☞ **09hr_SC-CUER_sb0185_pt08b**

Details:

(FORM UPDATED: 08/11/2010)

WISCONSIN STATE LEGISLATURE ...
PUBLIC HEARING - COMMITTEE RECORDS

2009-10

(session year)

Senate

(Assembly, Senate or Joint)

Committee on ... Commerce, Utilities, Energy, & Rail (SC-CUER)

COMMITTEE NOTICES ...

- Committee Reports ... **CR**
- Executive Sessions ... **ES**
- Public Hearings ... **PH**

INFORMATION COLLECTED BY COMMITTEE FOR AND AGAINST PROPOSAL

- Appointments ... **Appt** (w/Record of Comm. Proceedings)
- Clearinghouse Rules ... **CRule** (w/Record of Comm. Proceedings)
- Hearing Records ... bills and resolutions (w/Record of Comm. Proceedings)
  (**ab** = Assembly Bill) (**ar** = Assembly Resolution) (**ajr** = Assembly Joint Resolution)
  (**sb** = Senate Bill) (**sr** = Senate Resolution) (**sjr** = Senate Joint Resolution)
- Miscellaneous ... **Misc**

* Contents organized for archiving by: Gigi Godwin (LRB) (July/2011)

Agency	Interest or Permit	Contact	Application/ Notice Date	Status
Department of Natural Resources	Chapter 30 permit	Cheryl Laatsch 608-266-8943	10/02/2008	Response Pending
Historical Society	Protection of WHS-listed historical properties	Sherman Banker 608-264-6507	Submittal pending completion of Phase One	
Department of Transportation	High structure permit for the turbines	Gary Dikkers 608-267-5018	09/30/2008[33]	Response Pending
Department of Transportation	Heavy and oversize load permits	Dennis Leong (608)266-9910		Pre-CPCN discussions
Department of Transportation	Driveway permit for access roads	Robert Fasick 608-266-3438		
Department of Transportation	Utility (overhead/ underground in ROW)	Robert Fasick 608-266-3438		
Local				
Town of Randolph	Driveway permit for access roads	David Hughs 920-348-5258		
Town of Randolph	Utility (overhead/ underground in ROW)	David Hughs 920-348-5258		
Town of Scott	Driveway permit for access roads	Lee Barden 920-348-5559		
Town of Scott	Utility (overhead/ underground in ROW	Lee Barden 920-348-5559		
Village of Cambria	Parcel sub-division within extraterritorial areas for substation	Lois Frank cambria@centurytel.net		
Village of Friesland	Zoning change for possible O&M facility	Marcia Dykstra friesland@centurtytel.net		
Columbia County	Driveway permit	Kurt Dey		

[33] Application for preferred turbine sites. Application for alternates will follow FAA determination for alternate.

Agency	Interest or Permit	Contact	Application/ Notice Date	Status
Highway Dept.	for access roads	608-429-2136		
Columbia County Highway Dept.	Utility (overhead/ underground in ROW)	Kurt Dey 608-429-2136		
Columbia County Highway Dept.	Heavy and oversize load permits	Kurt Dey 608-429-2136		

1.8.2 Correspondence with Permitting Agencies

Copies of correspondence are provided in the relevant Appendices. Wisconsin Electric will continue to submit copies of correspondence after submittal of the application.

2.0 TECHNICAL DESCRIPTION OF TURBINES AND TURBINE SITES

2.1 Estimated Wind Speeds and Energy Production

DNV-Global Energy Concepts Inc. (DNV-GEC) was retained by Wisconsin Electric to complete an energy assessment for the Project. The full report is filed confidentially with the PSC and a redacted version provided to the public as provided in Appendix V. A discussion of key findings is provided in the following sub-sections.

2.1.1 Wind speeds and source of wind speed data used in analysis

Wind data were collected at five meteorological (met) towers associated with the project. The met towers are well situated to represent wind speeds at the proposed turbine locations and therefore all towers were used to characterize on-site winds. Data from two of the towers were available from April 2003, the data record for one tower begins in November 2003, and the other two towers have data beginning June 2004.

2.1.2 Wind roses (monthly and annual)

A wind rose depicts the frequency and energy content of wind by direction. Annualized wind roses estimated at 50 m for all five met towers were generated. The wind roses show a similar pattern, with significant energy-producing winds coming from the southwest and northwest. Monthly hub-height wind roses for each met tower were also generated. Wind roses are presented in the confidential version of the Wind Resource and Energy Assessment in Appendix V.

2.1.3 Gross and net capacity factor

Gross and net capacity factor estimates for each turbine under consideration were calculated. These factors are presented in the confidential version of the Wind Resource and Energy Assessment in Appendix V.

2.1.4 Estimated energy production of project

Estimates gross and net energy production was calculated for each turbine model under consideration. These production estimates are presented in the confidential version of the Wind Resource and Energy Assessment in Appendix V.

Production losses were estimated and are described in the Assessment (confidential information withheld in the public version).

2.2 TURBINE TYPE AND TURBINE CHARACTERISTICS

2.2.1 Manufacturer and model of turbines under consideration

The Project will likely choose a turbine from one of 5 potential turbine models. The wind turbines under consideration for use at the Project include the Vestas V82 and V90, the GE Energy 1.5sle, the Gamesa G87, and the Siemens S2.3.

The wind turbines share a similar design. They all are horizontal-axis, three-bladed wind turbines mounted on tubular steel towers. They differ in size and in details such as the blade length and the size/shape of the nacelle (which houses machinery atop the tower).

Figure 2.2-1 compares the size of the turbines considered. Section 2.2, includes performance attributes and a more detailed comparison of major turbine characteristics.

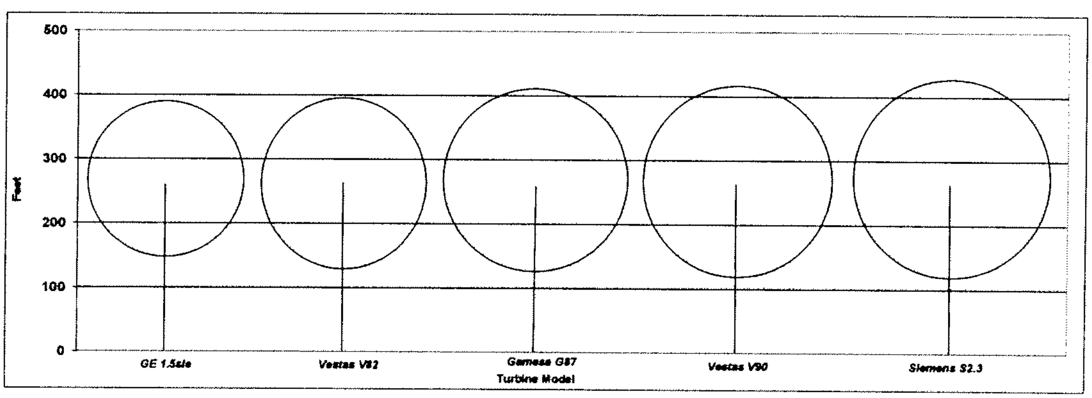


Figure 2.2-1 Relative Height of Turbines Considered

2.2.2 Turbine Delivery Date

The net impact of the market pressures is that turbine availability through 2010 is limited, equipment prices have increased substantially, and the ability to hold equipment delivery slots without substantial financial commitments is very limited. Based on these market realities, Wisconsin Electric is taking the following actions to minimize uncertainty, maintain the Project's benefits, and aggressively manage costs for customers:

- Obtain final proposals for the wind turbines in the Spring of 2009 to maximize the Project's economic negotiating position and operational fit of the equipment.
- Negotiate the reduction of any vendor payments to the greatest extent possible until after all material permits and approvals are in hand – 2^{nd} quarter 2009 at the latest.
- Work diligently with regulatory agencies to expeditiously complete the permit and approval processes.

2.2.3 Total number of turbines required for project

The Project as proposed requires 90 wind turbines that will generate up to approximately 207 MW of electric power.

2.2.4 Technical Characteristics of Turbines

The various wind turbines under consideration for use at the Project share a similar design. They all are horizontal-axis, three-bladed wind turbines mounted on tubular steel towers.

Table 2.2-1 Technical Characteristics of Turbines Considered

Manufacturer	Gamesa	General Electric	Siemens	Vestas	Vestas
Model	G87	1.5sle	S2.3	V82	V90
Rated capacity (MW)	2.0	1.5	2.3	1.65	1.8
Hub height – ft (m)	262.5 (80)	262.5 (80)	262.5 (80)	262.5 (80)	262.5 (80)
Blade length[34] – ft (m)	142.7 (43.5)	126.3 (38.5)	152.6 (46.5)	134.5 (41)	147.6 (45)
Swept Area – ft^2 (m^2)	63.994 (5,945)	50,127 (4,657)	73,194 (6,800)	56,844 (5,281)	68,479 (6362)
Total Height – ft (m)	402.8 (123.5)	388.8 (118.5)	415.1 (126.5)	397.0 (121.0)	410.1 (125)
Cut in wind speed – mph (m/s)	8.9 (4)	7.8 (3.5)	8.9 (4)	7.8 (3.5)	7.8 (3.5)
Cut out wind speed – mph (m/s)	55.9 (25)	55.9 (25)	55.9 (25)	44.7 (20)	55.9 (25)
Operational RPMs	9.0 - 19.0	10.1 - 18.7	6.0 – 16.0	14.4	9.0-14.5
Rated wind speed – mph (m/s)	29.0- 31.3 (13-14)	31.3 (14)	29.0-31.3 (13-14)	29.0 (13)	26.8 (12)
Weight of rotor – tons (metric tons)	~47	n.a.	~60	~47	~38
Weight of nacelle w/o rotor – tons (metric tons)	~82	~58	~82	~57	~71
Weight of tower – tons (metric tons)	~225	~154	~162	~132.2	~150.7

Density-specific power curve data sets for each turbine model are provided in the Appendix V, Wind Resource and Energy Assessment, Table 15.

2.2.5 Technical Characteristics of Turbine Towers

The various wind turbines under consideration for use at the Project share a similar tower design. Towers are of conical, tubular steel construction. The 80 meter class towers consist of 4 sections for ease of shipping, handling and field assembly. Each section is fabricated and painted at the factory and arrives at the site ready to assemble. Typically, the diameter at the base is in the range of 4.0 m (13.2 ft), gently tapering to a smaller diameter at the top. That said, a turbine vendor will specify appropriate tower dimensions in its final proposal where site-specific characteristics are considered.

2.2.6 Drawings of turbines including turbine pad and transformer

The diagram below shows a scale drawing representative of the turbine models under consideration. Three of the models utilize a design where the step-up transformer is located in the nacelle. The advantage of this design is that the weight of the transformer can provide additional counter-balance for the nacelle. The models utilizing this design are the Gamesa G87 and the Vestas V90. In these models, an externally located transformer is not required. The exact size of the pad mount transformer will be dependent upon which turbine is selected. However,

[34] As measured from hub centerline to blade tip.

based on the sizes of the turbines being evaluated, the transformer is likely to be in the range of 1700-2500 kVA. The transformers are approximately 6 feet tall, attached to a pad that is 8 by 9 feet. Please refer to the following drawing in Appendix G.

Figure 2.2-2 Typical Padmount layout

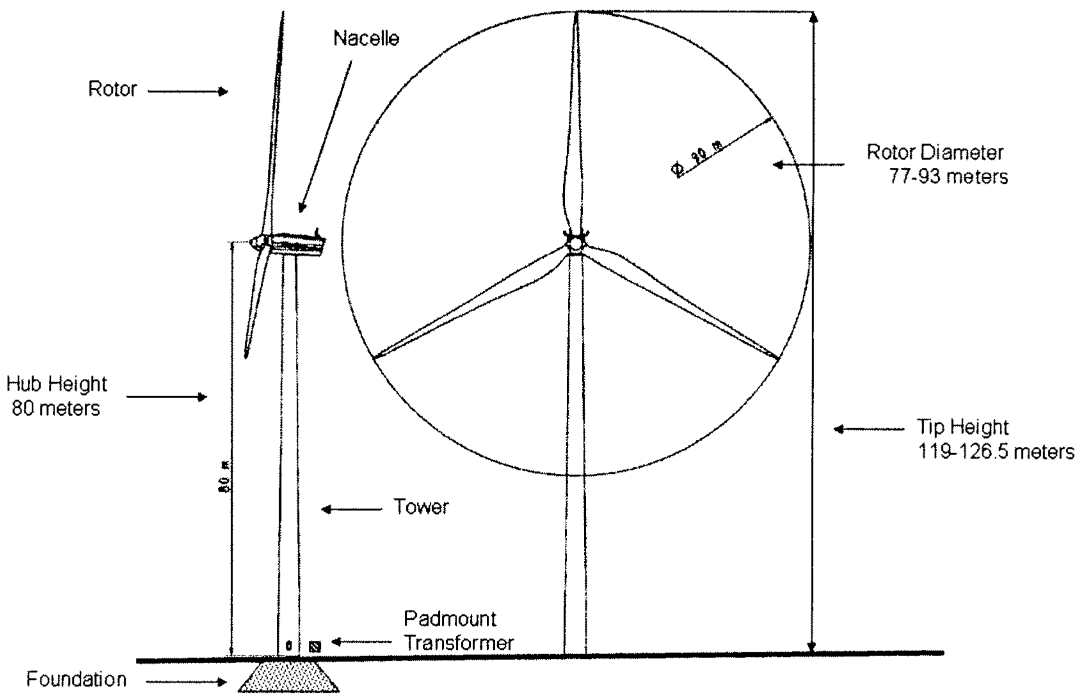


Figure 2.2-3 Turbine Elevation View

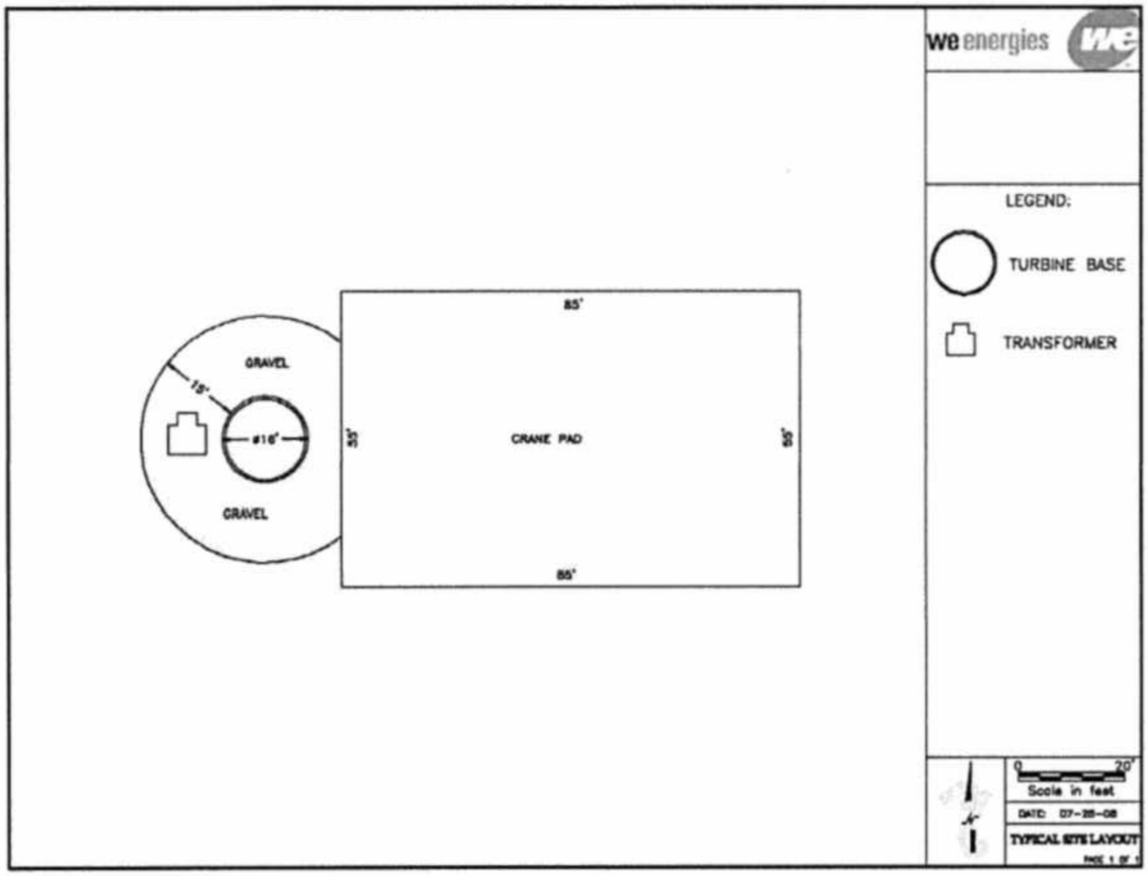


Figure 2.2-4 Turbine Plan View

2.3 CONSTRUCTION EQUIPMENT AND DELIVERY VEHICLES

2.3.1 Types of construction equipment and delivery vehicles

Construction equipment includes excavators, bulldozers, graders, concrete pumps, cranes, forklifts, trailers, plows, and trenchers will be delivered to the site via truck. It is likely that this equipment will be initially staged at the laydown area and O&M building construction parking lot.

The following delivery vehicles will typically be used for construction materials and components. Deliveries will be made directly to the construction sites.

- Delivery of road aggregate will be with end dump, side dump, and belly dump trucks
- Delivery of road fabric and culvert sections on low boy/flat bed semis
- Delivery of foundation reinforcing steel and anchor bolts on flat bed semis

- Delivery of ready-mixed concrete with traditional ready mix trucks
- Delivery of pad mounted transformers on flat bed semis
- Delivery of electrical conductor and fiber optic spools on low boy semis
- Delivery of turbine components on heavy/oversize load tractor trailers
- Delivery of substation main transformer on heavy/oversize load tractor trailer

Of the above, large component or equipment delivery includes lattice boom cranes, turbine components, and main transformer.

2.3.2 Gross vehicle weight for all vehicles using local roads

Table 2.3-1 Approximate Gross Vehicle Weight

Delivery Vehicle	Loaded	Unloaded
Aggregate Truck	73,000 lbs	28,000 lbs
Concrete Truck	68,000 lbs	28,000 lbs
Roll off Trucks	100,000 lbs	50,000 lbs
Low Boy Semi	100, 000 lbs	50,000 lbs
Fuel Trucks	65,000 lbs	32,000 lbs

2.3.3 Vehicles for turbine, tower, blade and crane delivery

The delivery trucks are specifically configured to carry the weight and size of the load. See Figure 2.3-1 through Figure 2.3-8 and Table 2.3-2 for drawings of typical truck configurations and a table of truck statistics.

Large cranes are delivered disassembled on low boy and flat bed semis similar to the truck/trailer shown in Figure 2.3-4. Each large crane requires 19 trucks. Of these, 4 carry crane component loads roughly weighing between 62,000 and 87,000 lbs. The remaining carry loads between 35,000 and 48,000 lbs.[35]

[35] Reference Manitowoc Model 16000 Product Guide: Trailer Load-Out Summary.

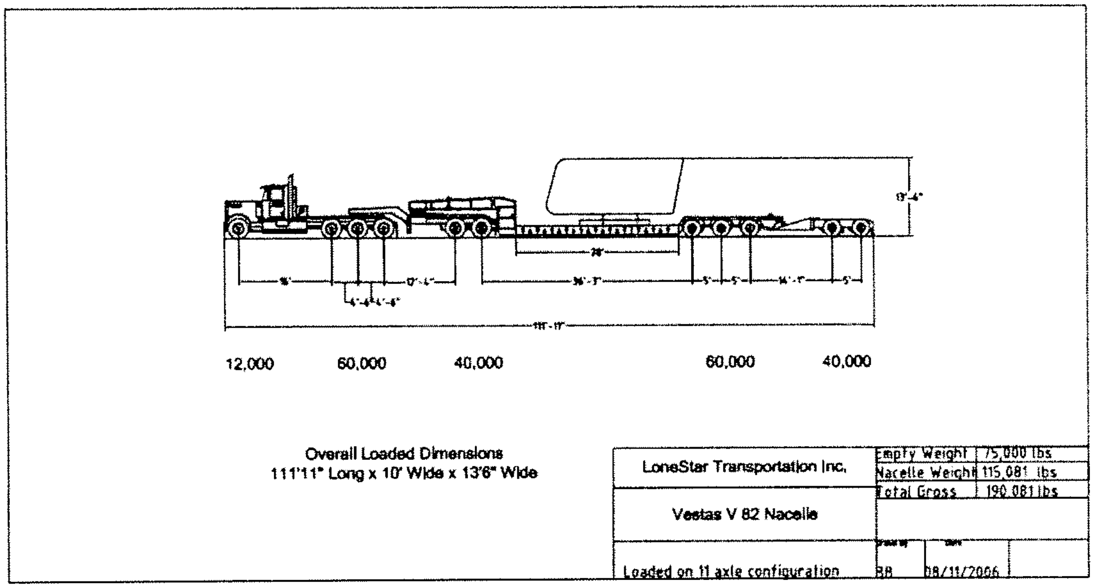


Figure 2.3-1 Nacelle Truck Configuration

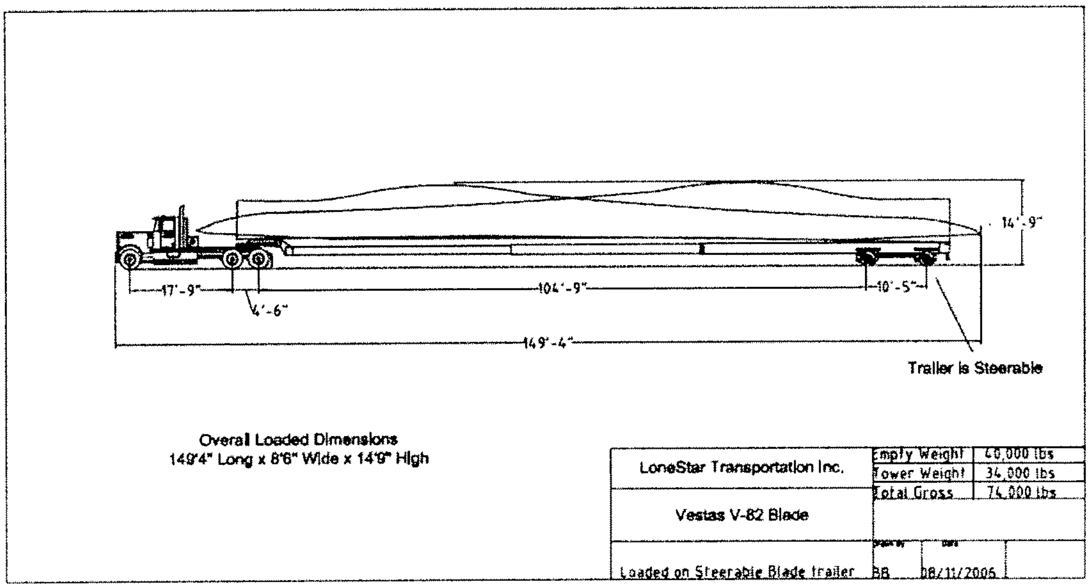


Figure 2.3-2 Blade Truck Configuration (2 blades per truck)

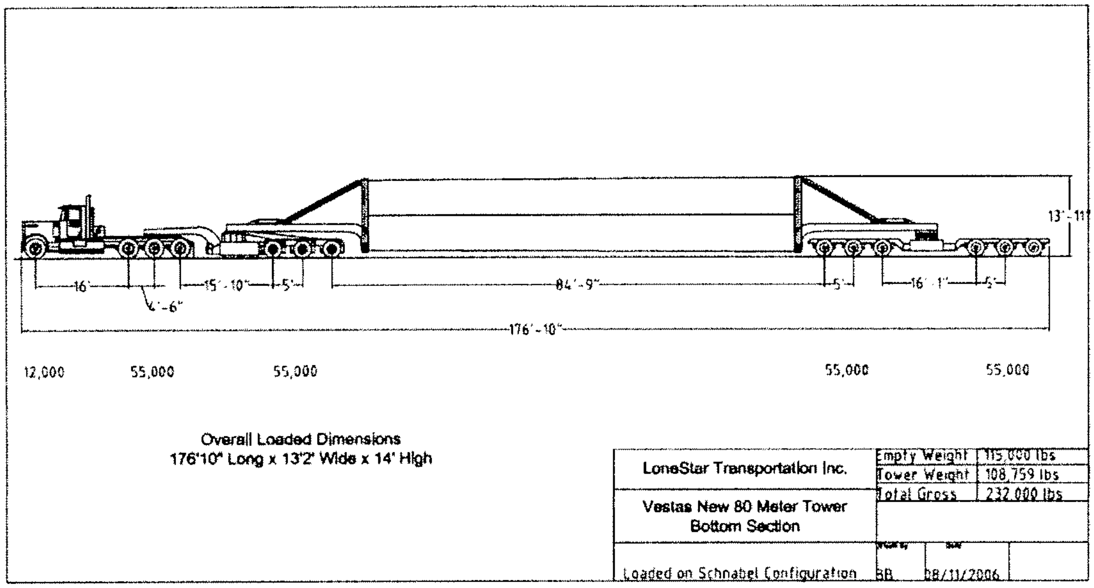


Figure 2.3-3 Lower Tower Section Truck Configuration

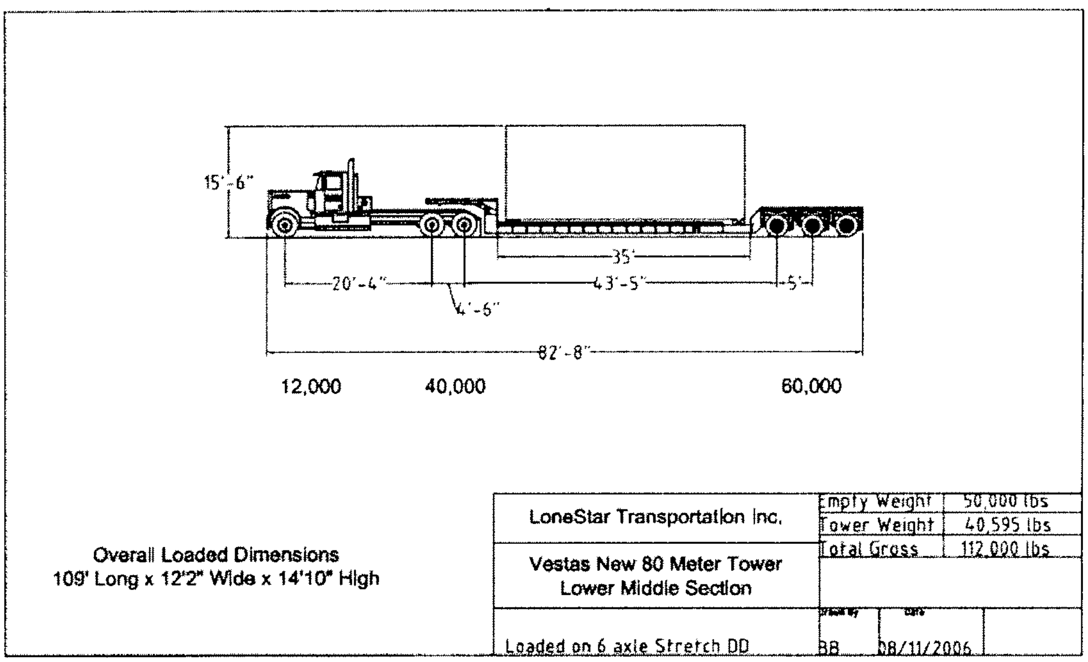


Figure 2.3-4 Lower Mid Tower Section Truck Configuration

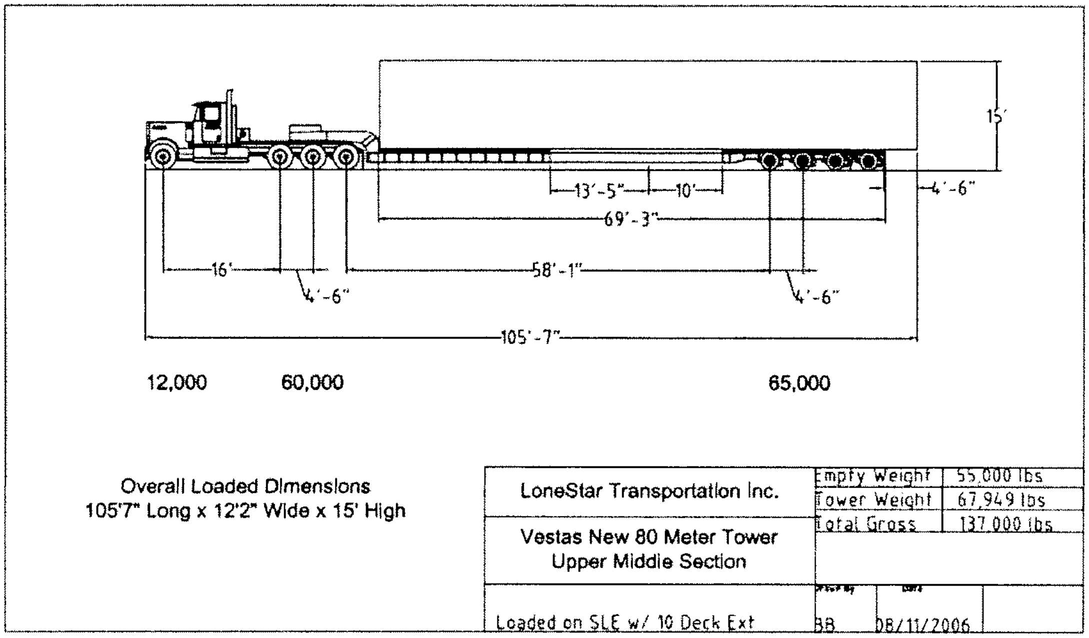


Figure 2.3-5 Upper Mid Tower Section Truck Configuration

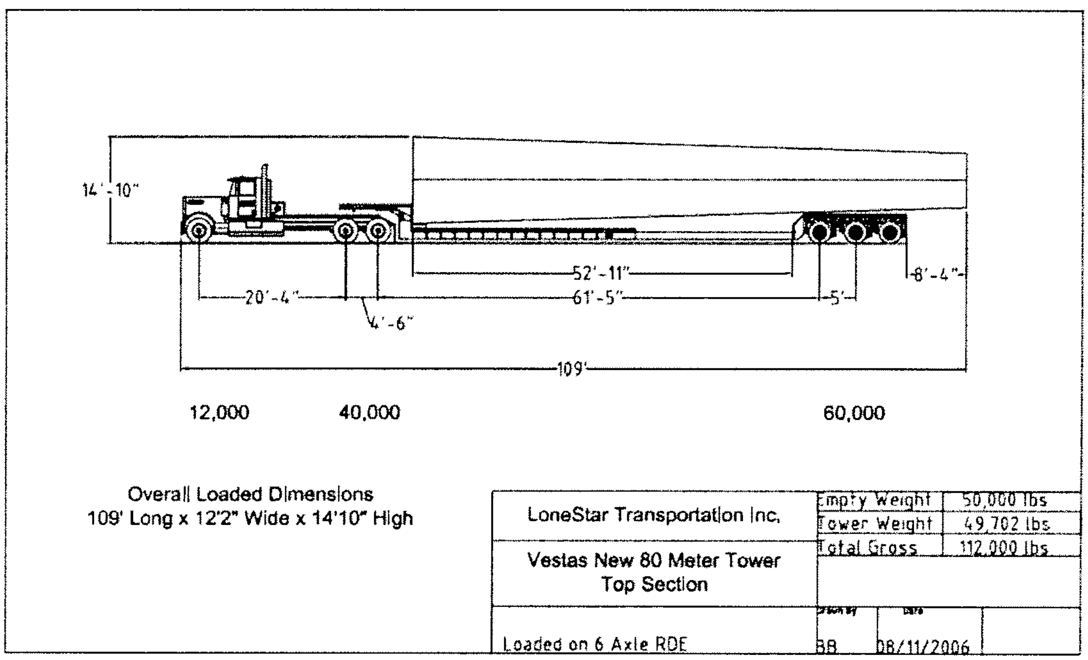


Figure 2.3-6 Upper Tower Section Truck Configuration

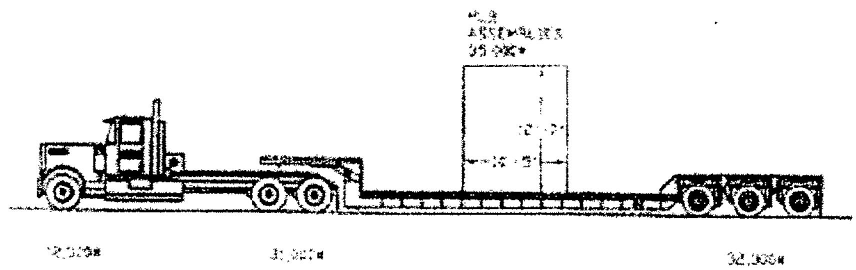


Figure 2.3-7 Hub Truck Configuration

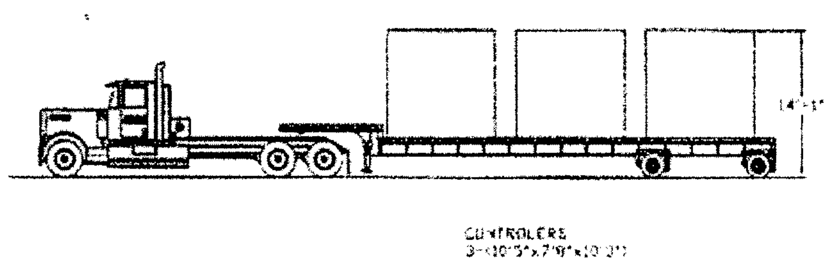


Figure 2.3-8 Controllers Truck Configuration (3 per truck)

Table 2.3-2 Truck Statistics for a Typical 1.65 MW Wind Turbine

Truck Type	Overall Length (ft)	Turning Radius (ft)	Minimum Ground Clearance (in)	Maximum Slope Tolerance (%)
Nacelle	112	150	6	10
Blade	149	150	24	12
Lower Tower	177	150	6	10
Lower-mid Tower	83	100	6	12
Upper-mid Tower	106	150	6	10
Upper Tower	109	150	6	10
Hub	83	100	6	12
Controller	80	100	24	12
Crane Delivery	70	90-100	6 or 24	12

Table 2.3-3 Approximate Component Shipping Stats - Typical 1.65 MW Turbine

Component	Weight (metric tons)	Dimensions
80 m Tower	140 (total of 4 sections)	Section lengths less than 23m, largest diameter 4.5m
Hub Assembly	15	Diameter 3.2 m, height 4m
Blades	7 (each blade)	2m width, 41m length
Nacelle[1]	57	Length 9m, width 3.5 m, height 4m
Controller	10	Height 7m, width 2.3 m
Transformer	8	Height 2m, width 1.7m, length 2m
[1] Includes gearbox and generator.		

2.3.4 Cranes - types and uses

Primary lift cranes are used for upper tower section installation and to lift the heavy main wind turbine generator components to the top of the tower. This crane will be a lattice boom crawler crane with a minimum rated capacity of 400 tons. The primary lift crane weight is approximately 500tons. Full assembly is required upon initial arrival to the site and takes approximately five 12 hour days or 60hours. Partial disassembly/reassembly will be required for some moves within the project area where crane walks are not practical.[36] The partial disassembly/reassembly takes approximately 36 hours not accounting for transit time.

Lattice boom crawler cranes will be used for base-tower and mid-tower section installation. These cranes will have a rated capacity of 200-300 tons. Weight of these cranes in traveling mode without counterweights is approximately 35 tons, fully assembled with all counterweights, approximately 180 tons. Full assembly is required upon initial arrival to the site and takes approximately 15 hours. Partial disassembly/reassembly will be required for some moves within the project area where crane walks are not practical. The partial disassembly/reassembly takes approximately 10 hours not accounting for transit time.

Lattice boom crawler cranes will be used for rotor assembly. These cranes will have a rated capacity of 100-200 tons. Weight of these cranes in traveling mode without counterweights is approximately 35 tons, fully assembled with all counterweights, approximately 250 tons. Full assembly is required upon initial arrival to the site and takes approximately 15 hours. Partial disassembly/reassembly will be required for some moves within the project area where crane walks are not practical. The partial disassembly/reassembly takes approximately 10 hours not accounting for transit time.

Solid boom rough terrain hydraulic cranes will be used for unloading turbine equipment and assisting the primary lift crane. They are also used to support construction of turbine foundations; unloading, placing and assembling components. These cranes will have a rated capacity of 60-75 tons. Weight of these cranes is approximately 45 tons. Assembly/disassembly is not required.

[36] See Section 2.4.4 Crane Routes.

Table 2.3-4 Typical Crane Technical Data

Crane Type	Lift Capacity	Weight	Arrival via	Inter-site movement via
Lattice boom crawler	400 ton	500 ton	Flatbed semis	Crane walk, flatbed semi
Lattice boom crawler	200-300 ton	250 ton	Flatbed semis	Crane walk, flatbed semi
Lattice boom crawler	100-200 ton	180 ton	Flatbed semis	Crane walk, flatbed semi
Solid boom all terrain	60-75 ton	45 ton	Self propelled	Self propelled

2.3.5 Roads and Infrastructure

Wisconsin Electric retained the services of Earth Tech, now Earth Tech AECOM, to compile data on public infrastructure within the Project limits and evaluate the suitability of that infrastructure to support the expected construction traffic.

The purpose of the investigation was to compile available data and provide field confirmation of the data to assess the impact of the proposed project on locally-owned infrastructure assets and to use in project haul route selection. A general understanding of the existing condition of publicly-owned assets (roads, bridges, and culverts) within the project limits aid in estimating the impact of construction traffic and estimating a cost of rehabilitation following construction. The investigation was designed to provide a general idea of asset conditions. This section is based on the Infrastructure Assessment Report findings. The full Infrastructure Assessment Report can be found in Appendix Y.

2.3.5.1 Methods to be used to handle heavy or large loads on local roads

The primary means of minimizing impacts to local roads due to heavy or large loads will be to avoid the use of routes where existing infrastructure has already failed or is in a failing condition. Avoidance of road assets means not using roads designated in the Infrastructure Assessment Report as already needing rehabilitation or reconstruction. Similarly, the Infrastructure Assessment Report indicates bridges that are load restricted, and those bridges will be avoided. None of the under-road culverts reviewed appear to require avoidance for route selection.

Where avoidance is not possible, mitigation of impacts by various means prior to use will be employed to preserve the asset conditions. Mitigation measures will be required as heavy and large loads may have an adverse impact on selected routes. Probable locations where local roads may need to be modified include local road intersections and turbine access road intersections with local roads. Road mitigation measures may include:

- Using appropriate haul vehicles for specific loads.
- Selecting appropriate truck/trailer length and number of axles/tires so that the load is distributed over a large area of pavement. This spread of load will minimize damage to pavement surfaces by spreading the weight over a large pavement area.
- Using wood mats or steel plates to cover roads at crane crossings.

- Using wood mats or steel plates for protection from outrigger pads.
- Improving intersections including construction of temporary turn lanes, enlarging turning radii. A map is included in Appendix A of the Infrastructure Assessment Report that indicates potential intersection improvement locations.
- Improving local roads at turbine access roads including temporary turn lanes and shoulder improvements.

No improvements were identified for the 247 culvert assets inventoried. For the nine (9) larger bridge/culvert structures that received a field inspection, Earth Tech recommends mitigating impact loads from project traffic by eliminating any settlement on approach slabs with an asphalt wedge and traveling at slow speeds. Many of these structures are on sag vertical curves with deteriorated pavement at the approach which may exaggerate the impact loads from heavy project traffic. Earth Tech further recommends that truck traffic cross one vehicle at a time near the centerline of the structure to spread vehicle loads over the inside beams where there is more structural capacity. No major improvements prior to use were identified for the bridge assets reviewed that are not in the avoidance category. Similar to the 9 bridge/culvert structures, asphalt wedge improvements are recommended for any bridge exhibiting settlement at the approach. Mitigation measures by the contractor will be required to follow the WDOT Facility Development Manual (FDM) standards, Wisconsin Standard Specifications for Highway and Structure Construction, and use the standards provided in the Manual of Uniform Traffic Control Devices (MUTCD). All deliveries to project site will be compliant with heavy-haul axle loading requirements.

2.3.5.2 Probable routes for delivery of heavy/oversized equipment and materials

A discussion of construction traffic is found in Section 2.3.6, with special focus on oversize deliveries under the sub-heading Equipment Delivery Trips. Once converging on the project area, delivery of equipment will disperse along local roads. Provisions for these deliveries are discussed throughout Section 2.3.5.

2.3.5.3 Potential for road damage and any compensation for such damage

Prior to commencing work on the project, all roads within the site will be video taped to document the existing conditions. After construction is completed, all roads will again be video taped to assess the after construction condition. An independent consultant will review before and after construction conditions of these roads and make recommendations as to the required mitigation measures including an estimate of cost for repair.

If public roads are damaged during the course of deliveries and construction, repairs will be appropriately coordinated with the local municipality to determine if they want to perform the repair work. If they do not desire to perform the repair work, repairs will be completed by a Wisconsin Electric contractor in accordance with the proper specifications.

An estimate of the cost to repair anticipated road damage will be calculated by an independent consultant. Repair costs would likely be similar to what Wisconsin Electric experienced with the

Blue Sky `Green Field project in Fond du Lac County. The Blue Sky/Green Field project is very similar to Glacier Hills in number of turbine sites, types of project traffic, amount of project traffic, mix of local road types, and condition of local roads. Little to no damage is expected on the bridges or culverts, similar to the experience on the Blue Sky/Green Field project.

Based upon the experience at Blue Sky/Green Field, the pavement areas that may be damaged are expected to be small, localized areas and mostly involve areas of edge cracking. To make a lasting repair, and for ease of construction, an area of pavement larger than the actual damaged area will be removed. Pavement repairs will follow Columbia County Highway Department standard practice. The Infrastructure Assessment Report has several sections which will be used as guidelines for repair practices.

Wisconsin Electric anticipates that permits for the use of local roads from the Towns of Randolph and Scott will be required.[37] These local permits will be held by Wisconsin Electric. Wisconsin Electric anticipates assuming complete responsibility for all damage resulting from the recurring trips to deliver components and materials.

All deliveries to project sites will be compliant with heavy-haul axle loading requirements.

2.3.5.4 Probable locations where local roads would need to be modified

To accommodate delivery of oversize loads, Wisconsin Electric plans to improve certain intersections. This may entail construction of temporary turn lanes and/or enlarging turning radii. A map is included in Appendix A of the Infrastructure Assessment Report that indicates probable intersection improvement locations.

2.3.5.5 Estimate tree pruning or removal

The existing public roadways have several areas where the tree canopy overhangs the traveled lanes. In areas where the tree limbs interfere with the delivery of components and equipment the limbs will be trimmed. Wisconsin Electric uses tree trimming experts to ensure that trees will not be harmed. Accepted utility practices and compliance with PSC 113.0511 and ATCP 21.17 Wisconsin Administrative Code will be employed.

Trees obstructing locations where the turbine access roads enter the public ROW will need to be removed to allow for the construction of the access road. It is important to note that the location has been agreed to by the landowner. These trees are the possession of participating landowners. As described in the facility siting sections of this document, landowner desires are accommodated to the greatest extent possible. For those landowners who decide they will keep the wood or trimmings that have been cut on their land, the Company will provide them information regarding ATCP 21.17 if it is applicable.

[37] Refer to Section 1.8, Required Permits and Approvals.

2.3.5.6 Electric distribution interruption

Local overhead electric distribution is used throughout the project area. It is certain that electric distribution will be interrupted. However, interruption of service will be minimized.

The local electrical lines in the area are about 16 ft above the traveled surface. Where these lines cross turbine site access roads, there is concern over possible interference with major equipment delivery. The vehicles and trailers used for transportation of the turbine equipment have a maximum travel height of 15 feet. For these deliveries, pole stands may be employed if needed to provide the appropriate clearance. Pole stands are used to lift the line above the truck as it passes underneath, eliminating the need for line disconnection.

Where pole stands are not practical, "line drops" will be used. Line drop is a term used for temporarily (for the duration of project construction) re-routing the distribution line down from its pole, underground beneath the access road, then up the pole on the other side. Hooking up the pre-installed line drop causes a brief interruption in service.

Where line drops or pole stands are not practical (highly unlikely), the expected outage for a material delivery would be 10 to 15 minutes.

Where the distribution lines intersect cross-country crane walks, distribution lines will need to be disconnected to allow passage of the crane. The typical outage for a crane walk would be approximately 20 to 30 minutes for the main erection crane. That said, when ever possible the use of line drops will be employed to minimize the need to disrupt electrical service.

For unavoidable local power outages, residents will be notified by telephone, mailer, door cards, and/or house to house contacts for the areas where power would be interrupted. Further, the outages will be coordinated with the local utilities and municipal officials to minimize any disruption to residential or business service.

2.3.6 Construction Traffic

Three (3) types of vehicle trips are associated with project activities: Worker trips, Construction Support trips, and Equipment Delivery trips. Worker trips are defined as project employees and contractors traveling to and from the job site. The majority of these trips are conducted in personal vehicles such as cars or pick-up trucks. Construction Support trips are defined as various standard truck types delivering construction material to the job site. Equipment Delivery trips are defined as various truck types - including many over standard size or over standard weight trucks – delivering turbine components to the job site. Further details of each trip type are included in the following sub-sections.

Worker Trips

General access to the project area will come from 360 degrees surrounding the site, limiting the concentration of worker traffic from any one direction. It is anticipated that the majority of the project workforce will come from Columbia County and the adjacent counties including Green Lake, Fond du Lac, Dodge, Dane, and Marquette. Construction workers would likely use a variety of routes depending on their home or temporary accommodations and would likely not concentrate traffic on any specific route with the exception of STH 33 which serves as a major east-west arterial traversing the project area. The nearest hotel lodging in the area is found in Fox Lake and Beaver Dam. Workers traveling from those sites and others arriving from Dodge County would travel to the project area along CTH 33, CTH A, CTH G, and STH 73. Workers coming from the Fond du Lac area would use USH 151, STH 68, and STH 33. More hotel accommodations are located in Dane County and workers arriving from there or from southern Columbia County would use STH 22, STH 73, STH 146, or CTH C. The Portage area offers some hotel accommodation and workers coming from there or points west would use STH 33 or CTH P. Arrivals from the north including Green Lake County and western Fond du Lac County would use STH 44 and STH 73.

Closer to the project area, County and Municipal/Town and some State roads may have minor impacts from increased worker traffic. Highways that might be affected by worker trips include in Columbia County CTH EF, E, F, P, H, and M; in Dodge County CTH A, C, F, and G; and across the project area STH 33, 73, 44, and 146. Municipalities that may have noticeable traffic impacts include Friesland, Cambria, Randolph, and Fox Lake as well as the Towns of Scott and Randolph. The City of Fox Lake may experience periodically noticeable traffic increases since it is situated close to the project area and several highways are routed through the city. There are other municipalities through which worker trips will travel en route to the project. However, those cities are more remote and therefore expect fewer trips (e.g., Pardeeville) or have more substantial traffic infrastructure (e.g., Beaver Dam) so that worker trip impacts would not be noticeable to their residents.

Within the project area, since the project is spread over a large area with the focus of construction activity moving from one location to another over time, traffic impacts will tend to be spread lightly over the project area and not be concentrated in any one area for an extended period of time. The exception will be at the location of the construction office. It is the construction manager's intent to manage the project from one main office site with associated parking and a laydown area. The majority of trades will commute to this central location, park their personal vehicles in a designated area, and then proceed to their work assignments.

Worker trips, while potentially having an impact on traffic congestion, are not expected to have any impact on local infrastructure. The exceptions to this are the timber bridges over the railroad on CTH M, Sterk Road, or Inglehart Road. The timber decking is in extremely poor condition with badly deteriorated members and loose connections. Increased traffic just from construction workers may cause serious deterioration and potential failure of the decking material. Wisconsin Electric will request all workers on the project not to use these bridges for any reason.

Appendix C of the Infrastructure Assessment Report has a complete list of the local roads in the area and their existing conditions.

Construction Support Trips

All construction material and equipment will be delivered by truck. A total of 8,215 truck trips are expected for construction support items. Anticipated construction support trips include the following major items:

- Mobilization/demobilization of construction equipment including excavators, bulldozers, graders, water trucks, concrete pumps, cranes, forklifts, trailers, plows, trenchers, etc. – 250 total trucks during the entire construction duration – 35-40 weeks.
- Delivery of road aggregate with end dump, side dump, and belly dump trucks – 5,000 total trucks during 10 week road construction period.
- Delivery of road fabric and culvert sections on low boy/flat bed semis – 25 trucks during the early stage of road construction.
- Delivery of foundation reinforcing steel and anchor bolts on flat bed semis – 100 trucks during the early stage of foundation construction period.
- Delivery of ready-mixed concrete with traditional ready mix trucks – 2,750 ready mix truck deliveries during the approximate 10 week foundation construction period.
- Delivery of pad mounted transformers on flat bed semis – 50 trucks during the 8 week electrical construction period.
- Delivery of electrical conductor and fiber optic spools on low boy semis – 40 trucks during the 8 week electrical construction period.

Locally produced materials such as road aggregate and concrete will be sourced from multiple locations near the Project site. Routes for these trucks will be carefully planned to minimize damage (and subsequent repair) and to minimize any permanent changes to the roads. Wisconsin has spring weight restrictions due to the unfreezing of soil layers underneath the pavement. Though the exact restriction dates are determined each year, the 35 year average spring restriction season is March 10 through May 10. During this time, heavy haul loads are restricted.

Highways that would be impacted by Construction Support Traffic include those located along Columbia County Highways EF, E, F, P, H, and M; Dodge County Highways A, C, F, G; and State Highways 33, 73, and 146. Town roads may be impacted as well, to the extent that turbine sites are located along those routes. Appendix C of the Infrastructure Assessment Report has a complete list of the local roads in the area and their existing conditions.

Equipment Delivery Trips

Equipment Delivery trips include turbine components and the project substation. Many of the trucks used for these trips are classified as over standard weight or over standard size.

Approximately seven (7) to ten (10) transport trucks per turbine (630 to 900 trucks for the project) are required to deliver the major turbine components, as follows:

- Controllers – 2-3 per truck (depends on vendor)
- Towers – 1 section per truck – 4 tower sections per turbine
- Hubs – 1 per truck
- Blades – 1-3 blades per truck (depends on vendor)
- Nacelles – 1 per truck

Turbine components are sourced from multiple locations including internationally. For deliveries from northern Lake Michigan ports, it is expected that components will travel along USH 41 south to STH 26 in Oshkosh, south on STH 26 to STH 49 in Waupun, west on STH 49 / CTH AW to STH 73 west of Waupun, south on STH 73 to the project site.

For deliveries from southern Lake Michigan ports, it is expected that components will travel through or around Milwaukee. After leaving Milwaukee, one of two main routes is expected. The first route would include taking USH 41 north to STH 33 in Allenton, west on STH 33 to the project site (CTH E and/or A may be used to bypass the City of Beaver Dam). The second route would be I-94 west to STH 26 in Johnson Creek, then STH 26 north to STH 60 near Clyman, then west on STH 60 to STH 73 near Columbus, then north on STH 73 to the project site (Hwy 151 may be used to bypass the City of Columbus).

Once the delivery vehicles arrive at the project site, the components will either be delivered to the construction laydown area or to the assigned turbine site. These movements will require the use of a variety of the town, county, and state roads in the area. Wisconsin Electric will avoid the use of roads that have been determined in the Infrastructure Assessment Report as requiring repair or rehabilitation. A map is included in Appendix A of the Infrastructure Assessment Report that indicates proposed oversize load routes and intersection improvement locations. Appendix C of the Infrastructure Assessment Report has a complete list of the local roads in the area and their existing conditions.

The substation for the project will require a step-up transformer which can be delivered on one (1) heavy, over-size truck load. A second transformer is being studied for installation as a spare; in that case, two transformer deliveries will be needed. The transformer will be sourced from one of the major providers of such equipment. It is anticipated that it will arrive locally via rail. There are locations near the project area that Wisconsin Electric has studied where the transformer could be transferred to a heavy haul truck. These include the UWGP Ethanol plant located north of STH 33 on Tessman Road, the rail siding located in the Village of Friesland along Richland Street, and two sites in or near the Village of Randolph. From any of the sites, the transformer would be transported via heavy haul vehicle to STH 33. The transformer would head west along STH 33 to Inglehart Road and then proceed south on Inglehart Road to the proposed Substation location.

Impacts due to the delivery of the major components are expected to be very minor. The vehicles delivering the components can travel at highway speeds and the intersection will be improved at accommodate the larger components. In certain cases the use of flagging personnel will be necessary for the delivering of components to the turbine sites. These disturbances will typically last for not more than a few minutes.

Discussions with Wisconsin Department of Transportation (WDOT)

Wisconsin Electric has begun discussions with WDOT to determine preferred routes, depending on the points of origin. The Company will continue to carefully plan and establish preferred routes and schedules for the all oversize deliveries, including those through the Milwaukee area. Final routes, once approved by WDOT will appear in the permit issued to the shipper.

As a result of our discussions with WDOT, Wisconsin Electric will request that the oversize loads be arranged to limit vertical clearances to 15 feet. WDOT has also informed Wisconsin Electric of certain city-specific restrictions that have already been incorporated into our initial plans.

The WDOT is implementing several mechanisms aimed at aiding the development of route plans and avoiding traffic restrictions. A computer/web-based program will allow haulers to access road planning data used by the WDOT operations staff. WDOT is in the process of creating route maps for each Wisconsin county. These tools will allow route planners to know about clearances, construction, load limits, and other activities that may prevent a certain route from being acceptable. This should increase the quality of the permit applications and speed up approval times.

2.3.6.1 Duration and time of day of traffic disturbances

According to the Infrastructure Assessment Report, impacts on local traffic are expected to be minor. Construction activities will take place over a widely dispersed area with multiple ingress and egress routes over improved roads. Based on a review of traffic data compiled in the Infrastructure Assessment Report's appendices and the proposed project traffic, no single location is expected to receive significant traffic impact. Furthermore, construction activities will be dispersed over approximately 8-10 months and not concentrated at any one location at any given time.

Worker trips and construction support trips will normally occur between the hours of 6:00 am and 6:00 pm Mondays through Saturdays. Since weather conditions may impact productivity and therefore the work schedule, extended hours may occur on an as-needed basis. Equipment delivery trips and wind turbine installation will generally occur within the same time slots. Some nighttime movement may be required because of travel permits, weather (e.g., too windy in the daytime to move cranes) or delivery schedules.

Local roads can be narrow, generally 16 to 24 feet wide in the project area. There may be some minor traffic disturbance associated with the potentially wide loads and on-coming traffic. Avoidance of peak travel times and traffic control actions allowed under contractor permits (e.g., flagmen, escort vehicles, etc.) can be used to minimize this potential impact. Similarly, oversize loads conducting turning movements may slow traffic for a short period at select locations, especially on the CTH system where higher traffic speeds may be expected. The selected contractor can use methods allowed under permit and following standards established in the MUTCD.

Utility cables will be buried under and along portions of State and County Highways 33, 146 EF and E, and local roads Vaughn, Dodge, Inglehart, Freisland, Cunningham, Crown, Larson, and Ross. During construction operations it may be necessary to close one lane of traffic during construction hours for the safety of the workers. During these temporary lane closures the contractor will be required to follow WISDOT and MUTCD standards for work zone safety. Where possible the use of directions boring will be used to minimize the impacts to the traveling public.

2.4 OTHER PROJECT FACILITIES

2.4.1 Turbine Site Foundation

The foundation supports the entire wind turbine assembly. Foundations are constructed by excavating a hole; placing reinforcing steel, tower mounting system (anchor bolt cage) and concrete forms; and pouring concrete into the excavation. Some foundations are deep and relatively slender ("pier foundation") while others are broad and relatively shallow ("spread footing foundation") as illustrated in Figure 2.4-1.

A typical pier foundation is a cast-in-place concrete cylinder. Its depth can be 30 ft or more. This type of pier is constructed by first excavating a cylindrical hole to the desired depth. Within the excavation, a smaller diameter, corrugated-steel casing is set concentrically within the larger diameter corrugated-steel casing. The anchor bolt cage for the pier foundation consists of steel tie rods within PVC sleeves. At the top and bottom of the cage are embedment rings which hold the tie rods in alignment. The tie rods run from the bottom of the foundation through the top providing anchors for the turbine tower. Soil backfill is placed within the central casing. The annular space between the outer casing and the excavation walls is backfilled with sand-cement slurry.

A typical spread footing foundation is comprised of a footing and a pedestal. The footing portion is octagonal and spreads out below grade within a circle approximately 55 ft in diameter. Its depth is approximately 8 ft. The pedestal portion is a concrete cylinder rising approximately 3 ft above the foundation. The anchor bolt cage for the spread footing foundation consists of steel tie rods within PVC sleeves. At the top and bottom of the cage are embedment rings which hold the tie rods in alignment. The anchor bolt cage extends from the bottom of the footing through the top of the pedestal providing anchors for the turbine tower.

Following the award of a turbine contract, foundation design is able to proceed. The appropriate foundation type and specific design is performed by the Project's Foundation Engineer. Considerations include the soil and geotechnical conditions at each final turbine location and cost. Regardless of foundation type selected, details of the foundation system design are performed by the Project's Foundation Engineer with foundation to tower interface design criteria provided by the selected turbine vendor.

Table 2.4-1 Typical Foundation Data

Parameter	Foundation Type[38]	
	Spread footing foundation	Pier foundation
Footing Sub-surface Dimensions	Octagon - 21 ft. each side	16 ft. ID 18 ft. OD
Pedestal Surface Dimensions	18 ft. OD	16 ft. ID 18 ft. OD
Footing Sub-surface Area	2059 sq. ft.	254 sq ft.
Pedestal Surface area	254 sq ft.	254 sq ft.
Depth	8-9 ft.	30 ft.
Disturbed Surface Area	17,600sq.ft.	2,825 sq. ft.
Excavated soil	5,500 cu. yd.	283 cu. yd.
Replaced	5,145cu. yd.	223 cu. yd.
Excess soil[39]	355 cu. yd.	60 cu. yd.
Concrete Mud Mat	30 cu. yd.	0 cu. yd.
Concrete[40]	325 cu. yd.	94 cu. yd.
Steel[41]	14,300 lbs.	23,900 lbs.

[38] Dimensions and quantities are for a typical foundation for the largest turbine under consideration.

[39] Following backfill of the installed foundation, excess excavated materials will be used on-site for the crane pad, roads and around the turbine base. No soil will need to be removed from the site.

[40] 5000 psi @ 28d

[41] ASTM A615, Grade 60 including anchor bolt cage and embedded steel.

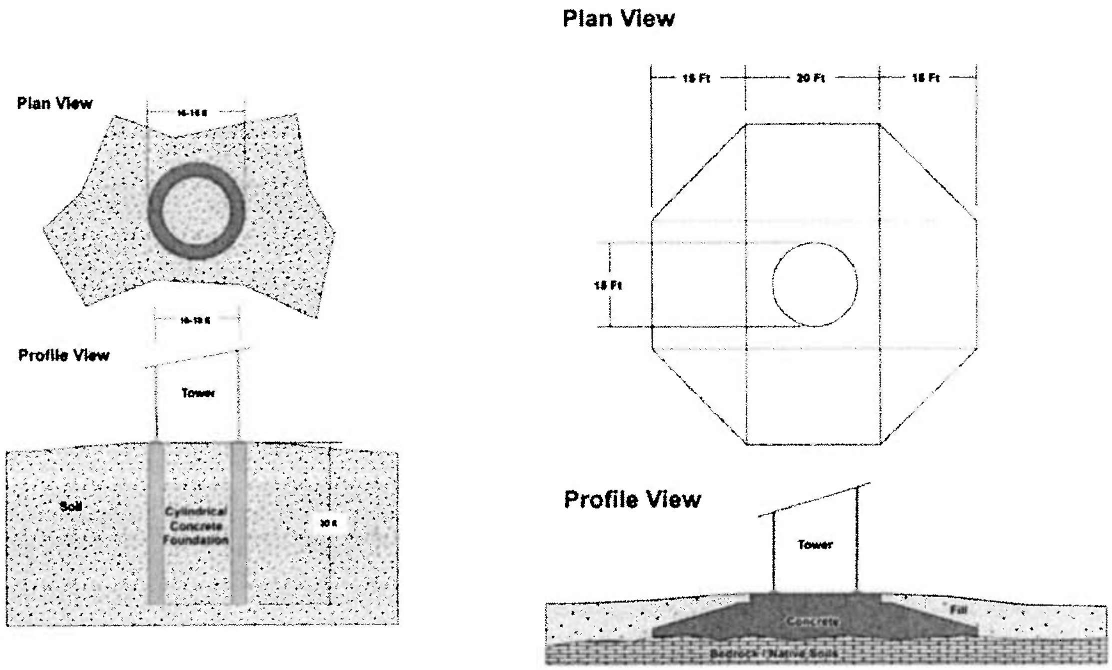


Figure 2.4-1 Typical Pier and Spread footing Foundations

2.4.2 Turbine Site Construction Area

During construction, a clear area of 1.6 acres (150 ft radius from the tower centerline) is established in which construction activities take place. This area provides sufficient space for turbine component laydown and assembly, and construction vehicle maneuvering and parking.

A plan view of a typical turbine site construction is shown in Figure 2.4-2.

Crane pads provide a stable surface for the main lift crane. Each pad is approximately 55 by 85 ft. Crane pads may either be constructed out of excavated materials or imported aggregate. The pads are compacted to the degree required by the crane selected by the construction contractor.

The component laydown area is adjacent to the crane pad. The laydown area is within an approximate 150 foot radius around the tower.

Construction vehicle parking is available on the gravel access roads and on the cleared construction area if needed.

Following construction, areas other than the turbine pad and gravel area around the turbine base will be restored to its pre-construction condition (see Figure 2.2-4 and Section 3.1.2, final paragraph, "Restoration"). The permanent turbine site area, including the permanent turbine pad, will cover approximately 0.15 acres.[42]

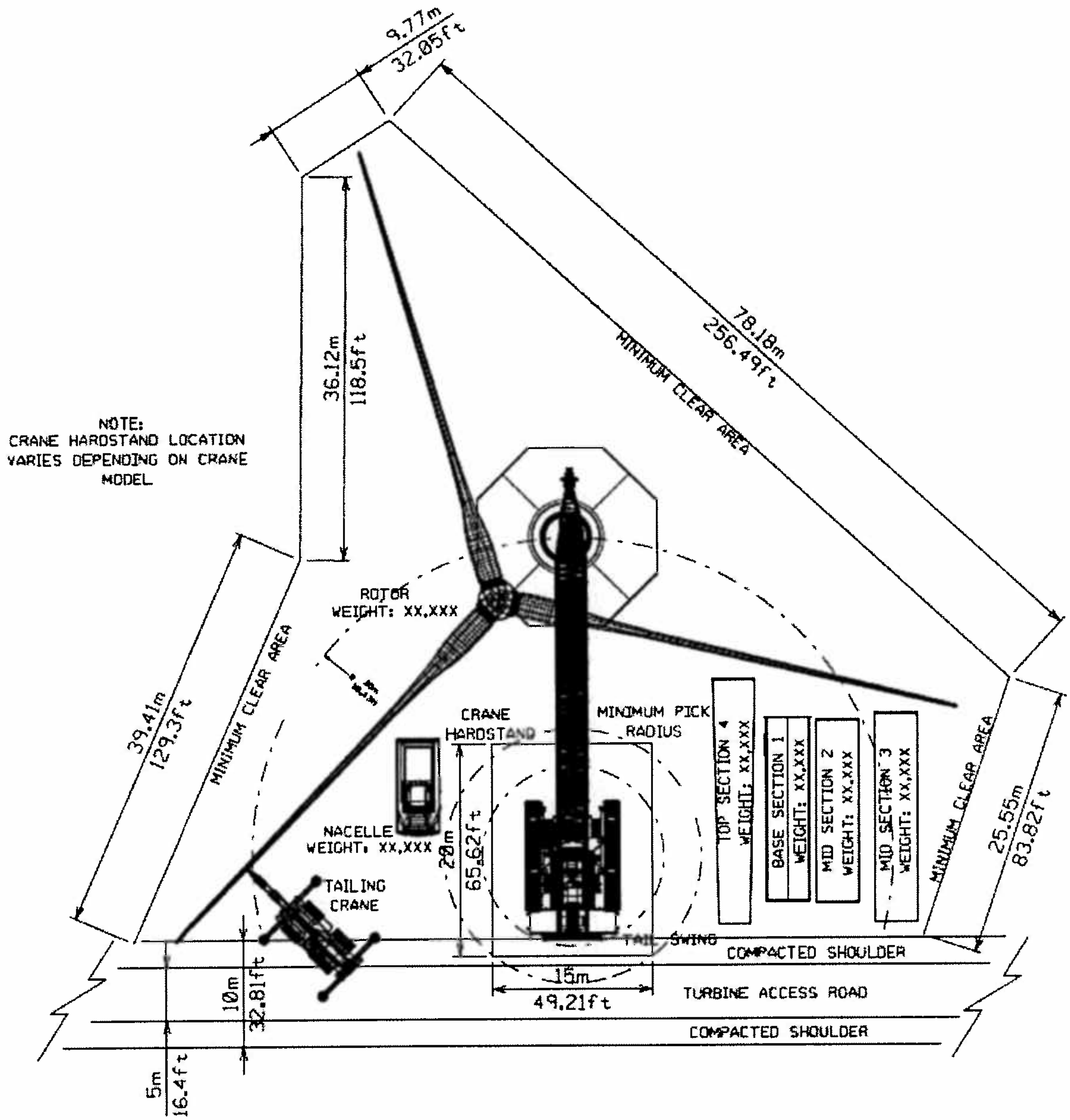


Figure 2.4-2 Construction Area Layout

[42] Estimated 119 x 55 ft rectangular area as encompassing crane pad plus graveled area around tower base.

2.4.3 Access Roads

One of the first steps in the construction process will be site clearing and building gravel access roads to connect each turbine site to existing public roads. For the 90 preferred sites, approximately 20 miles of access roads will be needed. Should alternate sites be utilized, the total number of miles would not be materially affected.

Access roads will have finished graveled surface will be approximately 16 ft for the primary travel path, with a range of 8 to 12 in. of compacted aggregate road material on top of a poly geofabric material. Organic materials will be stripped, windrowed, and stockpiled. A construction corridor approximately 50 ft wide is required to allow for proper stockpiling of soils for restoration. Prior to the road aggregate material being placed, the subgrade will be compacted.

For 10 to 12 ft on each side of the road where main erection crane travel is required, the road shoulders will be compacted, yielding a travel surface of up to 40 ft during the construction phase.

Following construction, the nominal 16 ft wide access roads will be retained for service vehicle travel and the remaining disturbed area will be restored to its pre-construction condition (see Section 3.1.2, final paragraph "Restoration").

Detail drawings of typical access road construction are included in Appendix G, Drawings. Please see the following drawings:

Figure 2.4-3 Typical Access Road Installation

No fences or gates are planned for the turbine access roads.

See Figure 1.1-2 in Appendix H, Project Maps for an overview of the project facility locations including access roads. Detailed views of the entire project area and facilities, with an aerial orthophoto (2007) background can be found as a MapBook at 1:8400 scale in Appendix I.

2.4.4 Crane Routes

2.4.4.1 Cross-country crane routes

Construction of a wind turbine requires a very large crane that can extend a lift boom to approximately 295 ft. The crane is brought to a turbine construction location in several pieces, as no single vehicle can transport the assembled unit.

A considerable amount of time and expense is required to assemble the crane, and once assembled, the crane stays assembled throughout its use at in the accessible local area.

Because of the size of the assembled crane, it cannot drive on or along public roads. Where access roads go from turbine to turbine, access roads can be used for these crane routes.

However, this is not the case for most turbines. Therefore, cross-country crane routes are needed.

For “crane walks,” the crane will be moved cross country under its own power along selected routes, where they can maneuver over the ground surface without encountering too many obstacles or short slopes that exceed 12%.

The final designation and layout of the crane routes can only be performed once the turbine model and construction contractor are selected. For the purpose of this application, crane routes for the preferred sites are described.

It should be noted that it is not practical to identify and describe all permutations and combinations of crane routes corresponding to the choices presented to the Commission of any 90 of the 118 viable and feasible turbine locations. Regardless, the crane route descriptions that follow are common to any crane walk applied by use of an alternate turbine site.

All crane routes are located on participating land with one exception. A crane route is tentatively planned that crosses the Union Pacific tracks south of USH 33. Wisconsin Electric has contacted the railroad company but has not yet secured their final approval for this crossing. If unable to reach agreement with the railroad, Wisconsin Electric will eliminate this crossing, dismantle the crane, transport it to the destination, and reassemble it.

2.4.4.2 Materials used and methods for construction

Cross country crane routes for wind projects situated in primarily agricultural land are arranged to follow the collector system route whenever possible in order to minimize disturbance and best coordinate with the landowner’s desires while at the same time optimizing the efficient execution of the Project.

The sequence and description and construction sequence, methods and materials used are as follows:

- Clear path corridor, nominal 50 ft width
- Remove minimum of 6 to 12” as needed of topsoil for nominal 34 ft crane route surface width
- Grade path surface for positive drainage away from the crane path with a maximum elevation difference of 2” between path edges.
- Grade in direction of travel should not exceed 12%. Provide grading and/or ditching to maintain existing drainage patterns and to provide positive drainage from crane path surface.
- Compact crane path and proof roll entire sub-base to identify potentially unsuitable shallow soil. Replace and soft, unsuitable soil with backfill approved by engineer.
- Smooth drum roll completed compacted crane path surface and minimize traffic over crane routes prior to crane walk. Prior to crane walk, verify a ground bearing capacity of nominal 4,500 pounds per square foot (psf)
- Construction notes:

(1) Engineered fill, geotextiles, geogrid or crane matting may be required in the event that unsuitable soils are encountered. Type and placement to be specified by onsite geotechnical engineer.
(2) Remove vegetation along crane routes as needed.
(3) Coordinate required relocation of overhead and underground utilities
(4) Use appropriate protective crane matting when crossing all public roads.

2.4.4.3 Crane route widths and depths

Cross country crane routes will be constructed to be a nominal 34 ft wide. Preparation will remove a minimum of 6" of topsoil and windrow for use in crane route restoration. Topsoil will be segregated from any excavated sub-soil to facilitate restoration. Additional topsoil removal may be decreased or increased provided ground bearing capacity of 4,500 psf can be achieved.

A detail drawing of typical crane route construction is included in Appendix G, Drawings. Please see the following drawing:

Figure 2.4-4 Typical Crane Path Construction and Restoration

Crane route crossings of wetlands and waterways will meet specific best management practices to ensure that there are minimal to no impacts to the resource. These practices are described in Appendix Z, Chapter 30 Application.

2.4.4.4 Crane route removal and land recovery

All cross country crane routes will be restored to pre-construction conditions; the soil will be de-compacted using a 12-18" deep chisel plow, backfilled with topsoil; at which point the surface will be restored to original condition, smoothed, contoured and stabilized in order to prepare the land for it's original use (farmland, grazing land, other).

Wisconsin Electric is committed to restoring disturbed lands to pre-construction status regardless of type of disturbance. Restoration activities for cross country crane routes will expeditiously follow the completion of project vertical construction. Regardless of other commitments articulated in our Agricultural Mitigation Plan, returning lands to productive use is further encouraged by provisions in our agreements with landowners.

2.4.4.5 Maps showing the location of all crane routes

See Figure 1.1-2 in Appendix H, Project Maps for an overview of the project facility locations including crane paths. Detailed views of the entire project area and facilities, with an aerial orthophoto (2007) background can be found as a MapBook at 1:8400 scale in Appendix I. Some alternative routes have been included and may be used, depending on final project configuration. A shapefile (GlcrHls_CranePaths.shp) has been provided for the proposed paths.

2.4.5 General Construction Areas

2.4.5.1 Lay-down areas outside of those found at the turbine sites

Wisconsin Electric plans a general construction area that will cover approximately 20 acres. Five of these acres will be purchased for the siting of the O&M facility. The 15 acres is leased on a temporary basis and is used during construction for equipment laydown and additional vehicle parking as needed. The construction laydown area is planned to be gravel surface.

2.4.5.2 Identify size and location of construction parking areas

Parking for construction trailers, personal vehicles, and construction vehicles is planned to be within the 5 acre footprint of the O&M facility and be approximately 300 x 440 ft. gravel surface (approximately 3 acres). Please refer to the following drawings in Appendix G .

Figure 2.4-5 Layout at Site A
Figure 2.4-6 Layout at Site B

2.4.5.3 Expected use of these areas after project completion

Following construction, the 20 acre area will be reduced to 5 acres to accommodate the permanent O&M building, employee parking and equipment storage yard. The permanent parking area will be paved. The temporary area will be restored to its pre-construction state and use.

2.4.5.4 Hazardous chemicals used on site during construction and operation

Potentially hazardous materials and chemicals, such as fuels, lubricants, paints and coatings that may be used during construction include the following:

Table 2.4-2 Chemicals used During Construction

Acetylene Gas	Non-Shrink Grout
Antifreeze Coolant	Oil Based Polyurethane Paint
Brake Cleaner Non-Chlorinated	Oxygen Gas
Construction Grout	Paint
Curing Compound	Portland Cement
Diesel Fuel	Propane Gas
Diesel Fuel #2	Roadway Surface Control Dust Agent
Elastomeric Latex Sealant	Safety Glasses Lens Cleaner
Formwork Release Agent	Silica
Hydraulic Oil	Starting Fluid
Isopropyl Alcohol	Unleaded Gasoline
Lubricant	WD-40
Motor Oil	

Table 2.4-3 Chemicals used During Operation

Hydraulic Oil	Oil Based Polyurethane Paint
Isopropyl Alcohol	Paint
Lubricant	Propane Gas
Motor Oil	Roadway Surface Control Dust Agent
Non-Shrink Grout	Safety Glasses Lens Cleaner
WD-40	Starting Fluid

2.4.5.5 Spill containment and cleanup measures

Storage and containment of all chemicals on site will be accomplished in compliance with all local, state, and federal regulations. The Spill Prevention, Containment and Countermeasures Plan (SPCC) is provided in Appendix Z.

All chemicals will be stored in properly labeled and approved containers. Flammable storage cabinets will be obtained and utilized as necessary. Flammable and combustible liquids will be stored 25 ft from other construction operations.

Material Safety Data Sheets (MSDS) will be available on site for all materials in quantities equal or greater than 55 gallons.

Paint used on site will be stored per local, state, federal, and manufacturer requirements. Low VOC (volatile organic chemicals) paints will be utilized when available.

Compressed gas cylinders will be secured and stored within the required 20 foot separation between oxygen and acetylene.

Fuel delivered to heavy construction equipment in the field will be delivered in truck mounted large capacity tanks with integrated pumping systems. Fuel tanks will be designed with a double containment system. Portable gas-cans will be stored in a trough secondary containment to avoid leakage or spillage onto the soil.

Construction of the project will use conventional (commonly diesel-powered) construction equipment such as pickup trucks, dozers, trenchers, excavators, ready-mix concrete trucks, and cranes. Fuels and lubricants used in this equipment may be considered hazardous and will be managed according to all applicable requirements. All construction waste, hazardous and non-hazardous, will be properly handled, removed from the project sites, and either recycled or properly disposed.

Operation of wind turbines requires the use of lubricants and other fluids. These include gear oil for the gearbox, hydraulic fluid for brakes, and grease for bearing surfaces. They will be stored and used in accordance with all applicable regulations. Lube oil, hydraulic fluid, and glycol are stored in 55 gallon drums placed on spill contained containment pallets inside the O&M building. Tubes of grease will also be stored inside the O&M building. Used lubricating oils will be recycled by a certified reclamation service, and used glycol will be managed as a Wisconsin universal waste and reclaimed. Any hazardous waste generated during normal operation and maintenance (e.g., rags) will be disposed of in a hazardous material collection container. A hazardous material removal service then properly disposes the material. It is anticipated that the facility will be a very small quantity generator (VSQG) as defined by NR 610.07.

No other hazardous materials are required for operation of the turbines and no waste stream is generated from the electricity generation process. Appropriate safety related equipment such as eye wash stations, first aid kits, and fire extinguishers will also be provided.

A specific Spill Prevention, Containment and Countermeasure (SPCC) plan is required for oil and oil products with (1) any single oil aboveground storage tank (AST) exceeding 660 gallons, (2) a total AST capacity exceeding 1,320 gallons (in containers with capacity of 55 gallons or greater), or (3) a total underground storage tank (UST) capacity exceeding 42,000 gallons.[43] Wisconsin Electric will not exceed the quantities for oil and oil products as listed above and therefore a plan specific to these products will not be required.

2.4.6 Transmission Interconnection

Two increments of interconnection have been requested of the MISO. Interconnection G706 (Queue #39041-01) is for 99 MW and H012 (Queue #39567-01) is for an additional 150 MW, providing a total of 249 MW.

The G706 interconnection was initiated by FPL Energy, LLC and formally assigned to Wisconsin Electric on March 14, 2008. This assignment was requested of FPL Energy by Wisconsin Electric as part of the transfer of ownership of the Project. The Feasibility, System Impact, and Facility Studies have been completed. Wisconsin Electric, AT, and MISO executed the G706 Large Generator Interconnection Agreement (LGIA) on September 18, 2008. Copies of the studies and agreement are included in Appendix U, Transmission

H012 was initiated by Wisconsin Electric on April 29, 2008. Studies for H012 began with the System Impact Study. Completion of the System Impact Study is expected in early to mid-November 2008. Based on our experience with G706, Wisconsin Electric projects a Final Facilities Study in the 1st quarter 2009 and the LGIA in the 3rd quarter 2009.

The studies being performed for both interconnections are based on 1.5MW wind turbines. Wisconsin Electric may need to request a re-study based on final turbine model selected or as the field of candidate turbines narrows. This situation would be the same as Wisconsin Electric experienced during the Blue Sky Green Field wind project, where re-studies were necessary due to a change in what appeared to be the turbine model that would be installed. Wisconsin electric expects the Glacier Hills project to have the same result as the Blue Sky Green Field case, where interconnection requirements were readily met by selecting modern turbines and power conditioning systems.

Wisconsin Electric will provide copies of future studies and agreements as supplements that Appendix U as they become available.

[43] 40 CFR part 112

2.4.7 Collector Circuits

At the turbine, there is a step-up transformer increasing the voltage produced by the turbine's generator to 34.5 kV collector system voltage. Collector circuits originate at the turbines and converge on the substation. Collector system runs include both fiber optic communication cables and electric power cables.

The design of the collector system uses a combination of underground and overhead construction; most of the collection system will be underground.

Two overhead "main branch" circuits are planned along Vaughn Road (on the south border of the project). These main branch circuits are used for bulk connection of the far eastern end of the project to the substation. This route is in the Town of Randolph east of Inglehart Road, encounters two ravines that need to be crossed. Crossing these ravines underground could be much more costly and technically challenging than overhead. The drawings of the circuits along Vaughn Road indicate all-overhead construction, although underground is still an option being evaluated. The ultimate decision on circuit type will depend on a variety of factors including geology and environmental impacts. Wisconsin Electric has included the route as underground in our environmental permits so that if the decision is made to convert an overhead section to underground, it will have been addressed from a permitting perspective.

The overhead section would be constructed using single pole structures with six 477 ACSR conductors supported on insulators. For this kind of circuitry, the wind industry typically uses armless type construction with insulators on fiberglass standoff braces. The utility industry typically uses three cross-arms with vertical insulators.

Minimum vertical clearance per the NESC is 19.5 ft for 34.5 kV overhead lines. Adding a 2-ft buffer for construction tolerances, Wisconsin Electric would design for a 21.5 ft vertical clearance. As indicated in the drawing of the overhead structure (see below) the distance from lower insulator to the top of the pole is expected to be 17.5 ft. Adding to these clearances is additional space that may be needed for lighting arrester installation and pole-in-ground distances, pole lengths are expected to be 60-65 feet. There may be certain poles that are taller to accommodate spans across the ravines.

The following drawings of the overhead structures can be found in Appendix G.

Figure 2.4-7 34kV Double Circuit Structure

The majority of the collector system utilizes underground, jacketed, concentric neutral, aluminum conductors.

Underground collector system design uses jacketed, concentric neutral, aluminum conductors. Main branch circuits from the substation utilize 1000 MCM cable. As the cables are spliced for branches to turbine sub-circuits, the conductor sizes are reduced to 500 MCM, 4/0 and 1/0 cable, depending on the ampacity requirements of the circuit branch in question.

Circuits are laid at the bottom of the 4 ft deep trench. Trench spoils are used to directly bury the cables into the ground. Topsoil is then overlaid onto the disturbed area for re-vegetation. If multiple circuits are to be laid in a common collector route, common practice is to maintain 5 ft spacing between to allow for heat dissipation. However, the precise minimum circuit separation will be determined by thermal resistivity tests performed during final design and field engineering.

Underground cable splices are normally direct burial for joining the end of a single conductor to the beginning of another. Primary junction enclosures will be used for terminating cables for "Y" splices of parallel cable. Some junction enclosures will be installed at cable splices to provide convenient locations for electrical testing. Junction enclosures are typically less than 4 ft wide, 4 ft high and 2 ft deep. See the following drawing in Appendix G for a diagram of typical underground layout.

Figure 2.4-8 Typical Cable Installation

A breakdown of wire and cable used for the combination overhead/underground collector system is tabulated below. Note that the total length of the collector run corridors for environmental impact prediction is not the same as the numbers provided below since some corridors hold multiple circuits (see Section 5.3.3).

Table 2.4-4 Collector Circuit Miles – Overhead/Underground

	Underground	Overhead
Circuit Miles	49	7

Based on our experience with the BSGF Wind Farm, Wisconsin Electric has chosen to include in the DNR Chapter 30 permit application for this project, requests for waterway or wetland crossings which would only be used should plans be changed as a result of the CPCN proceedings or as a result of unknown conditions discovered in the field. Underground cable crossings of the ravines with associated waterways and wetlands along Vaughn Road are one such request. Therefore, a description of impacts for both overhead and underground for the Vaughn Road ravine crossings are included. However, the feasibility of has not yet been verified; rather the description of both overhead and underground along Vaughn road is to disclose impacts associated with unknowns.

Table 2.4-5 Collector Circuit Miles – All Underground

	Underground	Overhead
Circuit Miles	56	n/a

See Figure 1.1-2 in Appendix H, Project Maps for an overview of the project facility locations including collection system routes. Detailed views of the entire project area and facilities, with an aerial orthophoto (2007) background can be found as a MapBook at 1:8400 scale in Appendix I. Shapefiles (GlcrHls_UGCollection.shp and GlcrHls_OHCollection.shp) have been provided for the proposed locations.

Collector routes are all located either on land under easement agreements or public road right-of-way with the exception of three crossings of the Union Pacific railroad tracks. Wisconsin Electric has contacted the railroad but has not yet completed the agreements for those crossings. These crossings will be bored under the tracks according to the railroad's specifications.

As a related note to the planned route, if multiple circuits are to be located along the road right-of-way in an area that has less than the requisite inter-circuit of spacing, both sides of the road will be used. Further, Wisconsin Electric may also attempt to secure voluntary road-adjacent cable easements from land owners in areas that could further optimize the construction of the collector system. In those cases, installation would occur in the easement area rather than the road right-of-way.

2.4.8 Construction Site Lighting

Wisconsin Electric plans not to need night time work at any of the construction sites or staging areas. However, if night work is performed, mobile trailer lighting systems and generators would be used to ensure that activities are completed in a safe manner.

Possible locations where this lighting would be used are the construction staging area on the O&M building property, individual turbine sites, and the substation.

All of the construction locations are in the Towns of Randolph and Scott with the O&M building potentially in the Village of Friesland. None of these governments have ordinances related to lighting (refer to Section 5.6).

2.5 SUBSTATION

The project includes a new ATC switching station and a collector substation (138/34.5 kV). Both substations are adjacent to one another and are preliminarily planned to be located on Inglehart road at its intersection with ATC's 138 kV transmission line that runs from Portage to North Randolph.

2.5.1 Drawing or diagram

Appendix G contains a site plan and site location of the switching/substation, and a one-line diagram and section views of the collector substation. See the following drawings.

T-OHD-STR-180	138kV dead-end steel turning structure
RSC-02-01	Site Plan
RSC-06-02	Elevation 1
RSC-06-03	Elevation 2
RSC-06-04	Elevation 3
RSC-10-01	One-line diagram

Wisconsin Electric has two MISO interconnect queue positions for the Project. G706 is for 99 MW, while H012 is for an additional 150 MW. G706 has completed all studies and the Large Generator Interconnect Agreement which can be found in Appendix U. H012 is in the process of System Impact Studies. The ATC switching station that has been specified in G706 calls for a straight 138 kV bus arrangement. The substation site plan included in this application shows the combined ATC and collector substations on a single drawing. The ATC portion is shown as the straight bus arrangement. With H012, ATC may require a 138 kV ring bus as indicated in the ultimate build-out scenario of the G706 MISO Facility Study (Appendix U).

Wisconsin Electric does not expect a 138 kV ring bus would impact the layout of the collector substation. However, as described below in Section 2.5.5, the collector substation has been planned with two transformers connected with switches, breakers, and buswork.

The site plan shows the easterly substation fence at its minimum distance from the adjacent road assuming turning radii for service and delivery trucks. Final determination of road setback will need to factor in landowner negotiations and alignment with ATC's 138 kV turning structures.

2.5.2 Plat and topographic maps - location of the substation

The proposed switching and substation locations are shown on a number of maps provided in figures in Appendices H and J.

2.5.3 Size of the land purchase required and orientation of the substation within the purchase parcel

Together, the ATC and collector portions of the substation are expected to occupy a space of 600 feet north-south and 750 feet east-west (total area of approximately 10 acres). The planned location of the substation is immediately south of and adjacent to the ATC right-of-way for X-6, which runs in an east-west direction. Wisconsin Electric plans to purchase a total of 20 acres. This will provide sufficient room for stormwater detention, communication tower, simultaneous construction laydown of both substations, and flexibility in aligning with the ATC turning structures, and provisions for road setbacks.

A certified survey for the substation facilities will be provided when completed.

Temporary areas will be returned to pre-construction condition. Refer to Appendix Z, Agricultural Mitigation Plan.

2.5.4 Current land ownership and control of property

The land for the planned substation is currently owned by the Larry J & Christine J Braaksma Lifetime Revocable Trust. The land is under Easement Agreement for the Project and the Braaksmas are participating landowners. There are two preferred and one alternate turbine sites also located on this property. Wisconsin Electric has not completed negotiations for the purchase of this property. The Braaksmas have expressed to DATCP and Wisconsin Electric their interest in selling and Wisconsin Electric has provided the Braaksmas an option to purchase agreement.

Additionally, Wisconsin Electric is currently in discussion with other property owners along X-6 for contingent locations.

Wisconsin Electric will provide information regarding changes in status of the negotiation as it occurs.

2.5.5 Required substation facilities

The collector substation will connect to ATC's 138 kV transmission line via a new 138 kV switching station which will be located adjacent to the collector station and the 138 kV transmission. All collector circuits will enter the substation underground.

The collector substation is being designed as a two-transformer station with both units installed onto a single lineup of 34.5 kv buswork and breakers. Wisconsin Electric may determine that the second transformer will be purchased and delivered to the station, but only kept as an on-site spare and not electrically connected. To provide the most complete view of the project from the perspective of the site plan, both transformers are shown as installed.

The collector substation includes the following if both transformers are installed:

- 138 kV Deadend Structure
- (2) 138 kV 1200 Amp Circuit Breaker
- (2) 138/34.5 kV 120/160/200 MVA Transformer
- (2) 138 kV three phase vertical break 1200 Amp Disconnect Switch
- (6) 138 kV Potential Transformers
- (2) 34.5 kV Main Breaker
- 34.5 kV Bus Tie Breaker
- (4) 34.5 kV Three Phase Vertical Break 3000 Amp Disconnect Switch
- 34.5 kV Bus with (8) 34.5 kV 600 Amp Collector Circuit Breakers
- (62) 34.5 kV 600 Amp Disconnect Switches
- (12) 34.5 kV Potential Transformers
- (6) 34.5 kV Current Transformers 3000/5
- 34.5 kV Grounding Transformer 100 MVA
- (8) 34.5 kV Grounding Transformer 100 kVA
- Control house (12x48)

If built as a straight bus, the ATC switching station includes the following:

- (4) 138 kV Deadend Structures
- (3) 138 kV 3000 Amp Circuit Breaker
- 138 kV three phase vertical break 3000 Amp Disconnect Switch
- (2) 138 kV wave traps and CCVT's for transmission line carrier communications
- 138 kV CVT's
- 138 kV Potential Transformers
- Control House (24x36)

If the ATC switching station is built as a 3 position ring bus, the following equipment would be installed:

- (4) 138 kV Deadend Structures
- (5) 138 kV 3000 Amp Circuit Breaker
- (16) 138 kV three phase vertical break 3000 Amp Disconnect Switch (total switches required for the ultimate six position ring)
- (2) 138 kV wave traps and CCVT's for transmission line carrier communications
- 138 kV CVT's
- (12) 138 kV Potential Transformers
- Control House (24'x36')

If built as a 4 position ring bus instead of a 3 position, the ATC switching station will add a deadend structure, a 3000 amp circuit breaker, and three potential transformers.

2.5.6 New Substation

The new substation will be built adjacent to the right-of-way for 138 KV line X-6. According to the Facilities Study for G706, line X-6 will be looped into and out of the substation, and will be terminated at two points inside the substation. No new transmission lines will be built for G706 and the switchyard is expected to be configured as a straight bus arrangement. The only transmission work outside the substation will be the dead end turning structures that loop X-6 into the substation. The turning structures will not require guy wires and will be located within the existing transmission ROW.

Power lines through the G706 substation are shown on a number of drawings in Appendices H and J.

Preliminary results of H012 system impact studies have indicated that some additional transmission work may be needed. The entire scope of the needed facilities has not been determined by MISO. If needed, the ATC switchyard may be configured as a 4 position ring bus.

Dead end turning structures will be made of steel, 90 feet tall, and specified as weathering brown. The structures will be located in the ATC transmission ROW.

A diagram of an ATC turning pole (T-OHD-STR-180 138kV dead-end steel turning structure) is included in Appendix G. Note that regardless of what is shown on the drawing, the pole will not require guy wires (as is ATCs preferred practice in actively farmed areas).

Permanent lights are expected to be installed in the ATC and collector system substation. The lights are positioned to illuminate the line switches, which enables work crews to visually confirm open circuits before working on the lines. All lights are expected to be metal halide flood lights on switched circuits. In this manner, none of the lights will be on except during times that personnel are in the substation, doing switching, at night. There will likely be photo-cell controlled, low wattage, wall packs at the doorway of each of the two control houses. No street lights are planned at the roadway entrances.

There are no zoning ordinances related to lighting.

2.5.7 Modifications to Existing Substations

ATC will need to revise the carrier frequencies associated with the interconnection of the G706 wind generator on existing line X-6. X-6 will be split into two new breaker sections. It has been determined to make carrier frequency changes at the Portage end. Drawing revisions will be required at North Randolph, and Friesland substations to reflect new line numbers and terminal designations. Field labeling will also be required. The existing power line carrier guard and trip frequencies will be adjusted to match those that will be installed at the proposed G706 Interconnection Substation. The line tuner at Portage will also be adjusted to match the new frequencies. The settings of the existing line protection relays will be modified and tested to provide for the addition of the proposed G706 Interconnection substation. The Portage, North Randolph, and Friesland substation drawings will be updated to indicate the addition of the proposed G706 Interconnection substation.

Wisconsin Electric will provide information on Interconnection H012 as it is made available by MISO.

2.5.8 Construction procedures

The Substation is constructed prior to commercial operations. The construction sequence is as follows.

- Install erosion control measures for entrance drive as detailed on the approved construction drawings. Install culvert and entrance drive from Inglehart Road.
- Install safety fence approximately 10 foot beyond the construction boundaries.
- Install construction erosion control measures including silt fence, straw bale barriers and riprap as detailed on the approved grading and erosion and sediment control drawings.
- Construct storm water runoff basin if required.
- Begin earth work operations and grade the substation to rough grade.
- Install concrete foundations.
- Install ground grid and below grade conduits.
- Finish grading the substation area and install crushed stone yard surface.
- Install and ground permanent substation fencing.

- Install steel structures, substation equipment and control building.
- Install power and control cable and terminate cables.
- Test and commission all equipment and relays.
- Connect the substation to the transmission system and energize.
- Complete permanent stabilization as detailed on the approved construction drawings, remove temporary erosion control measures as appropriate.

2.6 OPERATIONS AND MAINTENANCE BUILDING

2.6.1 Describe the purpose and use of the proposed O&M building

Utility-scale wind power projects typically include an operations and maintenance building (O&M Building) where offices, control room, locker rooms, lunch room, spare parts storage, and employee and equipment parking are provided. Deliveries of parts and supplies by couriers (U.S. Mail, UPS, FedEx, etc.) and trucks occur from time to time.

Employees would typically report to the O&M Building for work. Technicians typically drive utility-type service trucks (heavy-duty pickup trucks with tool storage) between the O&M Building and the individual wind turbines themselves. Technicians typically work in teams of 2 or 3, and work at the turbines to perform routine maintenance, repairs, and cleaning. Most maintenance and repair is accomplished within the wind turbine tower and nacelle, although occasional repair work requires the use of cranes to replace heavy components such as blades, generators, or gearboxes.

The O&M building is constructed prior to commercial operations. The construction sequence is as follows.

- Install erosion control devices
- Prepare O&M building site pad
- Form, reinforce, and place foundations
- Backfill foundation
- Place concrete slab-on-grade
- Frame and skin prefabricated metal building and enclosure
- Rough-in and insulate finished spaces
- Rough-in electrical, mechanical, and plumbing services
- Perform exterior and interior finishes work
- Install landscaping

2.6.2 Number of full-time employees working at the facility

Staffing for the Project would include 10 to 15 technicians, a site manager, inventory manager, and a receptionist/office manager. Additional specialized personnel may work at the Project for limited periods such as for specialized heavy maintenance work. See Section 3.2 for Workforce details.

2.6.3 Size of property needed

The property needed for the O&M facility is 5 acres. The O&M facility includes the O&M Building, paved employee parking lot, and outdoor graveled storage yard.

The facility is expected to be substantially similar to Blue Sky Green Field. A dimensioned layout drawing of the final configuration of the BSGF O&M facility is provided in Appendix G, Drawings. Please see the following drawing:

Figure 2.6-1 O&M Facility

2.6.4 Building and Building Footprint

The O&M Building consists of offices, control room, locker rooms, spare parts storage, and indoor garage. Paved and graveled employee and equipment parking lots are provided at the O&M Building site.

The building is expected to be substantially similar to Blue Sky Green Field. The O&M Building would have dimensions of approximately 56 feet by 160 feet (~9,000 ft^2), an overall height of less than 20 feet. It will be metal framed structure, constructed on an at-grade slab and similar in design to a farm shop.

Plan and elevation drawings of the final BSGF O&M Building are provided in Appendix G, Drawings. Please see the following drawing:

Figure 2.6-2 O&M Building Exterior Elevations
Figure 2.6-3 O&M Building Life Safety Plan

The O&M Building location is shown on the maps included in Appendices H and I.

2.6.5 Lighting and Security Plan for O&M Property

Permanent lighting for the O&M property will consist of security lighting at each entrance to the O&M building. Lights are directed toward the immediate vicinity of the entrance, thereby minimizing potential disturbance to any nearby residence. Storage yard lighting will also be provided. Yard lights will be directed downward, minimizing potential disturbance to any nearby residence.

Fences (6 ft high, chain link) will be installed around the O&M property storage yard. Access to the interior of the O&M building will be controlled via a key card system. Intrusion detection and electronic surveillance will be provided.

2.6.6 Other facilities needed

Electric, natural gas (if available) and telecom services to the O&M building will be required.

Potable water to service the O&M building will be required. Potable water may be obtained from a well if local municipalities do not service the O&M building location.

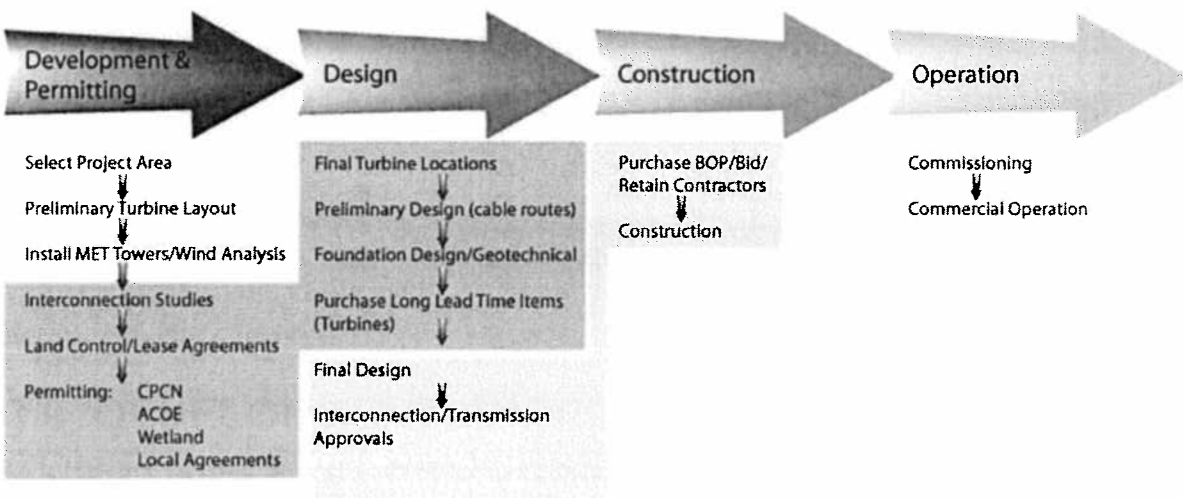
Municipal sewer service or a septic system will be required for the O&M building. During construction and operation, discharges from the O&M building will be to the building's sewer service or septic system.

Runoff from the parking lot during construction and operation will be directed to existing culverts as required by permits. A retention basin for parking lot runoff is anticipated.

No other facilities are planned.

3.0 DEVELOPMENT, APPROVAL, ENGINEERING, AND CONSTRUCTION PROCESS AND SEQUENCE

The purpose of this introductory section is to communicate an understanding of the sequence of tasks that enable the actual construction of a wind farm. The following graphic illustrates the general flow of development tasks for a wind farm from identification of a project area to commissioning and commercial operation. The shading between tasks indicates those steps that are directly related to each other and often occur concurrently with each other.



Development

As shown above, typically the wind development process begins with the identification of a project area that is well suited for a wind farm. Wind farms typically cover an area of land upwards of several thousand acres. The typical size of a utility wind farm in Wisconsin is between 5,000 and 20,000 acres.

There are a number of characteristics that create a suitable wind farm; these include the obvious which is persistent prevailing winds above a certain speed. Next, a wind developer will look for other attributes of an area such as the availability of open space for the placement of turbines, topography that enhances wind speeds, the availability of needed infrastructure such as roads and transmission interconnection points, and of critical importance is a local community that supports wind energy.

When these characteristics come together, a potential project area is identified. The next step in the process involves collecting and documenting wind data from locations within the project area. This is accomplished through the installation of meteorological towers that collect wind data on an ongoing basis. For certain project areas these towers may collect data for a number of years, as it is over a long period of time that the true wind characteristics of a particular area are revealed, as wind patterns, like weather, change from year to year. Once sufficient wind data are collected and analysis is then conducted of the data. Based on a preliminary turbine layout, and other preliminary details such as turbine size, estimates are made regarding the potential wind energy that could be generated from a wind farm at this location.

If the results of the wind analysis are favorable, and it appears a wind farm is economically feasible, the next step involves securing land control for purposes of locating turbines throughout the project area. Although land can be purchased, typically land is leased from property owners for the purpose of placing wind turbines, cables, and roads throughout the project area. If a wind developer is unsure as to when the project may actually be developed, but they wish to maintain control over an area they've deemed favorable for development, they will negotiate lease agreement "options" with property owners located within the project area. An "option" means the developer is reserving the right, to place wind farm related infrastructure on the property at some point in the future. Typically these options must be renewed every two to three years. Once the exact placement of all wind turbines and related structures is determined during preliminary design, final lease agreements can then negotiated with each property owner.

Other tasks typically begun during development include applying for an electric transmission system interconnection and gathering information for construction permits.

Preliminary Design

Advancing the project beyond the concept, commercial viability and constructability must be demonstrated to investors and customers. In the case of a Wisconsin utility, this demonstration is made to the PSC. In the case of the Glacier Hills Wind Park, a CPCN application is required to begin the deliberative process resulting in project authorization or denial.

During Preliminary design, activities are geared toward advancing project definition to provide a high level of confidence that project execution will occur as envisioned. Briefly, the activities (some perhaps begun during Concept Development) include;

- Performing detailed natural environment characterization including T&E species, avian, wetlands, waterways, land cover, land use, geology, floodplains
- Performing detailed human environment characterization including historic artifacts, land use, transportation, communication and utilities infrastructure, locations of residences and sensitive facilities, community ordinances and plans etc.,

- Performing additional engineering to update the conceptual design to more precisely define the wind-energy resource (includes revised turbine siting)
- Securing the turbine sites (exercising development option)
- Submitting an application for transmission interconnection
- Performing additional investigation to prepare the CPCN application and construction permits including articulating plans and alternatives, and identifying impacts and mitigation strategies
- Applying for other critical permits (WDNR, FAA and WDOT)

For Glacier Hills, completion of preliminary design has achieved the following;

1. Consummation of required landowner agreements.
2. Reasonable assurance of local government acceptance and cooperation.
3. Level of design definition sufficient to negotiate turbine and E&C contracts.
4. Level of detail sufficient to submit complete construction permit and CPCN applications.

Once this stage has been achieved, the applications are submitted. However, the project continues to be refined in preparation for start of construction following receipt of approvals and permits.

There is continued contact with landowners, the public and local governments. Negotiations with manufacturers, suppliers, and engineering and construction firms take place. Additional site investigation may take place as needed to provide a greater degree of certainty in contracts for project work (e.g., selected sub-surface investigation for facility footing or cable run estimates, sample heavy/oversize load permit applications for transport bids).

Since turbine delivery typically has a long lead time, it is critically important that contracts can be executed upon construction approval. Therefore, negotiations with potential turbine suppliers are critically important during this period.

As regulatory approval nears, with the dependent construction start date more certain, contracts are able to be finalized.

Upon issuance of construction approvals, contracts are executed. The turbine supply contract is of greatest urgency due to the long fabrication queue and the immediate need for proprietary information to finalize construction contracts and enable foundation design.

Final Design, Field Engineering and Construction

Upon regulatory approval to construct, the turbine order is placed and the engineering contractor is directed to develop the final "approved for construction" designs. This includes the final design of roads, the collector system and turbine foundations, and the substation and O&M facility. Both during and following this work, the balance of plant equipment is purchased, a construction contractor is retained, and construction drawings and specifications are finalized for all project infrastructure.

Final design and field engineering includes the following activities:

- Finalize layout for construction (survey and mark, collect and evaluate soil borings for roads, foundations and cables; survey and mark turbine locations and perform final verification of setback compliance; survey and mark cross-country crane walk routes).
- Finalize and issue "for construction" drawings and specifications for O&M facility, access roads, cables and substation.
- Finalize the design of turbine foundations in concert with turbine vendor design basis requirements and geotechnical evaluation of borings and issue construction drawings and specification for turbine foundations.
- Finalize and issue construction drawings and specification for cross country crane routes.
- Finalize the transportation plan for major component delivery to the project area and dispersion to turbine sites, including survey as-found condition of roads, intra-site route selection and preparation of permit applications.
- Finalize the materials delivery plan and intra-site routes selection.

Construction

The detailed construction sequence is described in detail in Section 3.1. However, during construction it is likely that unforeseeable conditions will be encountered requiring engineering approval of deviations or generation of alternate specifications. Close coordination between the construction and engineering contractors is an ongoing process during project construction.

Further, it is expected that other changes will be need to be made in the field to accommodate further landowner requests or newly disclosed or discovered conditions. These conditions could influence collection system cable, access road, and cross-country crane walk routing and turbine location. Prior to performing any change, Wisconsin Electric will verify that all regulatory commitments are preserved and that impacts of the change are less than or equal to those described throughout this Technical Support Document.

Commissioning and Operation

Following completion of construction, the project moves into a commissioning period were equipment is tested, problems identified and corrected, and then control of the equipment is turned over to operations. Commercial operations begin once all equipment has been successfully tested and test results accepted by Wisconsin Electric.

Proposed Post-CPCN Design Change Process

As mentioned in the previous discussion, changes in the project design will be required following the CPCN decision. Advancing the preliminary design through final design and construction requires adjustments to the plan to account for unknowns and evolving conditions and to further optimize the Project.

Some examples of site optimization experienced during the final design and construction of the Blue Sky Green Field Wind Project include:

- Certain cables were re-routed to minimize the length and cost of cable and to minimize wetland and/or waterway crossings. Many of these routes were not feasible during preliminary design until agreements were reached with landowners during detailed design and during construction.
- Crane routes were optimized to minimize wetland and/or waterway impacts, reduce the need to drop power lines, and reduce the number of crane breakdowns. Many of these routes were not feasible until agreements were reached with non-participating landowners during detailed design and during construction. Proposed crane routes varied significantly between different turbine suppliers and erection contractors and could not be optimized until the turbine and contractors were selected. Crane breakdowns were reduced from 24 to 9, resulting in significant cost and time savings of more than 30 days.
- Two turbines were shifted to higher elevations on the same parcel of land to increase their energy output. Relocations were not made until the cost to build on higher ground was estimated during detailed engineering and it was determined that these costs were more than offset by the increased generation.
- Two turbines were moved to alternate sites because they had significantly better wind resources.
- Two turbines were moved after soil borings indicated high organic content in the original locations.
- Two turbines were moved to maintain setbacks after the construction of new homes on adjacent parcels.
- Certain roads and driveway approaches were relocated to minimize impacts on wetlands/ waterways, due to landowner requests, to meet Town/County requests for traffic and safety considerations, to accommodate oversized turbine supply delivery trucks and to reduce road length and cost.

To permit Wisconsin Electric to capitalize on similar opportunities should they arise at Glacier Hills, Wisconsin Electric proposes to use the needed flexibility without prior review or approval by the PSC subject to the following conditions:

- Compliance with all local, state and federal laws, rules, permits and regulations.
- Compliance with the terms of the proposed or executed JDA, including setbacks and sound limits.
- Compliance with existing landowner agreements and any new landowner agreements.
- Compliance with all WDNR requirements for all wetland and waterways
- Compliance with construction methods & restoration commitments in this TSD.

- Any relocation consistent with turbine siting methodology in Section 1.5

For other changes, Wisconsin electric proposes to obtain prior PSC Staff approval.

3.1 CONSTRUCTION SEQUENCE

3.1.1 Construction schedule

The construction sequence and schedule (including critical path) is provided in Appendix F, Permitting and Construction Schedule.

The critical path of the schedule shows that with PSC approval of the Project in July, 2009, the Project can be placed into utility service by the end of December, 2011 thereby meeting the projected need date of December 31, 2011. The critical path is dominated by turbine manufacturing lead time, turbine delivery and turbine erection and commissioning.

The portion of the schedule that prepares for turbine delivery installation is currently planned to take advantage of optimal seasonal weather conditions.

3.1.2 Description of the staging and construction sequence

Wisconsin Electric has included photos of construction from our Blue Sky Green Field project in Appendix Q, Public Outreach. These photos are part of our construction booklet used in public outreach, and have been shared with residents and landowners in the area.

The photos in the construction booklet may be used by the reader to help visualize many of the activities described in the following sections.

Site Mobilization

- Clear vegetation and install erosion control measures as needed
- Lay aggregate base for trailers, parking, and project laydown area
- Set up temporary site construction offices; install power, lighting, and communications

Road construction and clearing

One of the first steps in the construction process will be site clearing, installation of erosion control devices, and building gravel access roads to connect each turbine site to existing town and county roads. The width of the gravel access roads will be approximately 16 ft for the primary travel path, but may need to be as wide as 40 ft during the construction phase, to allow for passage of the large cranes needed to erect the turbines. All access roads will be restored to the 16 ft width after construction is completed.

New site access roads for wind projects situated in farm field settings are arranged to minimize the distances constructed to best coordinate with the landowners' desires, at the same time optimizing the performance of the Project. The following guidelines / information apply:

- Construct turnouts off of public roads at 90 degree angles
- Attempt to maintain safe viewing distances at turnouts

- Locate turnouts so roadside ditch filling and corrections are minimized
- Locate roads to best coordinate with existing fence lines, homesteads, crop planting patterns, low drainage/water areas, etc.
- Design roads to accommodate all transport vehicles both to and from the turbine site
- Construct roads so there is a finished graveled surface that is 16 ft wide with a range of 8"-12" of compacted aggregate road material on top of a poly geofabric material. Organic materials will be stripped, windrowed, and stockpiled. Prior to the road aggregate material being placed, the subgrade will be compacted.
- For 8 -10 ft on each side of the road where main erection crane travel is required, the road shoulders will be compacted.
- Prior to commencing the detailed road civil engineering, a geotechnical investigation will be conducted to ensure on-site subgrade materials will be fit for purpose.

Build Site Access Roads

- Survey and lay out site
- Build entrances off of public roads including new culverts, culvert extensions, rip-rap protection, etc.
- Install erosion and sedimentation control measures
- Clear & grub vegetation
- Strip and stockpile topsoil
- Compact subgrade materials
- Place geotextile fabric on compacted subgrade (where required)
- Place and compact aggregate road surfacing
- Compact road shoulders (where required) for crane travel
- Perform testing on aggregate gradation, subgrade compaction, road section thicknesses, and road backfill

Foundation installation

Foundations are constructed by excavating a hole, placing reinforcing steel, and pouring concrete into the excavation. The turbine foundation will be designed based on site-specific soil and geotechnical conditions. Based on the conditions at each site, the foundation will either be a pier foundation or a spread footing foundation. These foundations are described in Section 2.4.1.

Foundation Construction

- Survey and lay out each turbine site
- Install erosion and sedimentation control measures
- Strip and stockpile topsoil
- Excavate foundation with a pedestrian ramp and proper slope protection
- Place mud concrete to protect subgrade (spread footing foundation only)
- Install foundation reinforcing steel (spread footing foundation only)
- Assemble anchor bolt cage and place in foundation center
- Install foundation formwork
- Bond grounding conductor to steel
- Place and finish foundation concrete
- Install foundation pedestal reinforcing steel

- Install foundation pedestal formwork
- Install power, communication, and grounding conduit in foundation pedestal
- Place and finish foundation pedestal concrete
- Strip formwork
- Install balance of foundation grounding conductor
- Backfill foundation
- Perform testing/inspections on foundation subgrade, reinforcing steel, anchor bolts, formwork, concrete, and backfill.

Following backfill of the installed foundation, any excess excavated materials will be used on-site for the crane pad, roads and around the turbine base. No soil will need to be removed from the site.

Collection and communication systems

The installation of the electric collection system cables and communication lines to interconnect all the turbine generators to the substation and SCADA monitoring station is performed prior to tower and turbine installation. These cables will be installed in one continuous operation using a trenching machine.

Collection System Installation

- Survey and lay out collection system runs
- Coordinate collection system/new access road crossings and, where appropriate, pre-locate below grade conduit to facilitate ease of installation of underground cable without disturbing new access roads.
- Install erosion control and sedimentation control measures
- Perform public road crossings with road bores
- Open cut trench in power collection system cabling and fiber optic communications cabling
- If trenching in rock, backfill of trenches with select imported sand materials will be required prior to installation of cable
- For overhead, install poles and string cable
- Splice collection system conductor
- Backfill, compact, and mark collection systems trenches
- Complete permanent soil/seeding restoration as appropriate
- Terminate and splice fiber optic conductor
- Install junction boxes and switchgear and perform terminations
- Excavate, place, and backfill generator step up transformer pad
- Receive, set, install, and terminate generator step up transformers
- Pull low voltage cabling between turbine controller and low voltage compartment of the generator step-up transformers
- Terminate low voltage cabling between generator step-up transformers and turbine controllers.
- Terminate collection system home runs at the Project substation

- Inspect, test, and commission collection system including backfill testing of collection system trenches and generator step-up transformer pads

Crane Route Preparation

- Install erosion control measures as appropriate
- Clear path corridor, nominal 50 ft width
- Remove minimum of 6 to12" as needed of topsoil for nominal 34 ft crane walk surface width
- Grade path surface for positive drainage away from the crane path with a maximum elevation difference of 2" between path edges.
- Grade in direction of travel should not exceed 12%. Provide grading and/or ditching to maintain existing drainage patterns and to provide positive drainage from crane path surface.
- Compact crane path and proof roll entire sub-base to identify potentially unsuitable shallow soil. Replace and soft, unsuitable soil with backfill approved by engineer.
- Smooth drum roll completed compacted crane path surface and minimize traffic over crane routes prior to crane walk. Prior to crane walk, verify a ground bearing capacity of nominal 4,500 pounds per square foot (psf)
- When route is no longer required, the route will be decompacted and restored as described in the Agricultural Mitigation Plan and Stormwater and Erosion Control Plan (Appendix Z).
- Construction notes:
  (1) Engineered fill, geotextiles, geogrid or crane matting may be required in the event that unsuitable soils are encountered. Type and placement to be specified by onsite geotechnical engineer.
  (2) Remove vegetation along crane routes as needed.
  (3) Coordinate required relocation of overhead and underground utilities
  (4) Use appropriate protective crane matting when crossing all public roads.

Tower and turbine installation

Crane Pads

- After foundation backfilling operations are complete, clean up turbine site and install the crane pad.
- Perform subgrade compaction and crane pad compaction testing.

Off-loading

Turbine components will be delivered to the turbine sites in two ways; (1) directly to the turbine site and (2) first to the O&M Building equipment laydown area and then to the turbine site. The second method is available to accommodate peaks in component deliveries, variability in local weather conditions and accommodate any transport permit conditions[44] that may arise at the time.

For direct delivery, the turbine components will be off-loaded from the delivery vehicles at the turbine site with a smaller crane and staged near the foundation in locations of appropriate proximity for the primary lift crane to be able to make the reach to pick up and set the components in place. The smaller crane will off-load the hub and blades, and will assemble the blades to the hub to complete the hub and three-blade assembly. Offloading could take one to three days depending on the frequency of component delivery.

For delivery first to the laydown area, the components are off-loaded then later reloaded for transport to the turbine site.

Tower base
The components to be located in the base of the tower may consist of the controller cabinet, switchgear, and Federal Aviation Administration (FAA) lighting panel. These components will be set on the foundation. The base tower section will then be set over these components on the anchor bolts of the foundation. Setting the base tower section involves setting the shim packs or leveling anchor bolt nuts and leveling the tower section prior to tightening the anchor bolts and grouting the tower section to the foundation. The grout typically requires a 5-7 day cure period prior to installing the remaining components. Setting the tower base could take 1-2 days to complete.

Turbine installation
The remaining erection sequence will begin once the primary crane arrives on the site, and could take one to two days to install the remaining components. The primary lift crane will set the second, third, and fourth sections of the tower, which are bolted together. The nacelle will then be set on top of the tower. Once the nacelle is set, the hub and blade assembly will be lifted and secured in place. Upon completing the installation, the primary lift crane will move to the next turbine location.

Once the turbine is installed, the remaining work is internal to the tower and nacelle. It includes completing all electrical and mechanical connections. This is typically followed by an electrical and mechanical systems checkout.

Turbine Component Receipt and Installation Sequence

- Receive, inventory, inspect, stage, and protect turbine component deliveries at each turbine site. Deliveries will be separated into controllers, tower sections, hubs, blades, and nacelle deliveries. Typically there are 7-10 delivery trucks per each complete turbine generator.
- Prepare each foundation pedestal with proper nuts and washers
- Set and anchor turbine controllers on foundation pedestal
- Set base tower section and level section with anchor bolt leveling nuts

[44] Wisconsin Department of Transportation has the responsibility and authority over these conditions.

- Set mid tower section
- Grout base tower section (wet set or pour in place) and cure grout
- Perform foundation anchor bolt tensioning and test
- Assemble rotor with hub and all three blades
- Set upper mid tower section (if required)
- Set top tower section
- Prepare and set nacelle
- Set rotor assembly
- Torque entire wind turbine assembly
- Perform tower wiring
- Inspect complete assembly for mechanical completion and turn over to wind turbine manufacturer for commissioning.

Site Restoration and Demobilization

The final construction phase will be reclamation and decompaction of all the land under temporary roads and crane pads. All areas not needed for future operations will be restored to their original use. A description of the methods used for reclamation of agricultural lands is in the Agricultural Mitigation Plan and permanent erosion control methods are described in the Stormwater and Erosion Control Plan in Appendix Z.

Site Restoration and Demobilization

- Dismantle and remove temporary site construction offices
- Remove site yard aggregate base, restore topsoil and reseed.
- Grade and cleanup all access roads prior to turn over
- Final grade all turbine sites, access road shoulders, and collection system areas that require reseeding. Areas that are in production crop land will not be reseeded. Removal of temporary erosion control measures as appropriate.

3.1.3 Estimate of time required to complete construction at a typical turbine site.

The following table presents the nominal construction activity duration at a particular turbine site.

Table 3.1-1 Typical Construction Activity Duration

Construction Activity	Duration of Activity at a Site (days)	Total Duration for the Project (days)[45]
Access Road Installation	1-2	135
Foundation and Crane Pad construction	2-3	135
Collector Cable	Not Applicable	135
Tower and Turbine Installation	4-5	135
Tower Wiring	3-5	120
Turbine Site Restoration	2	120

3.2 WORKFORCE

Construction

The construction process would begin with initial setup of trailers, laydown areas, electrical and phone hookups as well as initial road surveying and staking. This would involve a 3 person survey team, 3-5 trailer setup personnel, 2-3 electricians and 3-5 management personnel. All together between 10 to 20 workers would be on site initially.

As the project progresses with roadwork, foundations and collection system, the project workforce would increase to between 50 to 90 workers. Turbine equipment receipt and installation would begin toward the end of the foundation and collection system installation. There would be some overlap in manpower. One would typically see between 120 and 150 workers at this time as the erection work progressed, decreasing in manpower to between 80-100 workers as the foundations and collection system were completed and tower wiring begins.

As the turbine installation process completes and tower wiring, site restoration, and demobilization takes place, the workforce will decrease to around 25-60 workers at any one time.

The number of workers at each work site will vary, depending upon the activities being performed. Workers assemble at the construction office area (construction trailers and parking lot) and then transit to their assigned work site. While exact crew sizing and number of crews will be determined by the E&C contractor, the following are typical numbers of workers that may be at each work site. The balance of the construction staff will support the crews with inventory control and materials management and delivery.

[45] Source: Appendix F Permitting and Construction Schedule.

Table 3.2-1 Construction Crew Type and Size

Crew Type	Crew size	Number of crews in the field	Total workers in the field
Roads	5	3	15
Foundations	10	2	20
Collector Cables	6	5	30
Tower and Turbine Erection	10	3	30
Tower wiring	5	4	20
Restoration	5	3	15

Skilled construction workers would include electricians, laborers, engineers, carpenters, cement finishers, iron workers, construction management, and heavy equipment operators. Depending upon the availability of qualified persons, construction workers could be from regional sources.

Based upon past experience with the Blue Sky Green Field Wind Project, approximately 40% of the construction workforce would be from the local area (central Wisconsin).

Operation
Approximately 10 to 15 technicians, a site manager, inventory manager and a receptionist/office manager would be required for the operation of the Project. All these permanent workers would likely come from the local regional area (central Wisconsin). Additional specialized personnel may work at the project for limited periods such as for specialized heavy maintenance work.

Routine maintenance on a turbine is usually performed by a crew of 2 or 3 technicians dispatched from the O&M building to the turbine site.

4.0 PROJECT MAPS AND PHOTO SIMULATIONS

4.1 GENERAL PROJECT MAPS

The following Maps are provided in Appendix H:

Figure 1.1-1 Project Location
Figure 1.1-2 Project Facilities
Figure 4.1-1 Project Location (w/Aerial Image)
Figure 4.1-2 Topographic
Figure 4.1-3 Wetland
Figure 4.1-4 Land Ownership Mapbook
Figure 4.1-5 Public Lands (2 Mile Radius)
Figure 4.1-6 Flood Insurance Rate
Figure 4.1-7 Soil Associations
Figure 4.1-8 Geology and Bedrock

In addition to these thematic maps presented, detailed project facility information is provided in Appendix I and K in mapbook format. (1:8400 scale / 1 inch = 700 ft). The location of all proposed turbines, alternate sites, access roads, collection system, crane paths, meteorological towers, substation, O&M facility, laydown areas, wetlands and waterways are presented on an aerial background with basemap reference information.

The content of these maps is described in the following sections.

4.1.1 Project Area Maps

A general map depicting the project area within central Wisconsin is provided in Figure 1.1-1. The immediate project area is provided in Figure 4.1-1 on an aerial background. For cartographic clarity, the project boundary, turbines, access road locations and basemap reference information only are shown.

4.1.2 Topographic Maps

Figure 4.1-2 provides a set of maps illustrating project facilities overlaying a USGS 7.5 Minute Topoquad background at 1:24,000 scale. The extent of the map extends at least 2 miles from the project boundary.

4.1.3 Natural Resources and Land Use/Ownership Maps

4.1.3.1 Wetland Maps

Figure 4.1-3 provides a set of maps illustrating the WWI data acquired digitally from the Wisconsin DNR. The information is shown overlaying the colored orthophoto acquired by Columbia County in Spring of 2007.

This Figure also illustrates the wetland and waterway information delineated in the field and utilizing aerial photography. The information is shown along with a transpicuous layer of the WWI overlaying the colored orthophoto acquired by Columbia County in Spring of 2007.

4.1.3.2 Land Ownership Maps

Figure 4.1-4 is provided in mapbook format at a scale of 1:8400. The maps depict the project boundary, property and parcel ownership information, the location of proposed turbine sites, access roads, collector circuits, crane paths and additional basemap information as needed for reference. Land ownership data is current as of June, 2008, with updates to project participants as of October 22, 2008.

Digital parcel data was acquired from Columbia County in June, 2008. The dataset has been modified to reflect land owner participation in the project and to accommodate changes in county records as documented by Wisconsin Electric since data acquisition in June, 2008. Shapefile GlcrHls_CtyParcel_wModif_asof_June2008.shp has been provided.

4.1.3.3 Public Lands

Figure 4.1-5 illustrates the publicly owned lands within the project and within 2 miles of the project boundary. The data type researched includes parks, trails national, state and county forests, preserves and fisheries from the following sources:

- US Forest Service

- USGS Gap Analysis
- US Fish and Wildlife
- Wisconsin DNR Digital Data (various sources and departments)
- Wisconsin County Forests Association
- County Websites
  - Columbia County
  - Dodge County
  - Green Lake County

Please refer to Section 5.5 for list of public lands located within 10 miles of the project boundary.

4.1.3.4 Flood Insurance Rate Maps (FIRMs)

Figure 4.1-6 presents the Digital Flood Insurance Rate Maps (D-FIRMS) acquired from FEMA within one-half mile of the project. Areas are present within the project that are designated as having a 1% chance of annual flooding. No detailed hydraulic analyses have been performed in this area, thus no base elevations have been established. No proposed turbine sites are located within a 1% or greater flood zone.

4.1.3.5 Soil Survey Maps

Figure 4.1-7 depicts the soils found within the project area, grouped by soil association. The Soil Survey Geographic (SSURGO) database was acquired from the USDA Natural Resource Conservation Service (NRCS). A digital shapefile is provided (GlcrHls_SSURGO_Soils.shp) of the soils in the project area.

4.1.3.6 Bedrock Maps

Depth to bedrock was explored utilizing several sources of subsurface data. These sources include the WiscLITH database from the Wisconsin Geological and Natural History Survey (WGNHS) and well constructors logs acquired from WGNHS and WDNR. Please see Section 5.1.1 for a more complete description of the subsurface information researched. Figure 4.1-8 depicts the depth to bedrock as interpreted from the above listed sources.

4.2 COMMUNITY MAPS

The following Maps are provided in Appendix J:

Figure 4.2-1 Zoning
Figure 4.2-2 Sensitive Sites

The content of these maps is described in the following sections.

4.2.1 Zoning Maps

The townships of Randolph and Scott do not currently have zoning. Within 0.5 miles of the project area, the Villages of Friesland and Cambria are zoned. Please see Figure 4.2-1 for the current Village zoning with parcel boundaries. Shapefile GlcrHls_Zoning.shp has been provided. This data has been created by digitizing the information from hard copy maps and communication provided by the respective Villages. No electronic dataset by parcel breakdown was provided.

4.2.2 Sensitive Sites

Sensitive community sites including schools, day cares, adult day cares, hospitals, nursing homes, adult family homes, residential care apartment complexes, churches and cemeteries have been mapped within one-half mile of the project. Data sources include:

- Wisconsin Department of Children and Families
- Wisconsin Department of Health Services (WDHS)
- Columbia County
- ESRI and US TIGER Databases

A shapefile (GlcrHls_Sensitive_Sites.shp) has been provided with the location of the information gathered from the sources described above.

4.2.3 Relevant changes to the area since the photos were taken

The project area excluding the Village of Friesland is being monitored for new construction on a regular basis. This monitoring includes visual reconnaissance, contact with Columbia County for new building permit applications and land owner interviews during meetings and open houses. Since the acquisition of the aerial images provided by the county (acquired, Spring, 2007), the following construction has been noted:

- New home on northeast corner of Hwy 33 and Private Rd. (Parcel #11034-573)
- James & Kathleen Casey – New home (cottage), east of Ingelhardt Rd, southwest of Scharf Rd, north of Friesland Rd (Parcel #11034-362.01)
- Amanda & Joshua Rimmert – New home northeast of railroad tracks near Cty Hwy M & Cty Hwy E (Parcel # 11034-138.05)

Wisconsin Electric will continue to monitor the project area for new construction throughout the design and construction stages. New construction inside the Village of Friesland has not been noted, as the entire area falls outside of any setback zones.

4.3 PHOTO SIMULATIONS

Wisconsin Electric retained DNV Global Energy Concepts Inc. (DNV-GEC) to prepare photo simulations of the Project Area. Each photo simulation was conducted for the Siemens SWT-2.3, which is the largest wind turbine presently under consideration for the project. The photo simulations start with digital photographs taken by DNV-GEC in April 2008 and by Wisconsin Electric in July 2008 from known locations within the project area. To create a photo simulation, a model of the project area topography with turbine locations is overlaid on a photograph taken in the field and aligned. Global Positioning System (GPS) data points of items in the image aid in better alignment, ensure more accurate scale, and reduce uncertainty of the turbine locations in the resulting simulated photographs. Turbine geometry is selected and applied at the turbine locations using modeling software. Light settings are adjusted to match the sun's position and brightness in the original image as closely as possible. The turbine locations in the photo simulations are approximate; however, the photo simulations provide an accurate relative scale view of the turbines in the project setting. The top (nacelle and blades) of wind turbines yaw atop the tower so that the blades face into the winds as the wind changes direction. In these photo simulations the yaw position of the turbines is set to south-southwest (210°), the prevailing wind direction. This provides the most representative view possible from each location as the wind turbines will be yawed in this direction the majority of time.

The majority of the Project Area is covered by the viewing panoramas selected for the photo simulation. With just a few exceptions, all of the wind turbines appear in at least one of the photos. The full Photo Simulation report is attached in Appendix T.

5.0 NATURAL AND COMMUNITY RESOURCES, DESCRIPTION AND POTENTIAL IMPACTS

5.1 SITE GEOLOGY

5.1.1 Geology of the project area

Columbia County was glaciated by the Green Bay Glacier during the Wisconsin stage of glaciation. Glacial material remaining after the ice melted was derived mainly from the local bedrock formations. Sandstone and limestone are the main types of bedrock in this area. There are deposits of glacial till in the area, consisting of poorly sorted, crushed and mixed material of a somewhat fine texture and is more calcareous than in the western portion of the county.

The project is located in the Eastern Ridges and Lowlands physiographic province of Wisconsin (Martin, 1965).

The topography of the Eastern Ridges and Lowlands is bedrock-controlled as evident by the generally north/south trending cuestas. A cuesta is a ridge that has a steep escarpment on one side and a long gentle slope on the other. The project site is located in the western portion of this physiographic region in the general area of the Black River and Magnesium Cuestas. In general, the topography is a result of differential erosion of the bedrock formations underlying the glacial drift.

The glacial drift in the area consists primarily of ground and end moraine tills, consisting of clay, silt, sand, gravel, and boulders (Cotter et al, 1969). The glacial drift thickness in the site area ranges from less than 10 feet to more than 100 feet. The glacial drift in the project area is underlain by Ordovician and Cambrian bedrock, comprised primarily of dolomite and sandstone. In general, the bedrock gently slopes to the east. Historical uplift of bedrock in the site area exposed the older bedrock formations to erosional forces prior to more recent glacial deposition.

As described earlier, differential erosion of the bedrock formations have formed cuestas generally controlled by the less resistant dolomite rock formations of the Prairie du Chien Group. The age of the bedrock increases from east to west across the project area due to the eastward regional dip and historical erosion of the bedrock surface.

Data on the depth to bedrock was obtained from WiscLITH: A Digital Lithologic Database of Wisconsin Geology, published by the Wisconsin Geological and Natural History Survey (WGNHS). WiscLITH is a collection of geological data maintained by WGNHS. WiscLITH provides geologic records including lithographic and stratigraphic descriptions of samples from WGNHS geologic logs. The map presents the approximate locations of wells and depth to bedrock from the WiscLITH database. Bedrock in the project area generally occurs within 50 feet of the ground surface. Bedrock appears to occur at depths greater than 50 feet below ground surface at the northern and southern edges of the project area. Data from the Natural Resource Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database indicates several rock outcrops may occur within the area. In addition to reviewing the WiscLITH data, an STS geologist reviewed data from the WGNHS database of well constructors' reports. Although the data from the well constructors' reports were based on a well driller's interpretation, the depth to bedrock identified on the well constructors' logs is generally consistent with the depth to bedrock provided in the WiscLITH database which is based on interpretation by WGNHS geologic staff. A depth to bedrock map was prepared from the data gathered.

Please refer to Figure 4.1-8 in Appendix H, Project Maps.

References

Cotter, R.D., et al, Water Resources of Wisconsin, Rock-Fox River Basin, USGS Hydrologic Investigations Atlas HA-360, 1969.

Martin, Lawrence, The Physical Geography of Wisconsin, University of Wisconsin Press, 1965, 636 pp.

NRCS Soil Survey Database (SSURGO) (http://www.soils.usda.gov/survey/geography/ssurgo/)

WGHNS Well Construction Reports (http://www.uwex.edu/wgnhs/wcrs.htm)

WiscLITH: A Digital Lithologic and Stratigraphic Database of Wisconsin Geology, Wisconsin Geological and Natural History Survey, Open-File Report 2003-05, Version 2.0 – 2004

5.1.2 Geotechnical Report on Soil Conditions

The soils in the area have been formed in glacial deposits and recent alluvium. Most of the soils consist of silty deposits (loess) over glacial deposits. The glacial deposits in the southern and eastern portions of the project are primarily loamy glacial till. To the north and west the glacial deposits range from loamy to sandy glacial till, with areas of silty and sandy sediment. In the far west central portion of the project there are soils formed over sand and gravel deposits. Interspersed are poorly drained organic soils formed in organic matter accumulations.

The soils in Columbia County have been mapped by the Natural Resource Conservation Service (NRCS). The NRCS has identified six major soil associations, as shown in Figure 4.1-7. A description of each of the associations follows.

Plano-Griswold-Saybrook Association:
This association occurs in the southern and eastern portion of the project. These soils are classified as Mollisols, which are prairie soils characterized by deep rich topsoil. The soils in this association are moderately well-drained to well-drained and formed in silt deposits over calcareous sandy loam to loam glacial till. The thickness of the silty deposits may be as thick as five feet in the Plano soils and less than two feet in the Griswold soils. The soils have developed clay enriched subsoil. These soils tend to be deep (greater than 60 inches), but the soil mapping does show localized areas of rock outcrops. Outcrop locations are also identified in Figure 4.1-8.

St. Charles-Ossian-Dodge Association:
This association occurs on the fringe of the south-central portion of the project. The St. Charles and Dodge soils are well-drained and formed in silt deposits that are up to five feet thick over calcareous sandy loam and loam glacial till. Both soils also have clay enriched subsoil. The Ossian soil is found in lowlands and is very poorly-drained to poorly-drained. It is formed in organic accumulations over silty sediments or glacial till. Although these soils are generally considered deep, bedrock outcrops are mapped in the area of this association. Rock outcrops are identified in Figure 4.1-8.

LaPeer-Wyocena Association:
The LaPeer-Wyocena Association occurs in the northern and western portion of the project. The LaPeer soil formed in silty or loamy deposits over calcareous sandy to sandy loam glacial till. The Wyocena soil is similar; however, the loamy deposits it formed in are up to three and one-half feet thick. Both soils are classified as well-drained and have clay enriched subsoil. The soils are generally deep, but may have local areas of near-surface bedrock.

Grellton-Gilford-Friesland Association:
This association occurs across the central portion of the project. The Grellton and Friesland soils are well-drained and occur in upland positions. They formed in loamy deposits up to two and one-half feet thick over silty sediments that are underlain by sandy loam to loam calcareous glacial till. Both these soils have clay enriched subsoil. The Gilford soil is very poorly- to poorly-drained and formed in sandy sediment located in lowlands. These are all deep soils.

Houghton-Adrian-Palms Association:
The soils in this association are located in low positions in the landscape and are typically very poorly-drained to poorly-drained. The Houghton soils have greater than four feet of organic accumulation. The Adrian and Palms soils generally have about one to four feet of organic accumulation over sandy and loamy parent material. The soils in this association are characterized as deep.

Boyer-Oshtema-Dresden Association:
This association is located near the western border of the project area. The Boyer and Oshtema are well drained sandy soils over calcareous sand and gravel deposits. The Dresden soil is also

well drained, but formed in silty to loamy deposits, up to three and one-half feet thick, over calcareous sand and gravel. The soils have clay enriched subsoil and the Dresden soil tends to have thick organic enriched topsoil. These soils are typically deep.

General Soil Use and Limitations

The upland soils, especially those soils in the Plano-Griswold-Saybrook Association are well suited to agricultural use. Corn, wheat and hay are typical crops grown in the area. Poorly- and very poorly-drained soils, such as the Ossian, Gilford, Houghton, Adrian and Palms soils, may not be productive without artificial drainage.

The upland soils in the project generally formed in silty to loamy deposits that have clay enriched subsoil. These soils may be subject to moderate frost action and equipment compaction, especially when wet. The topsoil of these soils is generally silty in nature and may be eroded if it is not properly managed or maintained with a vegetative cover.

The poorly- to very poorly-drained soils may contain wetlands. These soils are saturated most of the year and may be subject to periodic flooding. Use of these soils may be limited by their wetness, low bearing capacity and frost action. These soils are scattered across the project, but are predominant in the area mapped as the Plano-Griswold-Saybrook Association.

Geotechnical Analysis and Conclusions

Subsurface exploration and geotechnical engineering evaluation has yet to be performed for this project. However, a review of the available soil and bedrock information indicates that it would be expected that mat-type foundations will be feasible at most locations throughout the project area. The glacial deposits present at the site should be suitable for this type of foundation system. Mat foundations with dimensions of 50 to 60 feet in plan and 5 to 6 feet in thickness would be expected. Soil bearing pressures of approximately 3,000 pounds per square foot would be used on a preliminary basis to size these mat foundations supported on soil materials. In general, the sandstone and limestone bedrock formations are expected to be at a depth whereby they will not effect the construction of the mat foundations. However, some bedrock outcrops are present across the project area, and bedrock elevations above 7 to 8 feet below grade could be possible. In this case, two approaches could be taken. One would be to remove the bedrock to the design foundation subgrade depth of 7 to 8 feet below grade and cast the foundation on the bedrock subgrade. Removal of bedrock 1 or 2 feet below the observed rock surface could likely be accomplished with rippers or jackhammers. Deeper excavations would likely require blasting for efficient removal of the rock.

The second approach would be to cast the mat foundation at a higher elevation than planned resting on the bedrock. This may result in a thinner concrete mat section, which would need to be anchored to the bedrock to develop overturning forces.

The depth and elevation of groundwater will be very site-specific depending on the depth of overburden and bedrock elevation below the site. If groundwater is greater than 5 to 6 feet below grade, dewatering can likely be accomplished by simple sump and pump techniques. Wisconsin