Wildlife Biologist	3/26/03

Study Area. The proposed project is located within Oklahoma, just south of the Kansas border (Figures 1-2). The proposed project area is characterized by gently rolling grasslands surrounded by agricultural fields (Figure 3). An abandoned school, Chilocco Creek and an associated woody riparian area are present within the project. Several small water impoundments are also present. Grasslands within the project area are interspersed with 2 – 8' tall cedar and Osage orange. A few small wheat fields are present.

RESULTS:

Raptor Issues

Nesting density and species occuring in the area. Nesting habitat for most raptor species in the project area is limited to wooded riparian areas, lone cottonwoods within grassland habitats and wooded fencerows. Ground nesting species, such as northern harriers and short-eared owls may nest within grassland habitats. Raptor species likely to nest within the project area include red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), and great horned owl (*Bubo virgianus*). Other species potentially nesting within the project area include short-eared owl (*Asio flammeus*), barn owl (*Tyto alba*), eastern screech owl (*Otus asio*), barred owl (*Strix varia*) and burrowing owl (*Athene cunicularia*), Swainson's hawk (*Buteo swainsoni*), red-shouldered hawk (*Buteo linneatus*), broad-winged hawk (*Buteo platypterus*), Cooper's hawk (*Accipiter cooperi*), and Mississippi kite (*Ictinia mississippiensis*).

Although no raptor nests were observed during the site visit, suitable nesting habitat for raptors is present within the project area. Overall, we rate the potential for raptor nests to occur within the project area as high. Based on the fact that no raptor nest structures were observed during the site visit, it is unlikely that the proposed project area supports extraordinary high densities of nesting raptors.

While the project area likely does not support extraordinary densities of nesting raptors, relatively large numbers of red-tailed hawks and other raptors may winter within the project area. During the winters of 1983-1984, 1984-1985 and 1985-1986 in tall grass habitats in Noble County Lish and Burge (1995) documented higher densities of wintering red-tailed hawks than reported from any area within the U.S. Noble County is located immediately south of Kay County. The authors speculated that tall grass habitats within Noble County provide exceptional winter habitat due to the presence of perches (hedgerows, powerlines etc) and high abundances of prey. The authors also speculated that winter storms often dissipate near the Kansas – Oklahoma border, providing relatively milder conditions for wintering red-tailed hawks. Much of the proposed project area occurs within prairie habitat, and may provide quality winter habitat for red-tailed hawks and other buteos, such as northern harriers.

Potential for prey densities. A variety of prey species likely occur within the development area throughout the year, including a variety of rodents. Several species of songbirds may occur during migration and the breeding seasons. No large concentrations of prey were observed during the initial site review, such as ground squirrel (*Spermophilus* spp) or prairie dog (*Cynomys* spp) colonies.

Due to the presence of prairie habitat, the area has the potential to support relatively high densities of prey species. However, because no obvious signs of colonial rodents were observed during the initial site review and no other factors were noted which would provide an extraordinary attractant for hunting raptors, the site, in its current condition, is given a medium potential for prey densities.

Does the topography of the site increase the potential for raptor use? At other wind plants located on prominent ridges with defined edges, raptors fly along the rim edges, using wind updrafts to maintain altitude while hunting, migrating or soaring. Turbines are often placed on prominent ridges in order to use higher wind speeds and updrafts that raptors also use. This development area does not contain any sharply defined ridges. While raptors likely hunt and fly through the project area, the topography of the site does not increase the potential for raptor use.

Federal and State Protected Species

Based upon species lists obtained from the USFWS web site for Kay County (USFWS 2003), existing literature, and habitat present within the project area, seven state (Oklahoma) or federally protected species have potential to occur within the development area (Table 1). Federal "Species of Concern" (SoC) or species protected by the Kansas Endangered Species Act are not addressed in this report unless they also are protected under the Oklahoma Endangered Species Act. It is unlikely that any of the federally protected species listed in Table 2 will occur regularly within the project area.

Table 2. A list of federally and state (Oklahoma) protected species potentially occurring within the project area.

Species	**Federal Status**	**State Status**
Bald Eagle (*Haliaeetus leucocephalus*)	Threatened	Threatened
Interior Least Tern (*Sterna antillarum*)	Endangered	Endangered
Piping Plover (*Chadradrius melodus*)	Threatened	Threatened
American Burying Beetle (*Nicrophorus americanus*)	Endangered	Endangered
Western White-Fringed Prairie Orchid (*Platanthera praeclara*)	Threatened	N/A
Whooping Crane (*Grus americana*)	Endangered	Endangered
Black-tailed prairie dog (*Cynomys ludovicianus*)	Candidate	None

Bald eagles are commonly found in Oklahoma during the winter (Sutton 1967, Mark Howery, pers. comm.). Although less common during the summer, bald eagles are documented as nesting near large bodies of water in Oklahoma (Sutton 1967). Within the vicinity of the project area, bald eagles are documented as nesting along the Arkansas River and Kaw Lake (Mark Howery, pers. comm.). Oklahoma serves as a wintering area for many bald eagles breeding farther to north and ranks among the top ten in states for numbers of wintering bald eagles (OKDWC No Date). Kaw Lake, located approximately 10 miles southeast of the project area, consistently supports 60 – 80 bald eagles each winter (Mark Howery, pers. comm.). Wintering bald eagles in Oklahoma are most often found close to large bodies of open water, however, they occasionally fly and hunt within upland areas (Sutton 1967). The proposed project area is located within an upland area approximately 10 miles from Kaw Lake and approximately 3 miles from the Arkansas River. Bald eagles may occasionally fly, hunt and scavenge within the project area. The project area is currently grazed by cattle. Bald eagle use of the project area may increase during the calving season as bald eagles may attempt to scavenge after birth and still born calves. However, the majority of eagle use within the region is expected to be concentrated along the Arkansas River and Kaw Lake. While the potential for bald eagles to collide with the proposed turbines exists, the probability of such collisions occurring is expected to be very low. No bald eagle fatalities have been documented at other wind plants within the U.S. (Erickson et al. 2001).

The interior least tern and the piping plover are listed as potentially occurring within Kay County, Oklahoma and Cowley County, Kansas (USFWS 2003, Dan Mulhern, pers. comm.). Both species typically occur and nest on large sandy areas, such as sand bars or shorelines. Potential habitat for these species within the region is limited to the Arkansas River. While the potential exists for these species to rarely fly through the project area during migration, no habitat for these species is present within the project area. The Arkansas River and associated sandbars are located approximately 3 miles from the project area. It is unlikely that the piping plover and the interior least tern will collide with turbines within the project area.

Little is known concerning the historical distribution and habitat requirements of the American burying beetle and the western white-fringed prairie orchid. Both species are thought to have occurred within tall grass prairie habitats, and their decline may be due to habitat loss and loss of naturally occurring disturbances. Due to the presence of prairie habitat within the project area, the potential exists for a relic population to occur. However, the potential is considered very low, and neither the Kansas nor the Oklahoma USFWS offices list these species as potentially occurring within Kay or Cowley Counties. Assuming populations of these species are not present at the site, the proposed project should not affect the burying beetle or fringed prairie orchid.

The whooping crane migrates through western Oklahoma between its wintering grounds in Texas and breeding areas in Canada, but occasionally occurs along rivers and in agricultural fields throughout Oklahoma during migration (USFWS 1992). The Salt Plains National Wildlife Refuge, located approximately 70 miles west of the project area, is an important stopover site and occurs on the whooping crane's migration route between Canada and Texas (Meine et al. 1996). The potential exists for a whooping crane to occur within the project area during migration. However, this is expected to be a very rare event, and it is unlikely the proposed project will affect whooping cranes.

The black-tailed prairie dog is listed as a candidate species and as occurring within Kay County, Oklahoma (USFWS 2003). As a candidate species, the black-tailed prairie dog receives no special protection under the Endangered Species Act. No prairie dog colonies were observed during the site visit.

STATE WILDLIFE ISSUES AND UNIQUE HABITAT

Greater prairie chicken (*Tympanuchus cupido*) populations are declining within the state of Oklahoma and all hunting seasons on the species in Oklahoma are closed (Bill Wentroth, pers. comm.). Reasons for the decline are unclear, but may be attributed to loss of prairie habitats to development and agriculture, and changes in grazing and burning regimes of remaining grassland habitats. Researchers and agency personnel in the Great Plains have expressed concern over the potential greater prairie chickens to avoid areas where large, manmade structures are built. The proposed project area contains grazed tall grass prairie surrounded by agricultural fields and the potential exists for prairie chickens to use the project area for leks, nesting and brood rearing habitat.

As described earlier, the project area contains grazed prairie surrounded by agriculture fields. Grassland habitats within this portion of Oklahoma are relatively rare. Prairie habitats are used by a variety of songbirds and mammals. Tall grass prairie habitats in Oklahoma may also provide excellent wintering habitat for red-tailed hawks. Due to the presence of a relatively rare habitat within the project area, densities of grassland songbirds and hunting raptors may be higher at the site than in the surrounding agricultural areas.

Overall, the project area is given a rating of high for habitat uniqueness.

BATS

A total of 22 species of bat occur within Oklahoma. Based on Bat Conservation International (BCI) range maps, eight bat species may occur within the project area (BCI 2002): big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), cave myotis (*Myotis velifer*), evening bat (*Nycticeius humeralis*), eastern pipistrelle (*Pipistrellus subflavus*), and Mexican free-tailed bat (*Tadarida brasiliensis*). It should be noted that relatively little research has been conducted on bat distributions, and the relative abundance of bat species within the development area is difficult to determine.

Potential roosting and foraging habitat for bat species is present within the development area. Bats may forage over the entire project area. Roosting habitat is present within wooded habitats and old buildings within the project area.

Bat casualties are found more often than birds during carcass searches at some wind plants in the U.S. Most of the bat casualties at wind plants to date are migratory species which conduct long migrations between summer roosts and winter hibernacula such as hoary bats, silver-haired bats and red bats. The high number of migratory bat deaths at wind plants may be related to the lack of echolocation during migration (Johnson et al. 2002). Based on bat casualties found at other wind plants, it is likely that migrating hoary bats, silver-haired bats and red bats will make up the majority of casualties within the proposed wind plant.

With the exception of the Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*) and the Ozark big-eared bat (*Corynorhinus townsendii ingens*), none of which occurs within the project area, bat species within Oklahoma do not receive federal or state protection. Some are listed as federal Species of Concern (SOC) which does not provide formal protection. However, bat deaths at wind plants are receiving increased attention from state and federal wildlife agencies. The ODWC may request baseline studies to determine species diversity and concentrated use areas and they may require carcass searches to be conducted during operation of the facility to document the level of impact.

NOCTURNAL MIGRATORY SONGBIRDS AND WATERFOWL

Many species of songbirds and some waterfowl migrate at night and may collide with tall man-made structures. Large numbers of songbirds may collide with structures at lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Birds appear to become confused by the lights during foggy or low ceiling conditions, flying circles around lighted structures until they become exhausted or collide with the structure. To date, no large mortality events have been documented at wind plants in North America (Erickson et al. 2001). However, turbines used by many wind developers are getting taller and are required to be lighted by the Federal Aviation Administration, increasing the risk of collision by nocturnal migrants with wind turbines.

The proposed wind plant does not appear to be located within an obvious migratory funnel for birds. Raptor, songbird, and waterfowl / waterbird migrations likely occur across broad areas moving in north – south orientation. Waterfowl migrations in the area are thought to be relatively heavy (Mark Howery, non-game biologist, ODWC, pers. comm.). Migrating birds likely use areas along the Arkansas River and tributaries, as stopover areas for feeding and resting, and migrating birds may occur more often in these areas. The project area occurs approximately 3 miles from the Arkansas River, and Chilocco Creek is present within the project area. Most songbirds migrating through the project area will be grassland species (Mark Howery, non-game biologist, ODWC, pers. comm.). Riparian areas associated with these waterways likely are used as stopover habitats for migrating songbirds. The Migratory Bird Treaty Act, administered by the U.S. Fish and Wildlife Service, protects many of these species. The overall risk of collision between birds and the proposed wind turbines will depend largely on the type of turbine chosen for the development, and cannot be evaluated at this time.

DISCUSSION:

Wildlife issues facing the proposed project area revolve around the presence of tall grass prairie in the project area. The largest issues facing the proposed project area is potential use of prairie habitats by high densities of wintering raptors and greater prairie chickens. If prairie habitats within the project area support densities of wintering raptors similar to those documented in Noble County (Lish and Burge 1995), species such as red-tailed hawks, northern harriers and rough-legged hawks (*Buteo lagopus*) may have an increased risk of collision with turbines. While these species are not protected under the Endangered Species Act, they do receive protection under the Migratory Bird Treaty Act.

The project area also contains potential habitat for greater prairie chickens. If greater prairie chickens occupy the project area, the ODWC will likely be concerned over the potential effects of the proposed wind plant to render habitat unsuitable for greater prairie chickens. Other potential ODWC concerns with the project may include waterfowl migrations in the project area. Due to the presence of water impoundments within the project area, there may be an increased potential for waterfowl fatalities within the project area.

The potential for species protected under the federal and Oklahoma Endangered Species Acts to occur within the project area is considered low. Although Oklahoma hosts one of the largest populations of wintering bald eagles within the U.S., most eagle use in the area is expected to be concentrated along the Arkansas River and Kaw Lake, from 3 – 7 miles from the project area.

The two largest issues facing the proposed project are potentially high densities of wintering raptors and potential presence of greater prairie chickens. If the area receives a high level of use by wintering raptors, the potential exists for raptor fatality rates to exceed those documented at other wind plants. Outside of California, documented raptor fatality rates at newer generation wind plants have been relatively low, the highest being Foote Creek Rim in Wyoming at 0.036 raptor fatalities / turbine / year (Erickson et al. 2001). If the proposed project proceeds, well designed baseline studies can identify areas of high use by birds and impacts minimized through appropriate turbine placement.

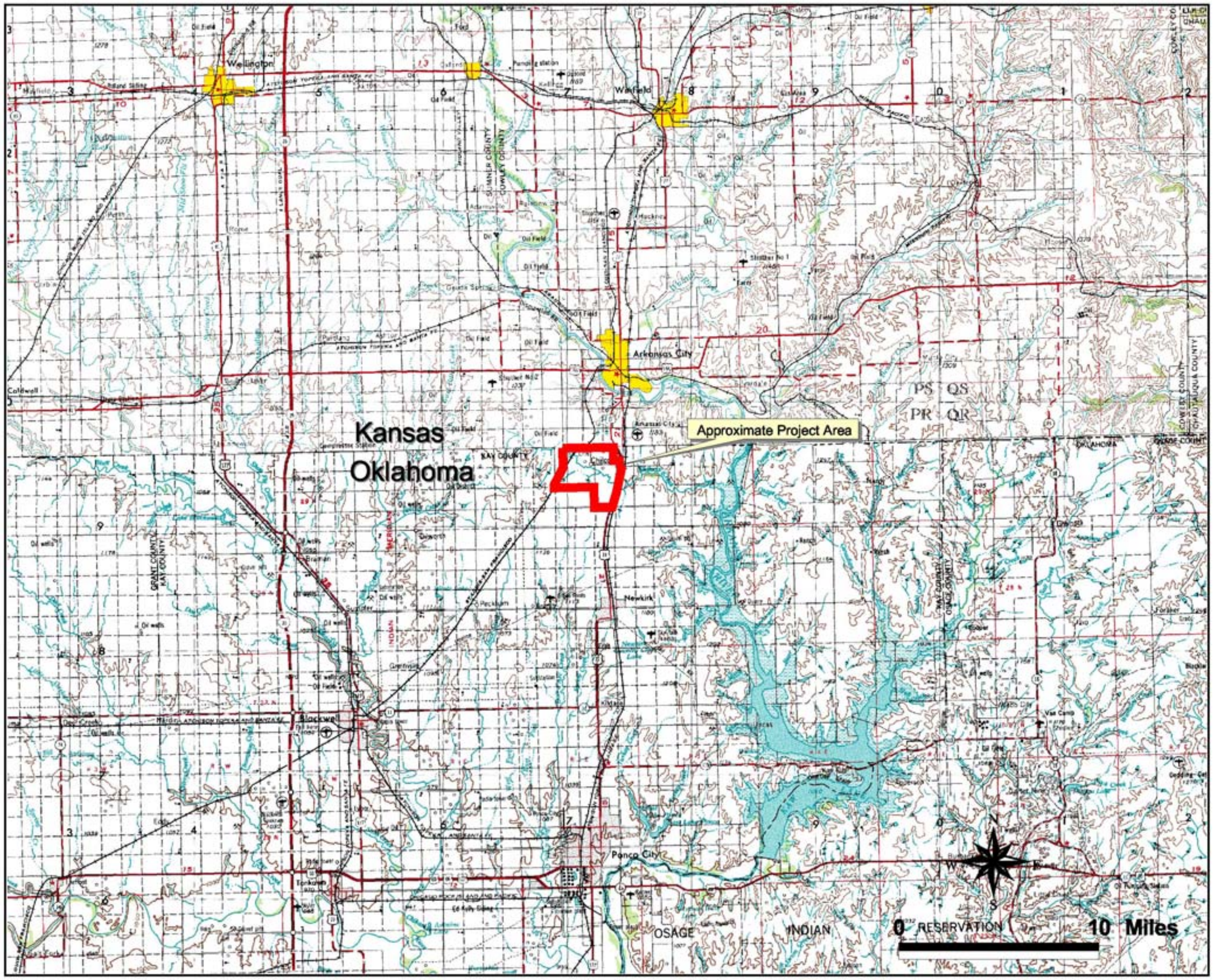


Figure 4. A map showing the approximate location of the project area.

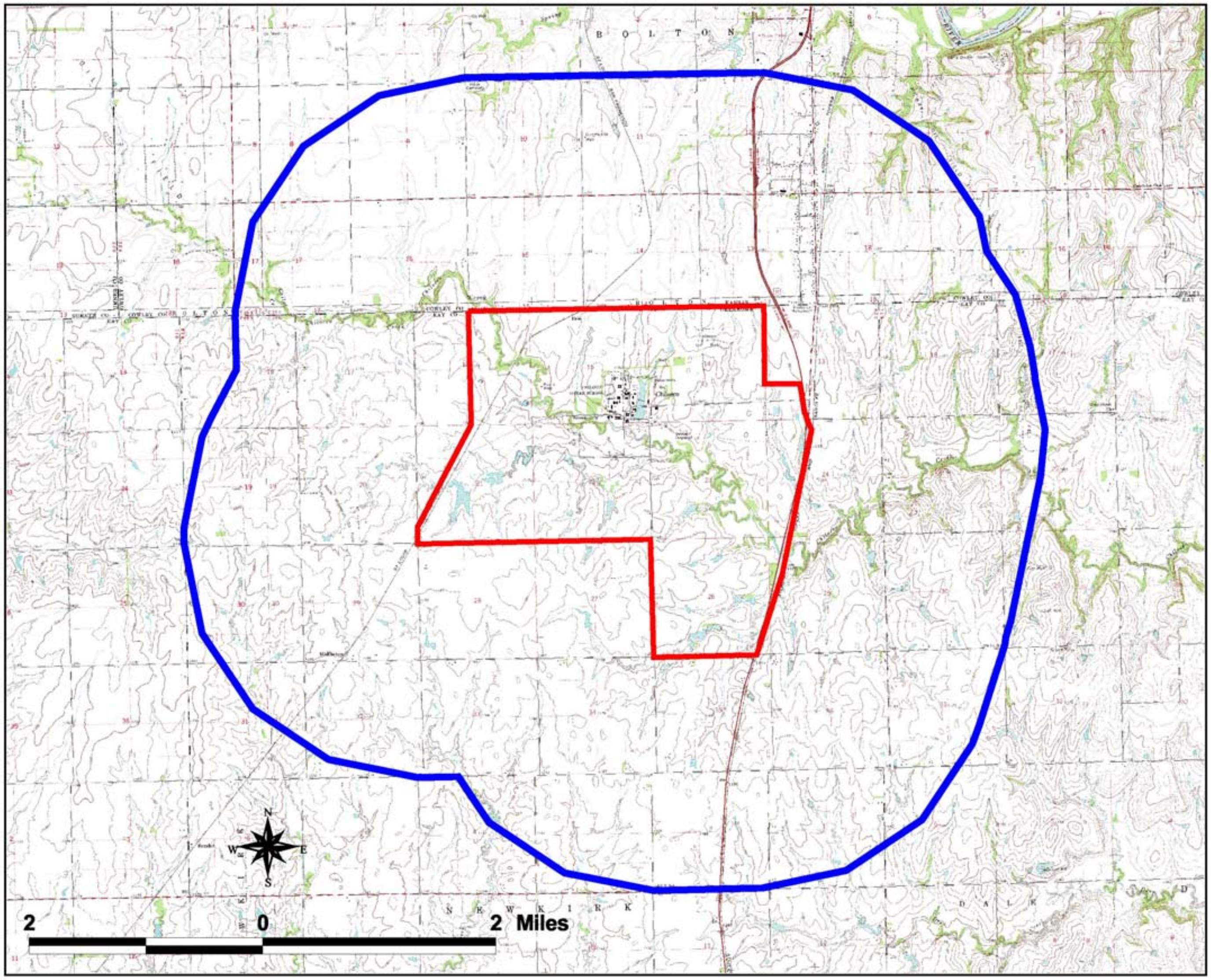


Figure 5. The approximate project area and a two mile buffer.

Figure 6. A photo of grazed, tall grass prairie habitat in the project area.

Table 3. A summary of the potential for wildlife conflicts in the proposed wind development area[1]. VH = Very High, H = High, M = Medium, and L = Low.

Issue	**VH**	**H**	**M**	**L**	**Notes**
Potential for raptor nest sites		✓			Mature trees provide potential nesting habitat
Raptor flight potential		✓			Ridges are shallow in the project area. However, area may be heavily used by wintering raptors.
Potential for raptor migratory pathway			✓		Raptors move through area, but likely are not funneled
Potential for raptor prey species		✓			Grassland habitats provide habitat for several prey species
Potential for protected species to occur				✓	Some may occasionally fly through project area
Potential for Big Game Issues				✓	
Uniqueness of habitat at wind plant		✓			Project area is tall grass prairie surrounded by agriculture
Potential for rare plants to occur				✓	Low to no chance for fringed prairie orchid to occur
Potential for use by bats		✓			Area may receive high use by bats, but most casualties are expected to be migrants
Other issues			✓		

[1] Summarized for the project area as a whole but the habitat of the project area varies throughout in its ability to support species of concern.

Literature Cited:

Bat Conservation International (BCI). 2002. U.S. Bats by State. http://www.batcon.org/discover/species/ok.html

Erickson, W.P., G.D. Johnson, M.D. Strickland, K.J. Sernka, and R.E. Good. 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. Prepared for the National Wind Coordinating Committee. Available at http://www.west-inc.com

Johnson, G., W. Erickson, M.D. Strickland, K. Sernka, K. Kronner and B. Gritski. 2002. Analysis of potential avian/wind plant interactions in Klickitat County, Washington: Supplement to the Klickitat County Programmatic Environmental Impact Statement.

Lish, J.W. and L.J. Burge. 1995. Population characteristics of red-tailed hawks wintering on tall grass prairies in Oklahoma. Southwestern Naturalist 40(2): 174-179.

Meine, Curt D. and George W. Archibald (Eds). 1996. The cranes: - Status survey and conservation action plan. IUCN, Gland, Switzerland, and Cambridge, U.K. 294pp. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/distr/birds/cranes/cranes.htm (Version 02MAR98).

Sutton, G.M. 1967. Oklahoma Birds. University of Oklahoma Press, Norman.

USFWS 1992. Oklahoma Endangered Species Accounts. http://ifw2es.fws.gov/Oklahoma/whooper.htm

USFWS 2003. Oklahoma Endangered Species by County. http://ifw2es.fws.gov/Oklahoma/ctylist.htm

"KAW NATION
WIND -SOLAR-BIOMASS FEASIBILITY STUDY"
Benefit Assessment

Description of Tribal Economic Benefits: The tribe will benefit economically from the deployment of renewable energy technologies in several ways. If the renewable resource is developed for sale of energy for the export market and the Project is owned by institutional investors, the Tribe will recognize economic benefits from jobs and the associated payroll, land lease payments, and Tribal taxes. In the example project pro-forma included in Tab 12 of this report, these values are approximately $6-$7 million over the life of the project. If the tribe owns the renewable facility, then the economic gain normally realized by the owner of such a project will accrue to the tribe; although this increment is small compared to the value of the above items. It is the objective of both the tribe and Disgen that construction and operations and maintenance jobs created as a result of the project must be awarded to tribal members. Such jobs are high quality (manufacturing equivalent) and long term. Further, a training program for tribal members will be established to fill such jobs as the opportunity for project expansion arises.

Environmental Benefits and Impacts: The environmental benefits will be determined by the number of kilowatt hours produced per year and the associated emissions avoided. Disgen will subsequently analyze the environmental impact based on the local electricity producers and the emissions history of those producers. Each kilowatt hour generated by a specific fossil fuel plant has an emission footprint. That data multiplied by the number of kilowatt hours produced by the renewable facility will result in a table of avoided emissions annually.

If properly sited, the renewable facility will have little, if any, adverse environmental impacts. However, if warranted, avian analyses may be conducted over several years and a noise assessment may be performed.

Culturally, tribes and their members take from nature only what is needed. Renewable technologies are at-one with the culture.

Socially, the greatest benefit will be derived form the creation of jobs and the expansion of the capabilities of the Sovereign Nation. The ability to serve an export market will do much to improve the economic status of the tribe and those economic benefits will accrue to the whole population.

Tribal Benefits: If and when the facility is constructed, the tribal benefits will be recorded in economic terms; the number of jobs created, the incremental cash flow to the tribe, the value of the energy purchases offset by the use of the renewable energy on the reservationwithin Kaw Nation's jurisdiction.. In addition, the educational benefits will be defined by the training programs and the graduates entering the wind industry, on tribal lands and off.

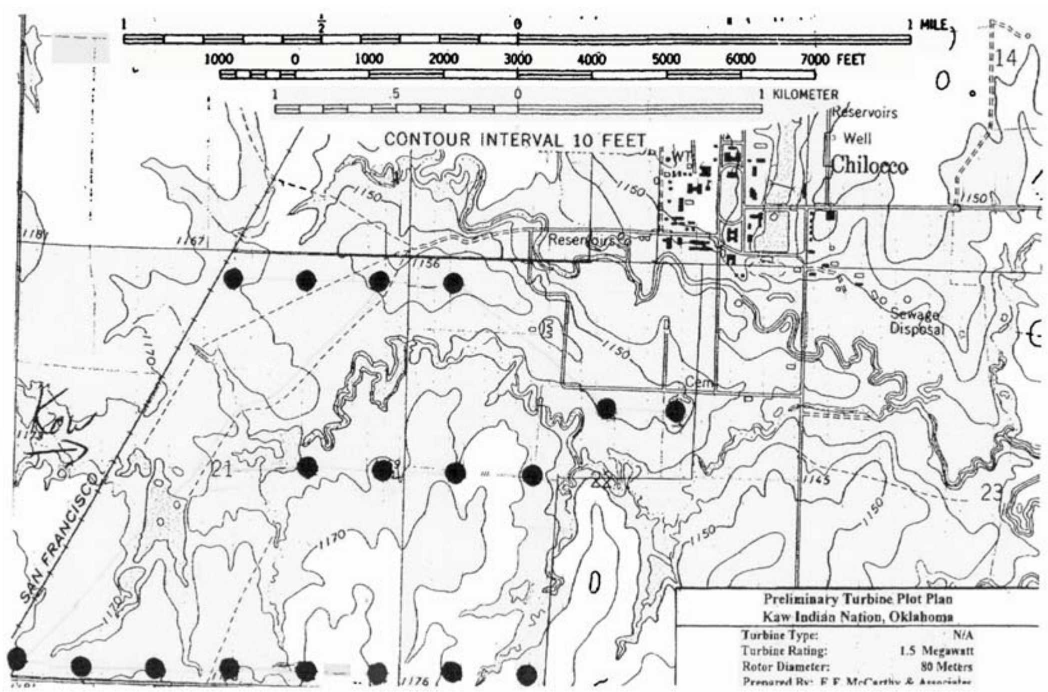
Potential Barriers and Plan of Mitigation: The single largest potential barrier is the possible unwillingness of any of the power purchasers in refusing to enter into the Power Purchase Agreement (PPA). The PPA is the financeable asset and is the basis for obtaining financial commitments from investors. It is not possible to know at this early stage of development whether the markets two years hence will be motivating such purchases. TheKaw Tribe Nation and Disgen will make every effort to motivate the buyers, but ultimately the decision on the PPA will reside with that buyer. Such is the risk of every renewable energy development. As the project is developed for export, the local utility may impose onerous wheeling rates as to render the project uneconomic. The resolution to these issues is negotiation between the parties to minimize the impact to each party. In addition, the emergence of the "Green Tags" market and national renewable portfolio standards will resolve most of these issues. These green tags and portfolio standards will allow the unbundling of the environmental attributes form the physical energy. The green tags will become the marketable asset and the physical energy will remain a commodity.

In the end, the only real showstoppers on renewable energy are (a) lack of resource, (b) lack of transmission and (c) lack of market.

"KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY"
Preliminary System Design

The Kaw Nation's wind project resulting from the feasibility study has been determined by the nationfrom a land-availability perspective optimization to be approximately thirty megawatts (27 MW). Without working with other tribes owning adjacent lands, the project area will accommodate only the 30 MW. Other tribal partnerships could expand this power generation capability by making available more land for turbines.

The wind turbine used to create a preliminary site plan is the GE Wind Energy 1.5 MW. A total of twenty (18) wind turbines have been located within the project area. This Below is a copy preliminary layout of the site plan.



The interconnection will be either to the Newkirk Municipal Utility at its substation (south) or to OG&E at its 115 kV transmission line to the west of the project site. Neither of these utilities has conducted any transmission studies, but it is believed based on Disgen's preliminary analyses that each of the interconnections is feasible. Should further funding become available for a detailed transmission analysis, Disgen, at the direction of the Kaw Nation, will submit the necessary applications to the Southwest Power Pool for the appropriate studies.

The system design is consistent with all commercial wind facilities being developed domestically (North America).

"KAW NATION
WIND -SOLAR-BIOMASS FEASIBILITY STUDY"

Tribal Training and Professional Development

During the feasibility study, tribal Kaw Nation representatives from the Tribal Kaw Nation Utility Commission (KNUC), the Tribal Historical Preservation Office (THPO)NAGPRA Program (NAGPRA) and the Tribal Environmental Department (KNED) participated in analyzing the location of the meteorological tower and conducting the archaeological analysis prior to installation of the tower.

The Tribal Administrator KNUC Director and staff for the feasibility study learned the skills required to install, maintain and service the meteorological tower and to remove and reinstall the data cards from the datalogger. In addition, summary data has been analyzed and supplied to the administrator Director along with training in understanding the data.

The Tribal AdministratorKNUC, the Environmental DepartmenNAGBRA Directort and THPO KNED staff have been involved in the detailed preliminary planning of the environmental studies and have participated in the studies. THPO The NAGPRA Director has managed the cultural studies.

As the development phase of the project proceeds, the tribal membership will receive training through General Council meetings which will occur monthly during the development period.

“KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY”
Long Term Operating and Maintenance Planning

As a result of the feasibility study, the Kaw Nation plans to submit an application to DOE for the pre-construction development activities leading to a 30 MW commercial wind facility at the Chilocco Indian School. The preliminary economics of that facility are included in Tab #12 of this report.

Imbedded in the economics are the costs to operate and maintain the facility. These costs are categorized as warranty, operations and maintenance, and administration costs. For the GE Wind Energy 1.5 MW wind turbine, it is assumed the warranty cost is included for the first two years in the price of the wind turbine. While an additional three years of warranty may be purchased from the manufacture, such a purchase assumption is not included in this preliminary financial model. Subsequent to the five year warranty period, a solicitation for qualified O&M providers will be conducted and the Kaw Nation or investors will select a longer-term O&M provider.

The operations and maintenance (O&M) cost is assumed to be $20,000 per wind turbine per year escalating with inflation. It is now known this assumption is about 15% conservative. The O&M plan includes routine preventive maintenance which requires two visits per year and unscheduled maintenance as needed to correct any other issues. A project of this size is likely to employee two full time technicians. The unscheduled outages may require engineers to be dispatched to the site for resolution of the more technical problems.

Administration is the function of collecting operational data, creating invoices for energy sales, delivering those invoices to the energy purchaser, paying the bills of the project and managing the maintenance contract of the maintenance provider. In addition, quarterly performance reports will be submitted to the debt and equity investors in the project. This report will include actual versus forecast in energy output as well as a meteorologist’s assessment of the output versus the actual wind resource available during that period. This is a task for one mid-level person with report review by a senior person. The budget is $30,000 per year escalating with inflation.

"KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY"
Plan for a Sustainable Renewable Energy Development Process

The Tribal ManagerKaw Nation Utilities Director of the feasibility study is was Bob Gaddis, P.E.. Bob has directed Disgen to provide its thoughts on the future of renewable energy development on the Chilocco Indian School. The principle objective is to provide economic benefit through the deployment of renewable technologies such that capital is available for the continued re-development of the school as a technical training center to support the aircraft industry job market in Kansas with Native American employees.

Having completed this initial feasibility study, the recommended near-term plan is to complete and construct the development of a 30 MW wind facility on the Kaw Nation owned land at the school. The cash proceeds from this development may provide funding for further development of the school facility itself. There are four other tribes who own abutting land which may allow a significant expansion of the wind facility should the transmission capacity be available and the other tribes desire to participate.

The long-term development plan is heavily dependent on national policy as it relates to incentives for renewable energy development and the pre-construction development funds made available to the Kaw Nation. It appears there are wood waste fuels available within a fifty mile radius sufficient to support a small biomass to energy project. Currently, such a project is not perceived to be economic without an economic use for the heat derived from the process. This situation is likely to change as time passes and improvements in technology emerge. In addition, there are new solar-thermal and gasification technologies currently being refined which may support a plan to capitalize on the hydrogen economy efforts.

If the Kaw Nation decides to commence the re-energy development of the Chilocco Indian School area, Disgen will provide its experience in energy efficiency technologies such as ground source heat pumps, energy control systems and lighting systems to support the school as a model of energy efficiency.

Preliminary Wind Resource and Theoretical Energy Estimates

Kaw Nation, of Oklahoma

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June, 2004

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What is the difference between Table 16 & 17?

What is the difference between capacity factor shown in eachtable and the "net" capacity factor shown in Table 20?

1.0 Introduction and Summary

A preliminary wind resource assessment is was prepared for the Chilocco Indian School on Tribal Trust Land owned by the Kaw Nation. The Chilocco Indian School is located in Kay County in north central Oklahoma, north of Ponca City. A 50-meter meteorological tower was installed on the reservation Kaw Trust land in November 2002 and over 18 months of data are were collected.

The average wind speed measured at 50-meters above ground level is for the period was 15.6 mph; the projected (calculated) annual average wind speed at 65-meters above ground level is 16.5 mph; and the projected annual average wind speed at 80 meters above ground level is 17.3 mph. A theoretical energy estimate, made for four turbines: the GE 1.5MW turbine with a 70.5m rotor diameter and a 77m rotor diameter, the Vestas V-80 turbine, and the NEG Micon NM82, and two turbine hub heights, 65 meters and 80 meters, are presented in Table 1. Assuming a gross to net ratio of 0.85, or 15% energy losses, the net capacity factor for the site ranges from 30.2% for the GE 1.5MW (70.5m) turbine on a 65m tower to 36.7% for a NEG Micon NM82 on an 80m tower.

Table 21 – Theoretical Energy Estimates and Net Capacity Factors for the GE 1.5MW Turbine, the Vestas V-8- Turbine, and the NEG Micon NM82 Turbine at the Chilocco Indian School.

Supplier	Rating (MW)	Rotor Diameter (m)	Hub Height (m)	Theoretical Gross Output (kWh)	Theoretical Net Output (kWh)	Net Capacity Factor
GE	1.5	70.5	65	4,662,000	3,963,000	30.2%
GE	1.5	70.5	80	5,127,000	4,358,000	33.2%
GE	1.5	77	65	5,114,000	4,347,000	33.1%
GE	1.5	77	80	5,571,000	4,736,000	36.0%
Vestas	1.8	80	65	5,671,000	4,820,000	30.6%
Vestas	1.8	80	80	6,224,000	5,290,000	33.5%
NEG Micon	1.65	82	65	5,741,000	4,880,000	33.8%
NEG Micon	1.65	82	80	6,238,000	5,303,000	36.7%

2.0 Wind Resource

The wind resource map of Oklahoma, prepared by staff from the National Renewable Energy Laboratory (NREL), and published in the Wind Resource Atlas of the United States, is presented in Figure 1. The Chilocco Indian School in Kay County is classified as Wind Power Class 3. Annual average wind speeds at 50 meters above ground level are estimated to fall into the range of 14.3 mph to 15.7 mph.

An updated wind resource map from the Oklahoma Wind Project Initiative (OWPI) is presented in Figure 2. This map also places the Chilocco Indian School in Wind Power Class 3.

Figure 7 – Wind Resource Map for Oklahoma

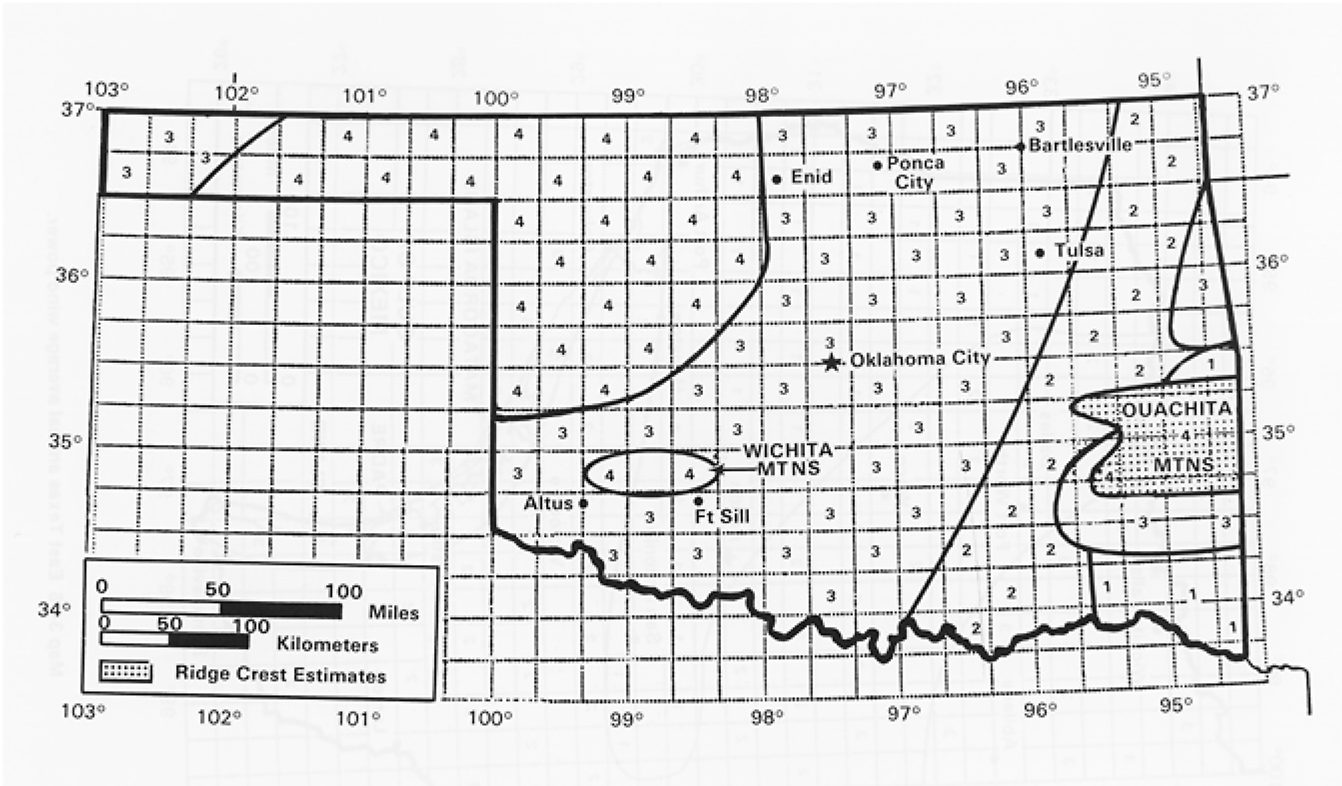
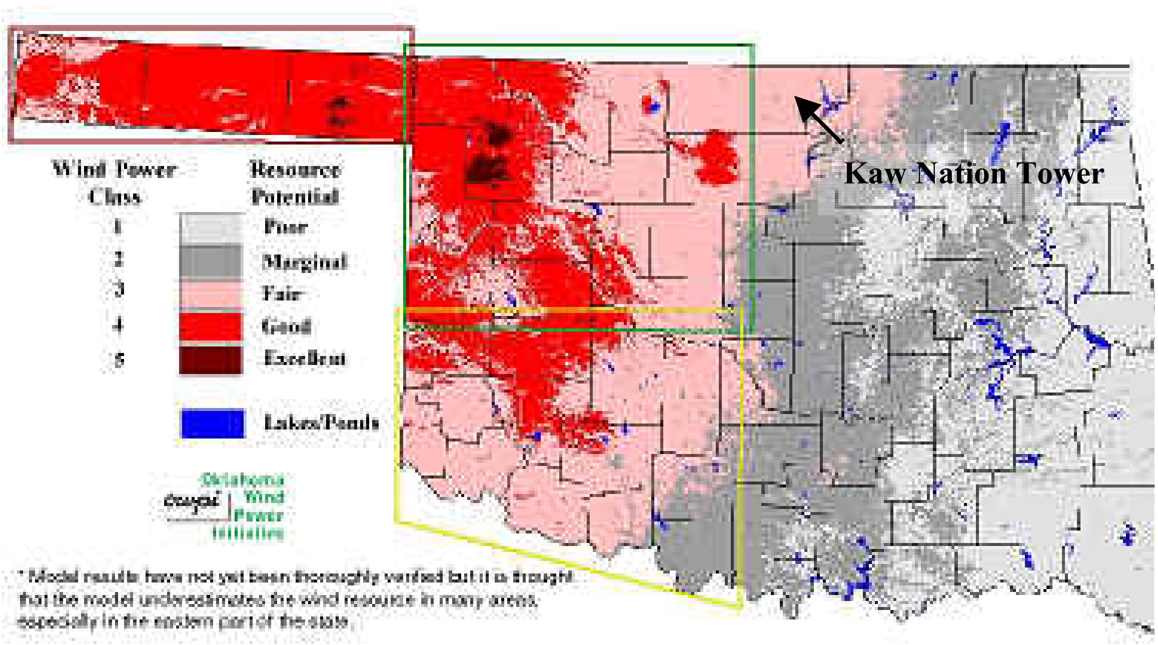


Figure 8 – Oklahoma Wind Resource Map Prepared by the Oklahoma Wind Power Initiative (OWPI)



3.0 Meteorological Data

3.1 On-Site Meteorological Monitoring Program

The meteorological tower was installed on the Chilocco Indian School in November 2002. This 50-meter NRG Talltowers is instrumented with three levels of wind speed and two levels of wind direction. One wind speed sensor is installed at 30-meter above ground level (agl), two wind speed sensors are installed at 40 meters agl, and two wind speed sensors are installed at 50-meters agl. One wind direction sensor is installed at 30-meters agl and one wind direction sensor is installed at 50-meters agl. Ambient air temperature is also collected at 2 meters above ground level. Maximum #40 anemometers and #200P wind directions sensors are used. A multiplier and offset of 1.711 and +0.8 is applied to convert the pulse counts from the Maximum #40 sensor to engineering units (miles per hour). The sensors are sampled once per second and hourly averages calculated using a NRG Systems Symphonie datalogger. The data is collected through use of a cellular telephone. Data recovery is excellent, exceeding 90% for all parameters.

3.2 Average Wind Speed

The average wind speed at the site over the period from November 2002 until May 2004 is 13.9 mph at 30-meters above ground level, 14.7 mph at 40 meters agl (both 40-meter parameters), and 15.6 mph at 50-meters agl (15.5 mph at the second sensor). Mean hourly summaries of the wind speed data are presented in Table 2 (30-meter data) to Table 6. The monthly average wind speeds reflect a spring season peak in the winds with a summer – fall minimum. The diurnal pattern of the hourly wind speeds at 50-meters agl (Tables 5 and 6) do not show a pronounced peak in the average wind speeds during the day or at night. However, examining the diurnal pattern of the 30-meter, 40-meter, and 50-meter average wind speeds, it is evident that at elevations above 50-meters, there most likely will be a pronounced nocturnal peak in the hourly average wind speeds which is typical for sites on the Southern Great Plains.

3.3 Wind Direction

The prevailing wind direction at the Chilocco Indian School is from the south. This is shown in a wind rose for the site (Figure 3). The wind rose is a graphical presentation of the joint frequency of wind speed (six wind speed categories) and wind direction (sixteen 22.5 degree sectors). The wind direction sectors with the highest frequency of occurrence are from 157.5 degrees to 202.5 degrees, or south- – southeast to south-southwest. The joint frequency of wind speed and wind direction is presented in a tabular format in Table 10 and Table 11.

Table 22 - Mean Hourly Wind Speed (mph) at 30 Meters

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
30M WIND SPEED (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	13.8	13.1	14.5	15.7	14.2	11.5	13.8	11.7	11.6	13.0	14.2	15.0	13.8
02	13.7	12.8	14.8	15.3	14.0	11.2	12.9	11.8	12.3	12.6	13.5	14.8	13.6
03	13.1	12.8	14.2	15.1	13.5	11.4	12.4	11.4	12.6	11.8	12.7	15.2	13.3
04	13.4	13.2	15.0	14.8	14.2	11.3	13.0	11.5	12.5	11.6	12.7	14.4	13.5
05	13.6	13.1	15.2	14.8	13.6	9.7	13.3	9.9	12.6	11.5	13.3	14.6	13.3
06	13.4	12.9	15.0	14.6	13.6	9.4	12.7	10.1	13.4	11.3	13.3	14.8	13.3
07	14.4	13.3	14.7	14.1	13.9	9.8	12.7	8.4	12.6	11.0	13.1	14.4	13.2
08	13.9	13.1	14.9	14.6	15.2	11.1	13.4	9.7	12.3	10.0	12.8	14.1	13.3
09	14.6	13.3	16.1	16.5	15.6	11.6	13.5	9.2	13.8	11.5	13.3	13.6	14.0
10	14.6	13.5	16.5	16.9	15.0	11.8	13.0	9.9	14.6	11.8	14.5	14.1	14.3
11	15.2	13.6	16.2	17.1	15.2	12.2	13.8	10.4	13.6	11.8	14.5	14.3	14.4
12	14.5	13.5	15.7	17.3	16.2	12.2	13.9	10.9	14.1	10.5	14.9	14.4	14.4
13	14.7	14.0	15.7	17.4	15.8	13.1	14.5	10.7	14.8	11.9	15.8	14.4	14.7
14	14.5	13.5	15.8	16.5	15.8	13.4	15.3	11.1	14.2	11.9	16.1	14.9	14.7
15	14.4	14.8	15.9	16.7	16.4	13.3	15.5	11.2	13.9	11.4	16.0	15.1	14.9
16	13.8	14.2	15.5	16.9	16.2	13.9	16.3	12.0	14.2	12.0	15.8	14.1	14.8
17	12.5	13.7	15.0	16.1	16.6	13.2	16.3	12.5	13.4	10.8	13.5	13.0	14.1
18	12.9	12.6	13.4	15.3	15.7	13.3	16.8	11.6	13.0	11.0	12.7	13.6	13.6
19	13.3	12.9	12.7	14.2	14.7	12.4	14.7	11.1	12.0	13.1	13.3	14.4	13.4

20	13.5	12.9	13.5	14.5	14.3	11.0	13.9	11.3	12.0	12.8	13.0	14.7	13.4
21	13.3	12.3	13.6	15.0	14.3	10.8	14.1	11.8	11.7	13.3	13.4	15.3	13.5
22	13.5	12.4	13.9	16.0	14.6	10.7	14.7	11.8	11.7	13.4	14.1	15.2	13.8
23	13.7	13.3	14.3	15.7	14.1	11.2	14.3	12.5	12.1	12.6	13.9	15.3	13.9
24	13.5	13.4	14.0	15.5	13.6	11.6	13.9	11.8	12.0	12.3	13.5	15.1	13.6
Mean	13.8	13.3	14.8	15.7	14.8	11.7	14.1	11.0	13.0	11.9	13.9	14.5	13.9
Good Hours	1454	1330	1488	1440	1358	720	711	744	720	734	1157	1433	
Missing Hours	34	38	0	0	130	0	33	0	0	10	283	55	

13,289 Hours of Good Data   583 Hours Missing   95.8% Data Recovery

Table 23 – Mean Hourly Wind Speed (mph) at 40 Meters (Logger Channel 3)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
40M WIND SPEED (CH3) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	15.2	14.4	15.7	17.0	14.3	12.6	15.3	13.1	13.2	14.8	15.6	16.5	15.1
02	14.9	14.1	16.1	16.9	14.7	12.5	14.4	13.1	13.6	14.3	14.9	16.3	14.9
03	14.2	14.2	15.6	16.8	14.3	12.4	13.9	12.5	13.8	13.4	14.2	16.6	14.6
04	14.5	14.6	16.4	16.2	15.2	12.7	14.5	12.5	13.9	13.4	14.4	16.0	14.8
05	14.9	14.5	16.7	16.5	14.2	10.8	14.7	11.0	13.8	13.3	14.8	16.2	14.7
06	14.5	14.4	16.4	16.3	14.3	10.5	14.1	10.9	15.0	13.1	14.7	16.4	14.6
07	15.5	14.8	16.1	15.6	13.8	10.4	13.5	9.3	14.1	12.8	14.5	16.2	14.4
08	15.5	14.3	15.9	15.7	15.0	11.3	13.7	9.6	13.1	11.1	14.1	15.4	14.2
09	15.6	14.2	16.8	17.3	15.3	11.7	13.8	9.2	14.3	12.1	14.1	14.9	14.5
10	15.0	14.4	17.2	17.4	14.5	12.1	13.2	9.9	15.1	12.3	15.3	15.0	14.7
11	15.7	14.3	16.8	17.7	14.7	12.3	13.9	10.3	14.2	12.1	15.2	15.2	14.8
12	15.1	14.0	16.2	18.0	15.5	12.1	14.3	10.8	14.8	10.8	15.8	15.0	14.8
13	15.2	14.6	16.3	18.0	14.8	13.1	14.7	10.6	15.3	12.3	16.6	14.9	15.0
14	15.1	14.3	16.4	16.8	14.6	13.5	15.5	11.0	14.7	12.3	17.0	15.8	15.1
15	15.0	15.5	16.6	17.1	15.3	13.6	15.8	10.9	14.4	11.7	17.0	15.8	15.2
16	14.4	14.9	16.1	17.3	15.7	14.0	16.6	12.1	14.8	12.5	16.8	14.8	15.2
17	13.3	14.4	15.8	16.8	16.0	13.3	16.5	12.5	14.0	11.5	14.6	14.1	14.5
18	14.0	13.3	14.4	16.1	15.2	13.6	17.2	11.7	13.7	12.0	14.2	14.9	14.3
19	14.4	14.0	13.9	15.5	14.5	12.7	15.1	11.6	13.0	14.7	14.8	15.8	14.3
20	14.7	14.0	14.7	16.0	14.2	11.5	14.8	12.2	13.0	14.4	14.7	16.3	14.5

21	14.7	13.2	14.9	16.2	14.2	11.7	15.5	13.0	12.8	15.1	15.0	16.9	14.7
22	14.9	13.5	15.2	17.4	14.7	11.6	16.2	12.9	12.8	15.0	15.7	16.9	15.0
23	15.3	14.6	15.5	17.0	14.6	12.0	15.9	13.7	13.3	14.2	15.5	16.9	15.1
24	14.7	14.8	15.4	16.8	13.8	12.7	15.4	13.1	13.2	14.3	15.0	16.7	14.9
Mean	14.8	14.3	15.9	16.8	14.7	12.3	14.9	11.6	13.9	13.1	15.2	15.8	14.7
Good Hours	1454	1331	1488	1265	945	720	711	744	720	734	1157	1409	
Missing Hours	34	37	0	175	543	0	33	0	0	10	283	79	

12,678 Hours of Good Data 1,194 Hours Missing 91.4% Data Recovery

Table 24 – Mean Hourly Wind Speeds (mph) at 40 Meters (Logger Channel 4)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
40M WIND SPEED (CH4) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	14.8	14.1	15.7	17.6	15.3	12.7	15.2	12.4	13.4	16.8	15.4	16.2	15.2
02	14.6	13.8	16.1	17.1	15.0	12.3	14.4	12.7	13.7	15.6	14.6	16.0	14.9
03	13.8	13.8	15.5	16.9	14.6	12.5	13.7	12.4	13.8	14.8	13.9	16.4	14.6
04	14.3	14.1	16.5	16.6	15.2	12.3	14.3	12.5	13.5	14.4	13.8	15.7	14.7
05	14.5	14.1	16.6	16.6	14.6	10.6	14.6	10.9	14.1	14.0	14.5	15.8	14.6
06	14.3	13.7	16.4	16.2	14.6	10.3	13.9	10.8	14.7	13.5	14.4	15.9	14.4
07	15.4	14.1	16.1	15.8	14.7	10.3	13.3	9.0	13.6	13.3	14.2	15.5	14.3
08	15.2	13.9	15.9	15.2	15.2	11.3	13.5	9.4	12.1	12.8	13.7	15.3	14.2
09	15.4	13.8	16.7	16.4	15.8	11.8	13.7	9.0	14.3	14.0	13.6	14.6	14.5
10	14.8	14.0	16.9	17.8	15.1	12.1	13.1	9.9	15.6	14.0	14.8	14.7	14.7
11	15.2	14.4	16.7	17.6	15.4	12.4	13.9	10.5	14.2	13.8	14.7	14.8	14.8
12	14.6	13.5	16.2	18.0	16.5	12.3	14.1	10.9	14.3	12.0	15.0	14.6	14.7
13	14.9	13.4	16.1	18.0	16.1	13.3	14.6	10.4	15.4	13.6	16.1	14.7	15.0
14	14.3	13.7	16.1	17.0	16.1	13.6	15.5	10.8	15.3	13.9	16.4	15.4	15.1
15	14.5	14.7	16.3	17.4	16.6	13.6	15.7	9.9	15.6	13.6	16.2	15.3	15.2
16	14.0	14.5	15.8	17.9	16.4	14.2	16.5	11.7	15.7	13.6	16.2	14.7	15.3
17	13.1	14.1	15.5	16.9	16.6	13.4	16.6	12.4	14.6	12.5	14.1	13.8	14.6
18	13.7	13.2	14.2	15.8	16.2	13.7	17.2	11.6	13.3	12.2	13.5	14.6	14.3
19	14.3	13.6	13.8	15.5	15.3	12.9	15.4	11.7	13.5	15.9	14.4	15.5	14.4
20	14.4	13.9	14.6	15.8	15.4	11.9	15.1	12.3	14.2	14.9	14.2	15.9	14.6

21	14.3	13.1	14.6	16.6	15.3	11.7	15.5	12.9	13.4	15.6	14.3	16.5	14.7
22	14.6	13.1	15.3	17.6	15.8	11.9	16.1	12.9	13.1	16.1	15.1	16.5	15.1
23	14.7	13.7	15.7	17.2	15.3	12.2	15.6	13.4	13.9	15.6	15.1	16.5	15.1
24	14.5	14.3	15.4	16.9	14.5	12.7	15.2	12.5	13.8	15.8	14.8	16.3	14.9
Mean	14.5	13.9	15.8	16.9	15.5	12.3	14.9	11.4	14.1	14.3	14.7	15.5	14.7
Good Hours	1454	1321	1455	1265	1358	720	711	744	552	547	1157	1444	
Missing Hours	34	47	33	175	130	0	33	0	168	197	283	44	

12,728 Hours of Good Data   1,144 Hours Missing   91.8% Data Recovery

Table 25 - Mean Hourly Wind Speed (mph) at 50 Meters (Logger Channel 1)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
50M WIND SPEED (CH1) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	16.1	15.4	16.8	17.9	16.6	13.7	16.6	14.1	14.1	16.0	16.7	17.6	16.2
02	15.8	15.1	17.1	17.7	16.6	13.6	15.7	14.1	14.8	15.6	16.0	17.3	16.1
03	15.1	15.2	16.7	17.7	16.1	13.4	15.1	13.6	14.7	14.5	15.6	17.7	15.8
04	15.3	15.6	17.6	17.2	16.5	13.9	15.7	13.6	15.0	14.4	15.5	17.0	15.9
05	15.7	15.4	17.7	17.4	15.8	11.8	16.0	11.9	15.0	14.3	15.9	17.4	15.8
06	15.4	15.2	17.3	17.1	16.0	11.3	15.2	11.8	16.1	14.1	15.7	17.4	15.6
07	16.4	15.7	17.1	16.3	15.8	11.0	14.1	10.1	15.4	13.9	15.4	17.1	15.4
08	16.4	15.2	16.6	15.8	16.1	11.5	13.9	9.8	13.8	12.0	15.0	16.8	15.0
09	16.3	14.6	17.0	17.2	16.4	12.0	13.9	9.3	14.5	12.4	14.5	15.8	15.0
10	15.3	14.5	17.4	17.6	15.7	12.3	13.3	10.0	15.5	12.4	15.6	15.4	15.0
11	15.9	14.7	17.0	17.8	16.0	12.6	14.1	10.5	14.4	12.4	15.4	15.5	15.2
12	15.3	14.2	16.4	18.2	17.1	12.3	14.5	10.9	15.0	11.1	16.0	15.3	15.2
13	15.5	14.9	16.5	18.3	16.7	13.4	14.9	10.8	15.4	12.5	16.9	15.3	15.5
14	15.3	14.6	16.7	17.3	16.8	13.8	15.6	11.1	15.0	12.6	17.2	16.1	15.5
15	15.3	15.8	16.9	17.7	17.3	13.8	16.0	11.1	14.7	12.0	17.3	16.2	15.8
16	14.7	15.2	16.4	17.9	17.3	14.4	16.8	12.3	15.0	12.8	17.2	15.2	15.7
17	13.9	14.5	16.2	17.3	17.7	13.6	16.8	12.7	14.2	11.9	15.2	14.7	15.1
18	14.8	14.1	14.9	16.8	17.2	14.1	17.6	12.0	14.3	12.7	15.1	15.7	15.1
19	15.4	14.7	14.7	16.0	16.8	13.3	16.0	12.1	13.7	15.5	15.7	16.8	15.3
20	15.7	14.9	15.7	16.7	16.7	12.5	16.2	13.2	13.9	15.3	15.8	17.3	15.6

21	15.7	14.2	16.1	17.2	16.7	12.6	16.9	14.1	13.8	16.2	16.1	18.0	15.9
22	16.0	14.3	16.3	18.1	17.0	12.6	17.4	14.0	13.9	16.1	16.7	18.0	16.1
23	16.3	15.4	16.5	17.9	16.6	13.0	17.2	14.9	14.2	15.3	16.7	17.9	16.3
24	15.7	15.6	16.4	17.7	15.9	13.7	16.6	14.3	14.1	15.6	16.1	17.6	16.0
Mean	15.6	15.0	16.6	17.4	16.6	12.9	15.7	12.2	14.6	13.8	16.0	16.6	15.6
Good Hours	1454	1342	1488	1440	1358	720	711	744	720	734	1157	1422	
Missing Hours	34	26	0	0	130	0	33	0	0	10	283	66	

13,290 Hours of Good Data   582 Hours Missing   95.8% Data Recovery

Table 26 – Mean Hourly Wind Speed (mph) at 50 Meters (Logger Channel 2)

MEAN HOURLY WIND SPEEDS

Chilocco Indian School
50M WIND SPEED (CH2) (MPH)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	16.1	15.3	16.7	18.0	15.8	13.2	16.6	14.0	14.1	15.9	16.5	17.3	16.1
02	15.8	15.1	17.1	17.7	16.1	13.2	15.7	13.9	14.6	15.4	15.9	17.2	15.9
03	15.1	15.2	16.7	17.6	15.3	12.5	15.1	13.5	14.6	14.3	15.4	17.6	15.6
04	15.4	15.5	17.5	17.3	15.7	12.7	15.6	13.5	15.0	14.3	15.3	17.0	15.7
05	15.6	15.3	17.6	17.3	15.7	11.8	15.8	11.8	15.1	14.1	15.7	17.2	15.7
06	15.4	15.1	17.3	17.0	15.9	11.3	15.0	11.8	16.1	13.9	15.5	17.2	15.5
07	16.4	15.5	17.0	16.3	15.8	11.0	13.9	10.0	15.3	13.7	15.3	16.9	15.3
08	16.4	15.1	16.5	15.8	16.0	11.5	13.7	9.7	13.7	11.9	14.8	16.6	14.9
09	16.3	14.5	16.9	17.2	16.4	11.9	13.8	9.2	14.5	12.2	14.4	15.5	14.9
10	15.2	14.5	17.3	17.5	15.6	12.2	13.2	10.0	15.3	12.3	15.4	15.2	14.9
11	15.8	14.8	16.9	17.7	15.7	12.5	14.0	10.5	14.2	12.3	15.2	15.2	15.1
12	15.1	14.1	16.3	18.1	16.8	12.3	14.3	10.9	14.8	11.0	15.7	15.1	15.0
13	15.4	14.7	16.3	18.1	16.5	13.3	14.7	10.8	15.2	12.4	16.6	15.1	15.3
14	15.2	14.3	16.4	17.2	16.5	13.8	15.6	11.1	14.8	12.4	16.9	15.9	15.4
15	15.1	15.6	16.8	17.5	17.0	13.7	15.8	11.2	14.5	11.9	16.9	16.0	15.6
16	14.7	15.1	16.2	17.8	17.0	14.4	16.8	12.2	14.8	12.6	16.8	15.1	15.6
17	13.8	14.6	16.0	17.1	17.5	13.7	16.8	12.8	14.1	11.7	15.0	14.6	15.1
18	14.7	15.4	14.7	16.6	17.0	14.1	17.6	12.0	14.2	12.5	14.8	15.6	15.1
19	15.5	14.5	14.5	15.9	16.5	13.4	16.1	12.3	13.9	15.4	15.5	16.7	15.2
20	15.7	14.9	15.6	16.7	16.6	12.7	16.2	13.4	14.0	15.1	15.6	17.2	15.6

21	15.6	14.2	16.1	17.2	16.8	12.6	16.8	14.1	13.9	16.0	15.9	17.8	15.8
22	15.9	14.3	16.4	18.1	16.9	12.0	17.3	14.0	14.1	16.0	16.5	17.9	16.1
23	16.2	15.3	16.5	17.8	16.1	12.1	17.0	14.9	14.5	15.3	16.4	17.7	16.1
24	15.7	15.6	16.4	17.7	15.1	12.4	16.5	14.3	14.4	15.5	16.0	17.7	15.9
Mean	15.5	14.9	16.5	17.3	16.3	12.7	15.6	12.2	14.6	13.7	15.8	16.5	15.5
Good Hours	1454	1331	1488	1440	1358	720	711	744	720	734	1157	1417	
Missing Hours	34	37	0	0	130	0	33	0	0	10	283	71	

13,274 Hours of Good Data   598 Hours Missing   95.7% Data Recovery

Table 27 – Mean Hourly Wind Direction at 30 Meters

MEAN HOURLY VALUES

Chilocco Indian School
30M WIND DIRECTION (DEG)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	134	144	169	173	129	146	167	155	134	166	169	184	156
02	138	156	174	165	126	152	159	152	154	164	178	193	160
03	139	144	184	162	138	156	159	152	166	176	162	187	160
04	152	139	190	164	134	124	182	150	162	154	163	188	160
05	156	146	175	174	135	147	173	151	181	158	177	176	163
06	154	149	181	177	120	145	173	134	188	133	197	177	162
07	162	138	174	176	144	174	172	144	156	138	172	180	162
08	158	148	177	175	147	173	168	154	170	155	186	191	168
09	156	145	179	180	152	182	175	184	158	151	189	190	170
10	164	166	161	183	139	173	180	171	192	162	189	186	171
11	171	168	189	173	169	169	155	161	172	165	193	186	174
12	166	163	181	177	158	151	146	154	166	193	200	194	173
13	166	183	178	170	169	159	152	150	168	184	204	208	177
14	169	181	170	170	149	160	143	145	161	189	210	199	172
15	165	199	188	172	155	159	140	141	171	198	197	205	177
16	180	177	194	178	153	147	141	137	171	200	196	207	177
17	157	175	188	166	140	158	144	129	149	198	196	197	169
18	155	175	194	173	128	132	143	141	114	165	181	195	163
19	149	176	179	181	118	130	134	139	115	168	200	195	161
20	146	168	181	161	121	127	139	137	121	172	172	172	154

21	136	159	170	167	125	130	139	142	109	139	154	175	149
22	134	143	158	170	137	138	150	130	112	143	163	168	148
23	135	157	174	160	131	141	154	129	116	158	164	171	151
24	141	149	173	172	127	140	162	137	116	171	159	181	154
Mean	153	160	178	172	139	151	156	147	151	167	182	188	164
Good Hours	1417	1290	1446	1440	1358	720	711	744	720	734	1157	1400	
Missing Hours	71	78	42	0	130	0	33	0	0	10	283	88	

13,137 Hours of Good Data 735 Hours Missing 94.7% Data Recovery

Table 28 – Mean Hourly Wind Direction at 50 Meters

MEAN HOURLY VALUES

Chilocco Indian School
50M WIND DIRECTION (DEG)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	137	145	169	174	130	136	164	158	138	171	164	186	157
02	146	152	174	172	128	164	158	157	148	157	165	190	160
03	135	154	184	169	138	151	158	168	159	182	166	189	163
04	167	149	191	160	134	125	182	155	178	164	165	183	163
05	159	158	187	170	136	162	175	157	183	163	187	172	167
06	155	153	183	173	127	154	173	142	191	151	197	185	166
07	157	149	182	178	144	171	172	151	160	131	183	182	165
08	159	159	183	175	146	169	176	157	171	161	200	200	172
09	156	149	178	179	150	178	170	182	159	152	195	197	171
10	162	161	166	187	137	170	176	162	191	161	188	185	170
11	169	167	187	172	173	165	151	162	172	165	198	191	175
12	151	160	184	176	156	146	143	154	165	193	206	201	172
13	159	182	182	175	166	155	148	161	168	182	209	211	178
14	179	178	179	168	153	155	138	146	172	187	216	200	175
15	165	198	186	177	152	155	135	143	182	196	204	207	178
16	167	183	192	176	157	142	136	138	171	199	195	215	176
17	159	177	186	164	157	154	139	130	149	197	202	199	171
18	155	180	192	177	132	127	139	141	116	178	181	199	164
19	155	169	178	185	117	126	130	140	118	159	208	205	163
20	153	168	175	161	127	123	135	139	123	173	181	182	157

21	137	167	176	168	120	127	135	144	112	153	166	177	152
22	136	143	166	169	139	135	147	132	116	156	166	171	151
23	143	150	168	160	125	138	152	132	119	161	174	172	152
24	154	149	174	167	127	139	160	141	132	172	163	171	156
Mean	155	163	180	172	140	149	154	150	154	169	187	190	165
Good Hours	1413	1285	1446	1440	1358	720	711	744	720	734	1157	1400	
Missing Hours	75	83	42	0	130	0	33	0	0	10	283	88	

13,128 Hours of Good Data   744 Hours Missing   94.6% Data Recovery

Table 29 – Mean Hourly Temperature (Degrees F)

MEAN HOURLY VALUES

Chilocco Indian School
TEMPERATURE (DEG)

11/01/02 - 05/31/04

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
01	27.2	29.0	41.4	50.5	58.6	63.4	73.0	73.0	59.4	51.5	39.3	32.4	46.3
02	26.7	28.1	40.7	49.9	57.9	62.5	72.2	71.7	58.9	50.6	38.9	31.9	45.6
03	26.2	27.6	39.6	48.9	57.1	61.8	71.2	71.3	58.2	50.0	38.1	31.4	44.9
04	25.5	27.2	39.1	48.0	56.7	61.4	70.3	70.3	57.6	49.1	37.7	30.8	44.2
05	25.0	26.8	38.9	47.3	56.4	60.7	69.4	69.3	57.5	48.9	37.6	30.6	43.8
06	24.6	26.6	38.5	47.0	56.5	61.4	70.3	69.0	56.7	48.7	37.3	30.1	43.6
07	24.1	26.5	38.8	48.8	59.3	64.9	73.9	71.9	58.2	48.7	36.2	29.8	44.6
08	24.6	27.4	41.5	52.2	62.2	68.4	78.0	76.0	61.4	52.5	37.7	30.1	46.9
09	27.7	30.2	44.3	55.3	65.0	71.2	81.7	79.6	64.2	57.3	41.5	33.0	50.1
10	30.4	33.0	47.2	58.0	67.3	73.5	84.4	82.8	66.9	61.2	44.7	36.0	52.9
11	33.2	35.7	49.8	60.4	69.3	75.6	87.0	85.4	69.1	64.2	47.4	38.6	55.4
12	35.6	38.0	51.9	62.2	71.1	76.8	89.1	86.8	70.6	66.2	49.6	40.7	57.4
13	37.6	39.9	53.8	63.6	72.3	78.2	90.6	88.1	71.8	67.6	51.0	42.5	59.0
14	39.5	40.5	55.6	64.7	73.3	78.8	91.6	88.7	72.2	68.0	51.8	43.2	60.1
15	40.5	40.8	56.5	65.3	73.8	79.2	92.3	89.3	72.9	68.3	51.9	43.6	60.7
16	40.4	40.7	56.2	65.2	73.7	78.5	92.5	89.0	72.8	67.5	51.0	42.5	60.3
17	38.5	39.6	55.3	64.7	72.8	78.0	91.9	87.8	71.8	64.8	47.9	39.7	58.9
18	34.4	36.8	52.7	62.9	71.2	76.2	90.4	86.6	69.2	60.9	44.6	36.7	56.3
19	32.4	34.3	48.9	59.1	67.8	73.1	86.9	82.9	65.8	57.6	42.8	35.8	53.5
20	31.1	33.0	46.7	56.6	64.5	70.1	82.7	79.3	63.9	56.1	41.9	35.1	51.4

21	30.2	31.9	45.7	55.2	63.0	68.2	79.7	77.1	62.1	54.5	40.7	34.2	50.0
22	29.3	30.9	44.1	53.8	61.7	66.7	77.8	75.9	61.1	53.6	39.8	33.6	48.8
23	28.6	29.8	43.1	52.7	60.8	65.8	76.4	74.7	60.3	52.6	39.6	33.2	47.9
24	27.6	29.3	42.2	51.7	59.6	64.7	75.3	73.5	59.6	52.1	39.3	32.7	46.9
Mean	30.9	32.6	46.4	56.0	64.7	70.0	81.3	79.2	64.3	57.1	42.8	35.3	51.2
Good Hours	1454	1348	1488	1440	1358	720	711	744	720	734	1153	1444	
Missing Hours	34	20	0	0	130	0	33	0	0	10	287	44	

13,314 Hours of Good Data   558 Hours Missing   96.0% Data Recovery

3.4 Wind Shear

Wind shear is the change or increase in wind speed above ground level. The simple wind power law is expressed as:

$$U_2 = U1\,(Z_2/Z_1)^{alpha}$$

Where U_2 and U_1 are the wind speeds at the upper and lower levels, Z_2 and Z_1 are the upper and lower elevations, and alpha is the wind speed power law exponent. The typical value for the wind speed power law exponent is 0.14 (1/7 power law). Depending on terrain and surface roughness, the value may vary between 0.05 and 0.35. The calculated value based on the 30 meter and 50 meter hourly average wind speeds for the meteorological tower at the Chilocco Indian School is 0.22, or a 12% increase in speed with height.

3.5 Projected Hub Height Wind Speeds

Using the observed 50-meter average wind speed of 15.6 mph and the power law exponent value of 0.22, wind speeds of 16.5 mph and 17.3 mph are projected for hub heights of 65-meters and 80-meters.

3.6 Peak Wind Speed

The highest 3-second gust for the Chilocco Indian School is estimated based on the peak wind speed information from the airport data collected at Oklahoma City, Oklahoma. The peak 5-second gust measured at Oklahoma City, Oklahoma over the period of record is 62 mph. Selecting the highest value, 62 mph, and adjusting it from 7 meters (21 feet) to 80 meters (262 feet) above ground level using the wind speed power law and a power law exponent of 0.22 yields a peak wind speed of 106 mph (47.3 mps).

Figure 9 - Wind Rose for the 50 Meter Level, Chilocco Indian School. The number in the center, 22.2%, is the percentage of time the wind speeds are less than 10 mph.

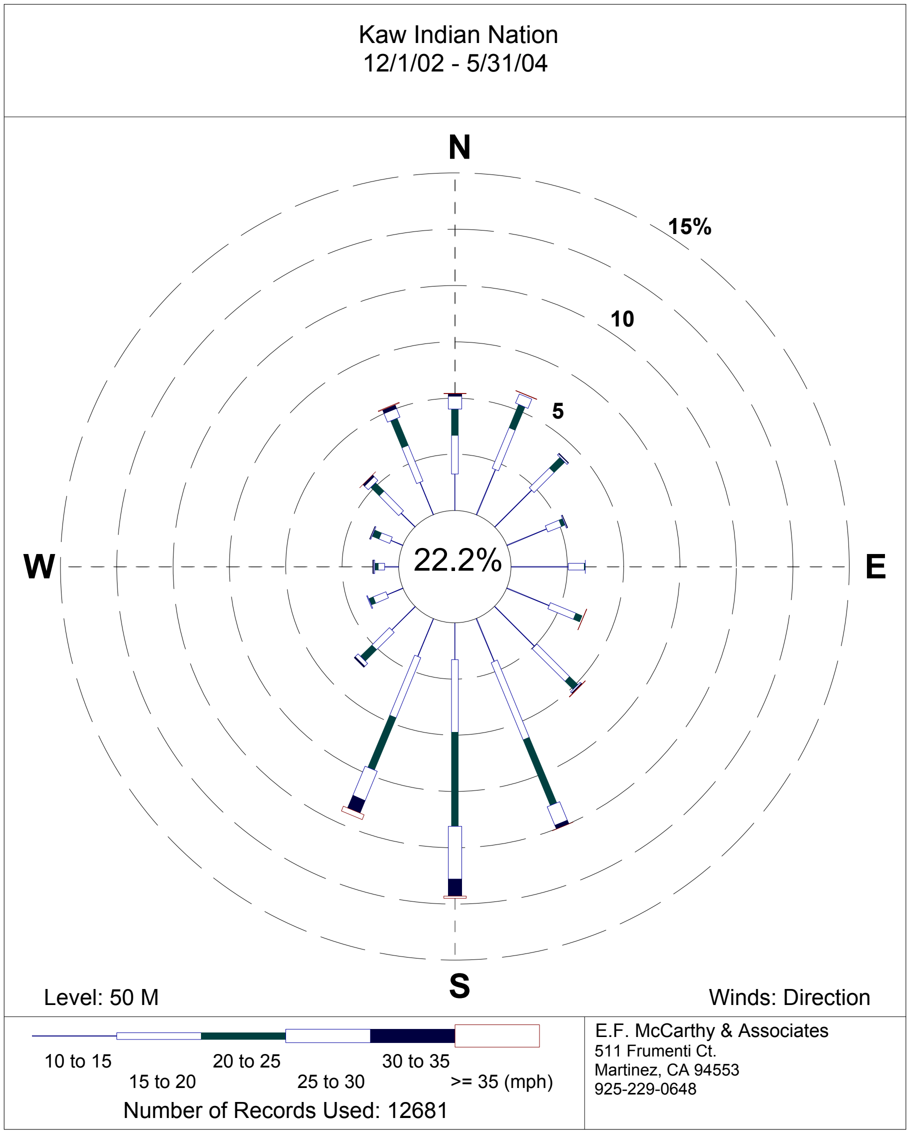


Table 30 – Joint Frequency of Wind Speed and Wind Direction (Hours of Occurrence) at 50 Meters

FREQUENCY DISTRIBUTION - Hours of Occurrence 11/15/02 - 05/26/04

Parameter
1: Chilocco Indian School
50M WIND SPEED (CH1) (MPH)

2: Chilocco Indian School
50M WIND DIRECTION (DEG)

Parm 2 - DEG	Parameter 1: MPH 0.0 to 10.0	10.1 to 15.0	15.1 to 20.0	20.1 to 25.0	25.1 to 30.0	30.1 to 35.0	35.1 to 50.0	Total
0.0 to 22.5	212	274	268	186	99	14	2	1055
22.6 to 45.0	228	281	214	119	19	7	1	869
45.1 to 67.5	240	271	103	33	4	0	0	651
67.6 to 90.0	299	279	94	12	4	1	0	689
90.1 to 112.5	289	292	108	20	6	1	0	716
112.6 to 135.0	251	289	199	33	4	1	2	779
135.1 to 157.5	195	297	349	177	26	9	0	1053
157.6 to 180.0	161	244	521	568	269	68	10	1841
180.1 to 202.5	148	201	375	443	231	97	25	1520
202.6 to 225.0	164	253	282	206	71	26	6	1008
225.1 to 247.5	109	139	84	42	12	2	0	388

247.6 to 270.0	119	91	57	18	3	2	0	290
270.1 to 292.5	94	75	37	30	5	1	0	242
292.6 to 315.0	145	92	111	40	19	4	0	411
315.1 to 337.5	153	188	235	131	43	15	3	768
337.6 to 360.1	160	213	194	140	54	20	4	785
Total	2967	3479	3231	2198	869	268	53	13065

13,065 Good Hours 351 Hours Missing 97.4% Net Data Recovery

Table 31 – Joint Frequency of Wind Speed and Wind Direction (Percent Occurrence) at 50 Meters

FREQUENCY DISTRIBUTION - Percent Occurrence 11/15/02 - 05/26/04

Parameter
1: Chilocco Indian School
50M WIND SPEED (CH1) (MPH)

2: Chilocco Indian School
50M WIND DIRECTION (DEG)

	Parameter 1: MPH							
Parm 2 - DEG	0.0 to 10.0	10.1 to 15.0	15.1 to 20.0	20.1 to 25.0	25.1 to 30.0	30.1 to 35.0	35.1 to 50.0	Total
0.0 to 22.5	1.6	2.1	2.1	1.4	.8	.1	.0	8.1
22.6 to 45.0	1.7	2.2	1.6	.9	.1	.1	.0	6.7
45.1 to 67.5	1.8	2.1	.8	.3	.0	.0	.0	5.0
67.6 to 90.0	2.3	2.1	.7	.1	.0	.0	.0	5.3
90.1 to 112.5	2.2	2.2	.8	.2	.0	.0	.0	5.5
112.6 to 135.0	1.9	2.2	1.5	.3	.0	.0	.0	6.0
135.1 to 157.5	1.5	2.3	2.7	1.4	.2	.1	.0	8.1
157.6 to 180.0	1.2	1.9	4.0	4.3	2.1	.5	.1	14.1
180.1 to 202.5	1.1	1.5	2.9	3.4	1.8	.7	.2	11.6
202.6 to 225.0	1.3	1.9	2.2	1.6	.5	.2	.0	7.7
225.1 to 247.5	.8	1.1	.6	.3	.1	.0	.0	3.0

247.6 to 270.0	.9	.7	.4	.1	.0	.0	.0	2.2
270.1 to 292.5	.7	.6	.3	.2	.0	.0	.0	1.9
292.6 to 315.0	1.1	.7	.8	.3	.1	.0	.0	3.1
315.1 to 337.5	1.2	1.4	1.8	1.0	.3	.1	.0	5.9
337.6 to 360.1	1.2	1.6	1.5	1.1	.4	.2	.0	6.0
Total	22.7	26.6	24.7	16.8	6.7	2.1	.4	100.0

13,065 Good Hours   351 Hours Missing   97.4% Net Data Recovery

4.0 Annual Energy Estimate

4.1 Gross Annual Theoretical Energy Estimate

The projected hub height wind speeds at 65-meters and 80-meters are combined with the density adjusted (1.18kg/m^3) power curves of the GE 1.5MW turbine (70.5m rotor and 77m rotor), the Vestas V-80 1.8MW turbine, and the NEG Micon 1.65MW turbine. The gross theoretical energy projections are presented in Tables 12 through 19.

4.2 Net Annual Theoretical Energy Estimate

The gross annual theoretical energy output is adjusted by various loss factors to estimate the actual or net energy delivered to the substation. These losses take into account the wind turbine out-of-service time associated with scheduled and unscheduled downtime, electrical line losses from the turbine to the substation, control system losses, array losses due to wake effects between adjoining turbines, and lost power associated with blade icing and blade soiling.

The annual net energy production for a single turbine is calculated using the following formula:

$$AEP_{net} = AEP_{gross} * (1 - EL)$$

where AEP_{net} is the Annual Net Energy Production of the wind facility;

AEP_{gross} is the Annual Gross Energy Production of the wind facility;

EL is the product of individual energy losses (%);

EL is the product of the individual energy losses and is calculated as follows:

$$EL = 1-(1 - L_{array}) * (1 - L_{blade}) * (1 - L_{collect}) * (1 - L_{control}) * (1-Availability)$$

where L_{array} = Array losses

$L_{soiling}$ = Blade contamination losses

$L_{collect}$ = Collection system from turbine to grid

$L_{control}$ = Control, grid, and miscellaneous losses

Availability = Availability is the percentage of calendar time that the turbines are functional and ready to deliver power to the grid.

Table 32 – Theoretical Energy Estimate – GE 1.5MW Turbine (70.5M Rotor) on 65M Tower

```
THEORETICAL WIND TURBINE PRODUCTION            11/01/02 - 05/31/04

Wind:      50M WIND SPEED (CH1)
         Chilocco Indian School

         Wind Speeds Multiplied By  1.06

Turbine: GE 1.5 SL (1500Kw)70M ROTOR 1.18KG/M**2

         Rated at:         1500 kW at 30.0 MPH
         Maximum Output:   1500 kW at 30.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	2638	19.8		
Cut-in To Rated	10.1-30.0	10130	76.2	6,289,912	88.9
Rated To Cut-out	30.1-56.0	522	3.9	782,736	11.1
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		10652	80.2		

```
kW-hrs at Capacity / Total kW-hrs    11.1

hrs at Capacity / hrs of Operation    4.9

Mean Wind Speed                      16.5 MPH

Energy Produced                 7,072,648 kW-hrs

Annual Production Rate          4,661,881 kW-hrs

Capacity Factor                       .35

13290 hrs of Good Data    582 hrs Missing     95.8% Data Recovery
```

Table 33 – Theoretical Energy Estimate for GE 1.5MW Turbine (77M Rotor) on 65M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School

Wind Speeds Multiplied By 1.06

Turbine: GE 1.5 SL (1500Kw) 77M ROTOR 1.18KG/M**2

Rated at: 1500 kW at 30.0 MPH
Maximum Output: 1500 kW at 30.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	2638	19.8		
Cut-in To Rated	10.1-30.0	10130	76.2	6,975,988	89.9
Rated To Cut-out	30.1-56.0	522	3.9	781,945	10.1
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		10652	80.2		

kW-hrs at Capacity / Total kW-hrs 10.1

hrs at Capacity / hrs of Operation 4.9

Mean Wind Speed 16.5 MPH

Energy Produced 7,757,933 kW-hrs

Annual Production Rate 5,113,581 kW-hrs

Capacity Factor .39

```
13290 hrs of Good Data    582 hrs Missing     95.8% Data Recovery
```

Table 34 – Theoretical Energy Estimate for a GE 1.5MW Turbine on an 80M Tower

```
     THEORETICAL WIND TURBINE PRODUCTION            11/01/02 -
05/31/04

     Wind:      50M WIND SPEED (CH1)
              Chilocco Indian School

              Wind Speeds Multiplied By  1.11

     Turbine: GE 1.5 SL (1500Kw)70M ROTOR 1.18KG/M**2

              Rated at:        1500 kW at 30.0 MPH
              Maximum Output:  1500 kW at 30.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	2398	18.0		
Cut-in To Rated	10.1-30.0	10161	76.5	6,682,357	85.9
Rated To Cut-out	30.1-56.0	731	5.5	1,096,172	14.1
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		10892	82.0		

```
     kW-hrs at Capacity / Total kW-hrs    14.1

     hrs at Capacity / hrs of Operation    6.7

     Mean Wind Speed                      17.3 MPH

     Energy Produced                 7,778,529 kW-hrs

     Annual Production Rate          5,127,157 kW-hrs

     Capacity Factor                       .39

     13290 hrs of Good Data    582 hrs Missing     95.8% Data Recovery
```

Table 35 – Theoretical Energy Estimate for a Vestas V-80 Turbine on a 65M Tower

```
    THEORETICAL WIND TURBINE PRODUCTION           11/01/02 -
05/31/04

    Wind:      50M WIND SPEED (CH1)
             Chilocco Indian School

             Wind Speeds Multiplied By  1.11

    Turbine: GE 1.5 SL (1500Kw)77M ROTOR 1.18KG/M**2

             Rated at:        1500 kW at 30.0 MPH
             Maximum Output:  1500 kW at 30.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 10.0	2398	18.0		
Cut-in To Rated	10.1-30.0	10161	76.5	7,357,032	87.0
Rated To Cut-out	30.1-56.0	731	5.5	1,095,188	13.0
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		10892	82.0		

```
    kW-hrs at Capacity / Total kW-hrs    13.0

    hrs at Capacity / hrs of Operation    6.7

    Mean Wind Speed                      17.3 MPH

    Energy Produced                 8,452,220 kW-hrs

    Annual Production Rate          5,571,215 kW-hrs

    Capacity Factor                       .42
```

13290 hrs of Good Data   582 hrs Missing   95.8% Data Recovery

Table 36 - Theoretical Energy Estimate for a Vestas V-80 Turbine on 80M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School

Wind Speeds Multiplied By 1.06

Turbine: Vestas 80M(1800kW) POWER CURVE 1.18KG/M

Rated at: 1800 kW at 35.8 MPH
Maximum Output: 1800 kW at 56.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 9.0	2033	15.3		
Cut-in To Rated	9.1-35.8	11168	84.0	8,443,158	98.1
Rated To Cut-out	35.9-56.0	89	.7	160,200	1.9
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11257	84.7		

kW-hrs at Capacity / Total kW-hrs 1.9

hrs at Capacity / hrs of Operation .8

Mean Wind Speed 16.5 MPH

Energy Produced 8,603,358 kW-hrs

Annual Production Rate 5,670,837 kW-hrs

Capacity Factor .36

13290 hrs of Good Data 582 hrs Missing 95.8% Data Recovery

Table 37 – Theoretical Energy Estimate for a Vestas V-80 on 80M Tower

THEORETICAL WIND TURBINE PRODUCTION 11/01/02 - 05/31/04

Wind: 50M WIND SPEED (CH1)
Chilocco Indian School

Wind Speeds Multiplied By 1.11

Turbine: Vestas 80M(1800kW) POWER CURVE 1.18KG/M

Rated at: 1800 kW at 35.8 MPH
Maximum Output: 1800 kW at 56.0 MPH

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 9.0	1884	14.2		
Cut-in To Rated	9.1-35.8	11253	84.7	9,166,572	97.1
Rated To Cut-out	35.9-56.0	153	1.2	275,400	2.9
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11406	85.8		

kW-hrs at Capacity / Total kW-hrs 2.9

hrs at Capacity / hrs of Operation 1.3

Mean Wind Speed 17.3 MPH

Energy Produced 9,441,972 kW-hrs

Annual Production Rate 6,223,603 kW-hrs

Capacity Factor .39

13290 hrs of Good Data 582 hrs Missing 95.8% Data Recovery

Table 38 – Theoretical Energy Estimate for a Micon NM82 on 65M Tower

```
     THEORETICAL WIND TURBINE PRODUCTION          11/01/02 -
05/31/04


     Wind:      50M WIND SPEED (CH1)
                Chilocco Indian School
              Wind Speeds Multiplied By  1.06

     Turbine: NEG MICON 1.65 1.18KG/M**3 3/04

              Rated at:        1650 kW at 31.3 MPH
              Maximum Output:  1650 kW at 45.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 8.9	1983	14.9		
Cut-in To Rated	9.0-31.3	10943	82.3	8,110,795	93.1
Rated To Cut-out	31.4-56.0	364	2.7	598,950	6.9
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11307	85.1		

```
     kW-hrs at Capacity / Total kW-hrs     6.9

     hrs at Capacity / hrs of Operation    3.2

     Mean Wind Speed                      16.5 MPH

     Energy Produced                 8,709,745 kW-hrs


     Annual Production Rate          5,740,961 kW-hrs

     Capacity Factor                       .40



     13290 hrs of Good Data    582 hrs Missing     95.8% Data Recovery
```

Table 39 – Theoretical Energy Estimate for Micon NM82 on 80M Tower

```
THEORETICAL WIND TURBINE PRODUCTION           11/01/02 -
05/31/04

Wind:      50M WIND SPEED (CH1)
         Chilocco Indian School

         Wind Speeds Multiplied By  1.11

Turbine: NEG MICON 1.65 1.18KG/M**3 3/04

         Rated at:        1650 kW at 31.3 MPH
         Maximum Output:  1650 kW at 45.0 MPH
```

Status	MPH	Time hrs	Time %	Production KW-hrs	Production %
Below Cut-in	Under 8.9	1824	13.7		
Cut-in To Rated	9.0-31.3	10914	82.1	8,560,182	90.4
Rated To Cut-out	31.4-56.0	552	4.2	904,200	9.6
Above Cut-out	Over 56.0	0	.0		
Contactor Closed		11466	86.3		

```
kW-hrs at Capacity / Total kW-hrs     9.6

hrs at Capacity / hrs of Operation    4.8

Mean Wind Speed                      17.3 MPH

Energy Produced                 9,464,382 kW-hrs

Annual Production Rate          6,238,374 kW-hrs

Capacity Factor                       .43

13290 hrs of Good Data    582 hrs Missing     95.8% Data Recovery
```

The loss factors for a project on the Chilocco Indian School are estimated to total 15%, so the gross to net ratio is assumed to be 0.85. The projected gross theoretical energy output, net theoretical energy output, and net capacity factors are presented in Table 20.

Table 40 – Theoretical Energy Projections and Net Capacity Factors for The GE 1.5MW Turbine, the Vestas V-80 Turbine, and the NEG Micon 1.65MW Turbine

Supplier	Rating (MW)	Rotor Diameter (m)	Hub Height (m)	Theoretical Gross Output (kWh)	Theoretical Net Output (kWh)	Net Capacity Factor
GE	1.5	70.5	65	4,662,000	3,963,000	30.2%
GE	1.5	70.5	80	5,127,000	4,358,000	33.2%
GE	1.5	77	65	5,114,000	4,347,000	33.1%
GE	1.5	77	80	5,571,000	4,736,000	36.0%
Vestas	1.8	80	65	5,671,000	4,820,000	30.6%
Vestas	1.8	80	80	6,224,000	5,290,000	33.5%
NEG Micon	1.65	82	65	5,741,000	4,880,000	33.8%
NEG Micon	1.65	82	80	6,238,000	5,303,000	36.7%

**"KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY"
Data Acquisition System**

The Kaw Nation and Disgen selected as a meteorological (MET) tower the NRG 50 meter system. The system includes a cellular signal capability which emails daily data to Disgen and its meteorologist Ed McCarthy. The system has performed sporadically but no data has been lost. The datalogger also includes a data card which records all data regardless of the performance of the cellular system.

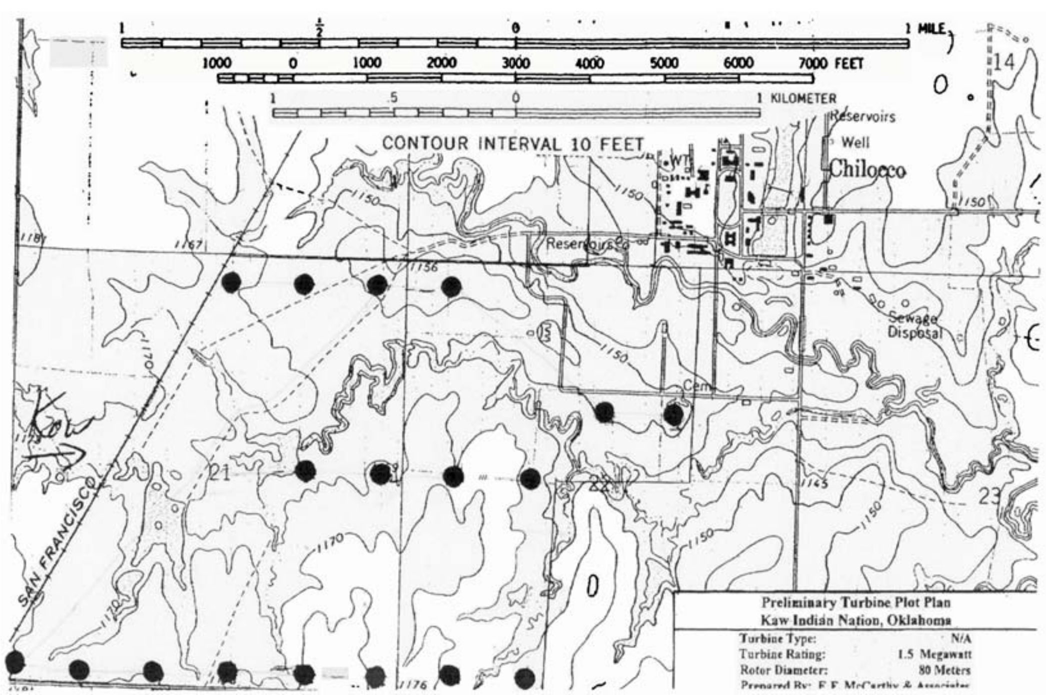
The tower is instrumented with two wind speed sensors and one wind direction sensor at the 50 meter level, two wind speed sensors at the 40 meter level and one wind speed sensor and one wind direction sensor at the 30 meter level.

The MET equipment is generic and does not come equipped with serial numbers.

**"Kaw KAW NATION
WIND- SOLAR-BIOMASS FEASIBILITY STUDY"**

Site Description

The project area, which is all on Tribal Trust Land of the Kaw Nation, selected for final analysis is located approximately 1/4 miles south and west of the Chilocco Indian School proper and about two miles east of US Highway 77. The elevation is 1150 feet. The area is primarily used for livestock grazing and contains a few short trees within the project area. There are no permanently occupied dwellings within one mile of the site. A lessee who grazes cattle at the site has a temporary shelter within one mile of the site. There is a three phase distribution line that runs south to the community of Newkirk, Oklahoma approximately seven miles distant that interconnects to an Oklahoma Municipal Power Administration substation. There is a 115kV transmission line, running north and south, owned by Oklahoma Gas and Electric, an investor owned utility, approximately one mile to the west of the project area. In order to interconnect a 30 MW wind facility, it is likely that an interconnection to the 115 KV line would be required. Preliminary discussions with the Southwest Power Pool (SWPP) did not provide any information as to the available capacity on the line. A preliminary site plan, based on the wind data collected and analyzed is: shown below.



The area has been subjected to a forest fire in the past and does not contain dense stands of trees.

**"KAW NATION
WIND -BIOMASS FEASIBILITY STUDY"
Meteorological Tower Location**

The location of the tower is:	N 36.9708 W 97.0869
	Instrumentation: 50M 2 Anemometers, 1Vane 40M 2 Anemometers, 1Vane 30M 1 Anemometer