DOE/EA-1859

FINAL
ENVIRONMENTAL ASSESSMENT

for the

KIRKWOOD COMMUNITY COLLEGE WIND TURBINE PROJECT

CEDAR RAPIDS, IOWA

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Golden Field Office

MAY 2011

DOE/EA-1859

FINAL
ENVIRONMENTAL ASSESSMENT

for the

KIRKWOOD COMMUNITY COLLEGE WIND TURBINE PROJECT

CEDAR RAPIDS, IOWA

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Golden Field Office

MAY 2011

COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy

TITLE: *Environmental Assessment for the Kirkwood Community College Wind Turbine Project* (DOE/EA-1859)

CONTACT: For additional copies or more information on this final Environmental Assessment (EA), please contact:

Melissa Rossiter
NEPA Document Manager
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy
Golden Field Office
1617 Cole Blvd
Golden, CO 80401
Desk Phone: 720-356-1566
Blackberry: 720-291-1602
Email: melissa.rossiter@go.doe.gov

ABSTRACT: The U.S. Department of Energy (DOE) has provided Federal funding to the Iowa State Energy Office (ISEO) under the State Energy Program (SEP). ISEO is seeking to provide $1,050,000 of its SEP funds to Kirkwood Community College (College), who would use these funds to purchase equipment for one 2.5-megawatt wind turbine.

Before DOE decides whether to authorize ISEO to provide SEP funds to the Kirkwood Community College Wind Turbine Project (proposed Wind Turbine Project), DOE must first complete review under the *National Environmental Policy Act* (NEPA). Thus, this EA analyzes the potential environmental impacts of the construction, operation, and decommissioning of the proposed project and the alternative of not implementing this project (the No-Action Alternative).

The proposed wind turbine project is expected to offset an average of more than 35 percent of the College's electrical demand from nonrenewable energy with renewable wind power production. Ultimately, this transition to renewable energy production will offset the College's use of imported energy, stabilize long-term energy costs, and reduce the environmental impacts resulting from the use of fossil energy. Achievement of the proposed Wind Turbine Project will have the indirect effect of reducing the College's overall carbon footprint. The Wind Turbine Project would also promote collaboration among industry, government, and the College for research and workforce education. Overall, the turbine would stand 427 feet at its tallest blade extent. The project would include an approximately 400 foot access road, and 1,120 feet of underground electrical transmission cables to connect the project to an existing distribution line. The proposed project would be located on approximately two acres of land owned by the College in Cedar Rapids, Linn County, Iowa.

AVAILABILITY: This EA is available for review on the DOE Golden Field Office Reading Room Website, http://www.eere.energy.gov/golden/Reading_Room.aspx, and the DOE NEPA Website, http://nepa.energy.gov/DOE_NEPA_documents.htm.

ACRONYMS AND ABBREVIATIONS

APE	area of potential effect
CFR	Code of Federal Regulations
College	Kirkwood Community College
dBA	decibel on an A-weighted scale, used to approximate the human ear's response to sound
DNL	Day Night Average Sound Level (also L_{dn})
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EA	Environmental Assessment
FAA	Federal Aviation Administration
GHG	greenhouse gas
ISEO	Iowa State Energy Office
MBTA	*Migratory Bird Treaty Act*
MW	Megawatt
NEPA	*National Environmental Policy Act*
NRHP	National Register of Historic Places
Recovery Act	*American Recovery and Reinvestment Act of 2009*
SEP	State Energy Program
SHPO	State Historic Preservation Office (r)
U.S.C.	United States Code
USACE	U.S. Army Core of Engineers
USFWS	U.S. Fish and Wildlife Service

CONTENTS

Section Page

1. INTRODUCTION ... 1
1.1 National Environmental Policy Act and Related Procedures ... 1
1.2 Purpose and Need ... 2
1.2.1 Purpose and Need of DOE's Proposed Action ... 2
1.2.2 Kirkwood Community College's Purpose and Need ... 2
1.3 Public Involvement and Consultations ... 3
1.3.1 PUBLIC SCOPING ... 3
1.3.2 CONSULTATIONS ... 3
2. PROPOSED ACTION AND ALTERNATIVES ... 5
2.1 DOE's Proposed Action ... 5
2.2 Kirkwood Community College's Proposed Project ... 5
2.2.1 Project Location and Uses ... 5
2.2.2 Description of Proposed Facility ... 5
2.2.3 Construction and Installation ... 10
2.2.4 Operation ... 10
2.2.5 Decommissioning ... 11
2.3 No-Action Alternative ... 11
2.4 Committed Measures ... 12
3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS ... 13
3.1 No-Action Alternative ... 13
3.2 Environmental Resource Areas Not Carried Forward for Further Analysis ... 13
3.2.1 Geology and Soils ... 14
3.2.2 Water Resources – Groundwater ... 14
3.2.3 Waste Management ... 14
3.2.4 Intentional Destructive Acts ... 15
3.3 Considerations Carried Forward for Further Analysis ... 15
3.3.1 Land Use ... 15
3.3.1.1 Affected Environment ... 15
3.3.1.2 Direct and Indirect Impacts ... 16
3.3.2 Visual Quality ... 17
3.3.2.1 Affected Environment ... 17
3.3.2.2 Direct and Indirect Impacts ... 18
3.3.3 Noise ... 23
3.3.3.1 Affected Environment ... 25
3.3.3.2 Direct and Indirect Impacts ... 28
3.3.4 Cultural Resources and Historic Preservation ... 32
3.3.4.1 Affected Environment ... 32
3.3.4.2 Direct and Indirect Impacts ... 33
3.3.5 Biological Resources ... 34
3.3.5.1 Affected Environment ... 34
3.3.5.2 Direct and Indirect Impacts ... 35
3.3.6 Water Resources – Surface Water ... 36
3.3.6.1 Affected Environment ... 36
3.3.6.2 Direct and Indirect Impacts ... 40
3.3.7 Human Health and Safety ... 41
3.3.7.1 Affected Environment ... 41
3.3.7.2 Direct and Indirect Impacts ... 42

3.3.8 Transportation 44
3.3.8.1 Affected Environment 44
3.3.8.2 Direct and Indirect Impacts 45
3.3.9 Socioeconomics and Environmental Justice 45
3.3.10 Air Quality 46
3.3.10.1 Affected Environment 46
3.3.10.2 Direct and Indirect Impacts 46
3.3.11 Infrastructure and Energy 47
3.3.11.1 Affected Environment 47
3.3.11.2 Direct and Indirect Impacts 47
3.4 Irreversible and Irretrievable Commitment of Resources 48
3.5 Unavoidable Adverse Impacts 48
3.6 The Relationship Between Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity 48
4. CUMULATIVE IMPACTS 49
4.1 Introduction 49
4.2 Reasonably Foreseeable Actions 49
4.3 Summary of Cumulative Impacts 49
4.3.1 Cumulative Greenhouse Gas Impacts 49
4.3.2 Visual Resources 50
4.3.3 Biological Resources 50
4.3.4 Noise 50
5. REFERENCES 51

LIST OF TABLES

Table Page

3-1 Maximum and Expected Duration of Shadow Flicker 22
3-2 Common Outdoor and Indoor Sound Sources and Typical Associated Sound Levels 24
3-3 Maximum Permissible Sound Levels from Limited Sources by Receiving Land Use 26
3-4 Summary of Baseline Sound Monitoring Results 27
3-5 Predicted and Existing Wind Turbine Sound Levels at Nearby Residences 30

LIST OF FIGURES

Figure Page

2-1 General Location Map 6
2-2 Location of Wind Turbine Project on Kirkwood Community College Campus 7
2-3 Kirkwood Community College Map 8
2-4 Kirkwood Community College Wind Turbine Project Site Plan 9
2-5 Simulation of the Wind Turbine Project Installation 11
3-1 Shadow Flicker Contour Map 21
3-2 Monitoring Sites for Measuring Baseline Sound Conditions 27
3-3 Predicted Noise Map with Rings Labeled 29
3-4 Surface Waters in the Vicinity of the Proposed Wind Turbine Site 37
3-5 Map of Wetlands Within the General Area of the Wind Turbine Project 39

3-6 Road Map of Kirkwood Community College Area showing Iowa Department of Transportation Functional Classifications 44

APPENDICES

Appendix A: Environmental Assessment Scoping
Appendix B: Consultation Letters
Appendix C: Noise Assessment
Appendix D: Shadow Flicker Assessment
Appendix E: Microwave Assessment
Appendix F: Wetlands Assessment

1. INTRODUCTION

The Iowa State Energy Office (ISEO) is proposing to provide a portion of its State Energy Program (SEP) grant to Kirkwood Community College (College) to purchase equipment for one 2.5-megawatt wind turbine generator on the College's campus in Cedar Rapids, Iowa. The goal of the College Wind Turbine Project is to offset an average of more than 35 percent of the College's electrical demand from nonrenewable energy with renewable wind power production. Ultimately, this transition to renewable energy production will offset the College's use of imported energy, stabilize long-term energy costs, and reduce the environmental impacts resulting from the use of fossil energy. When running at full capacity, the turbine would offset over 50 percent of the Cedar Rapids campus demand on peak load days, 70 to 80 percent on low demand (low heat, low cool) days, and 100 percent at night. Achievement of the proposed Wind Turbine Project will have the indirect effect of reducing the College's overall carbon footprint. The Wind Turbine Project would also promote collaboration among industry, government, and the College for research and workforce education.

The purpose of this Environmental Assessment (EA) is to evaluate the potential environmental impacts of authorizing ISEO to provide SEP funding to the College Wind Turbine Project . DOE's Proposed Action would authorize a total of $1,050,000 in SEP grant expenditures by the College to purchase equipment for the proposed Wind Turbine Project. The total cost of the proposed Wind Turbine Project would approximately be 8,100,000. Other funding for the Wind Turbine Project is expected from the Iowa Alternate Energy Revolving Loan Program loans ($3,000,000) and from the College's sources ($3,050,000). Federal funding of projects requires compliance with the *National Environmental Policy Act of 1969* (42 U.S.C. 4321 *et. seq.*; NEPA). In accordance with NEPA implementing regulations, DOE is required to evaluate the potential environmental impacts of Federal funding decisions. Thus, preparation of this EA addresses NEPA compliance and the related environmental impacts of the Proposed Action.

The purpose of the DOE SEP is to promote the conservation of energy and reduce dependence on imported oil by helping States develop comprehensive energy programs and by providing them with technical and financial assistance. SEP is authorized under the *Energy Policy and Conservation Act*, as amended (42 U.S.C. 6321 *et seq.*). States can use SEP funds for a wide variety of activities related to energy efficiency and renewable energy (42 U.S.C. 6321 *et seq*. and 10 CFR Part 420). In the *American Recovery and Reinvestment Act of 2009* (Pub. L. 111-5, 123 Stat. 115; Recovery Act), Congress appropriated $3.1 billion to the DOE SEP, and the State of Iowa received $40,546,000, pursuant to a Federal statutory formula for distributing these funds.

1.1 National Environmental Policy Act and Related Procedures

The National Environmental Policy Act (42 U.S.C. 4321 et seq.; NEPA), the Council on Environmental Quality's NEPA regulations [40 Code of Federal Regulations (CFR) Parts 1500 to 1508], and the DOE NEPA implementing regulations(10 CFR Part 1021) require that DOE consider the potential environmental impacts of the Proposed Action before making a decision to implement the Proposed Action. This requirement applies to decisions about whether to provide different types of Federal financial assistance to States and private entities.

In compliance with these regulations, this Environmental Assessment (EA)

- Examines the potential environmental impacts of the Proposed Action and the No-Action Alternative;

- Identifies unavoidable adverse environmental impacts of the Proposed Action;
- Describes the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- Characterizes any irreversible and irretrievable commitments of resources that would be involved should DOE decide to implement its Proposed Action.

This EA provides DOE and other decisionmakers the information needed to make an informed decision about the construction, operation, and eventual decommissioning of the proposed 2.5 Megawatt Wind Turbine Project. The EA evaluates the potential individual and cumulative impacts of the proposed project. For purposes of comparison, this EA also evaluates the impacts that could occur, if DOE did not provide funding (the No-Action Alternative), under which DOE assumes the project would not proceed. The EA does not analyze other action alternatives.

The proposed Wind Turbine Project site is not within a 100-year or 500-year floodplain; therefore, this EA does not include a floodplain assessment. Similarly, the proposed project would not affect wetlands. However, this EA describes how DOE considered and evaluated these features of the natural environment in accordance with requirements of Executive Orders 11988, *Floodplain Management*, and 11990, *Protection of Wetlands*, and DOE's implementing procedures in 10 CFR Part 1022, *Compliance with Floodplain and Wetland Environmental Review Requirements.*

1.2 Purpose and Need

1.2.1 PURPOSE AND NEED OF DOE'S PROPOSED ACTION

DOE's purpose and need is to ensure that SEP funds are used for activities that meet congressional statutory aims to improve energy efficiency, reduce dependence on imported oil, decrease energy consumption, create and retain jobs, and promote renewable energy. Providing funding as part of the State of Iowa's SEP subgrant to the College would partially satisfy the need of DOE to assist U.S. cities, counties, states, territories, and American Indian tribes to develop, promote, implement, and manage energy efficiency and conservation projects and programs designed to:

- Reduce fossil fuel emissions;
- Reduce the total energy use of the eligible entities;
- Improve energy efficiency in the transportation, building, and other appropriate sectors; and
- Create and retain jobs.

Congress enacted the Recovery Act to create jobs and restore economic growth through measures that, among other things, modernize the nation's infrastructure and improve energy efficiency. Provision of SEP funds for the proposed project would partially meet these goals.

1.2.2 KIRKWOOD COMMUNITY COLLEGE'S PURPOSE AND NEED

The purpose of the Wind Turbine Project is to reduce the College's reliance on imported carbon-based energy, stabilize long-term energy costs, and reduce impacts resulting from energy production and use on the environment. Secondarily, the College is proposing to create a vocational training program focusing on renewable energy. The on-campus wind turbine would also serve as a laboratory for students.

1.3 Public Involvement and Consultations

1.3.1 PUBLIC SCOPING

In accordance with applicable regulations and policies, DOE sent scoping letters to potentially interested local, State, and Federal agencies, including the Governor of Iowa, the Iowa State Historic Preservation Office (SHPO), U.S. Fish and Wildlife Service (USFWS), the U.S. Army Corps of Engineers (USACE), Federal Emergency Management Agency Region 7, and to representatives of the Sac and Fox Tribe of the Mississippi in the State of Iowa. DOE also sent scoping letters to other potentially interested individuals and organizations to solicit public comment (Appendix A), published the scoping letter on DOE's Golden Field Office's Public Reading Room (http://www.eere.energy.gov/golden/reading_room.aspx), and advertised the scoping comment period from October 13 to November 15, 2010, in the *Cedar Rapids Gazette*. The scoping letter described DOE's Proposed Action and requested assistance in identifying potential issues to be evaluated in the EA.

In response to the scoping letter, DOE received two comments. Those comments, which are included in Appendix A, were from the State of Iowa, Department of Natural Resources, and Iowa State Archaeologist. For both, DOE and the College are following the guidance provided, which is normal compliance with regulations.

The College also conducted a public meeting on December 7, 2010, to discuss the College's proposal to construct and operate a wind turbine in the College's main campus in Cedar Rapids, Iowa. Meeting notification was sent to 1,700 residents in the area, email notification was sent to local, State, and Federal agencies with potential interest, and a meeting notice was published in the *Cedar Rapids Gazette*. The meeting was conducted and five individuals attended (Appendix A). No written comments were received.

1.3.2 CONSULTATIONS

Below is summary of the consultations that were conducted. Consultation request and response letters are included in Appendix B.

Iowa State Historic Preservation Office

A "Request for SHPO Comment" form and supporting documentation was hand-carried to the Iowa SHPO on August 10, 2010, requesting information on historic properties within and near the proposed site. The form also contained a certification that no historic properties will be affected by the proposed Wind Turbine Project. In a letter dated August 24, 2010, the Iowa SHPO concurred that the Wind Turbine Project would have no adverse effects on historic properties (Appendix B).

U.S. Fish and Wildlife Services

Representatives of the College corresponded with the USFWS and received a letter dated August 24, 2010, in which USFWS concurred that the proposed Wind Turbine Project would be located in an area that has no suitable habitat for the Federally listed prairie bush clover (*Lespedeza leptostachya*) or western prairie fringed orchid (*Platanthera praeclara*) and would have no effect on these species. USFWS noted that the Federally listed endangered Indiana bat (*Myotis sodalist*) does not occur in Linn County, but could migrate through the area and that the placement of the turbine is not adjacent to any migratory areas, refuges, major flyways, or known avian nesting areas (Appendix B). The College would monitor the wind turbine for impacts to birds and bats and would notify DOE and USFWS if operation of the wind turbine results in mortality of these species.

U.S. Army Corps of Engineers

On July 2, 2010, the College sent a request for a wetlands determination to the USACE. The Kirkwood received a response from USACE dated July 14, 2010, which stated that the proposed Wind Turbine Project property does not contain any wetland areas or other waters of the United States and that Department of Army authorization is not required (Appendix F).

Federal Aviation Administration

On April 20, 2010, the Federal Aviation Administration (FAA) issued a "Determination of No Hazard to Air Navigation" to the College. Determination is for the 427-foot wind turbine located at the proposed Wind Turbine Project site (Appendix B).

1.3.3 DRAFT ENVIRONMENTAL ASSESSMENT

DOE issued the Draft EA for comment on April 16, 2011, and posted it on the DOE Golden Field Office Reading Room Website (http://www.eere.energy.gov/golden/Reading_Room.aspx) and DOE NEPA Website (http://nepa.energy.gov). DOE sent postcards to the individuals listed in Appendix A of this EA to notify them of the EA's availability on the web and to announce a 15-day public comment period on the Draft EA. A Notice of Availability was published in the local paper, *Cedar Rapids Gazette*. The comment period ended on April 21, 2011. DOE received no comments on the Draft EA.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 DOE's Proposed Action

DOE's Proposed Action in this EA is to authorize ISEO to expend Federal SEP funding to purchase equipment for the College Wind Turbine Project (Proposed Action), a 2.5-megawatt wind turbine generator, on the College campus in Cedar Rapids, Iowa. The College's Wind Turbine Project will include construction, operation, and eventual decommissioning.

DOE has authorized ISEO to use a percentage of its Federal funding for preliminary activities, including the preparation of this EA and associated analyses. Such activities are associated with the proposed Wind Turbine Project and do not impact the environment or represent an irreversible or irretrievable commitment by the DOE in advance of the conclusion of the EA for the proposed Wind Turbine Project.

2.2 Kirkwood Community College's Proposed Project

The College proposes to design, construct, operate, and eventually decommission the wind turbine on its campus. Specifically, the College would use SEP funding to purchase wind turbine equipment to offset more than 35 percent of the College's electrical demand using renewable wind power production. The Wind Turbine Project would support the College's transition from non-renewable energy to renewable wind power production. The Wind Turbine Project would also support the College's Sustainability Center, which is a proposed vocational training program focusing on renewable energy. The Sustainability Center is not part of the proposed Wind Turbine Project.

2.2.1 PROJECT LOCATION AND USES

The proposed Wind Turbine Project would be located on the campus of the College in Cedar Rapids, Linn County, Iowa (Figure 2-1). The College is an established educational facility with a large campus located in the southern part of Cedars Rapids. The area surrounding the College has a combination of established development including light industrial, residential, and transportation corridors (Figure 2-2). The campus has over 35 buildings and facilities (Figure 2-3). The proposed site of the Wind Turbine Project is north of the baseball/softball fields (item 7 in Figure 2-3) and east of the Community Training and Response Center (item 6 in Figure 2-3); an area currently maintained as a vacant grass field. Adjacent land use includes play fields, a wooded creek area, campus buildings, and vacant maintained campus land. It is located in Section 15, Township 82 North, Range 7 West (Figure 2-2).

2.2.2 DESCRIPTION OF PROPOSED FACILITY

The proposed Wind Turbine Project would consist of a single 2.5-megawatt wind turbine with a total height of 427 feet above ground level. The wind turbine being evaluated in this EA is the Clipper Liberty 2.5 MW CW99 turbine. The height of the tower at its hub is 262 feet and the blades are 164 feet long. The nearest building, a garage that is part of the College Training and Response Center, is 630 feet to the west. The nearest residence is 1,040 feet north of the proposed turbine location. The Wind Turbine Project would be connected to the Alliant Energy distribution grid via a new underground electrical cable to existing overhead electrical distribution lines located about 2,000 feet northwest of the turbine (Figure 2-4). Other turbines will be considered by the College during procurement. For example, the GE 2.5 MW turbine is under consideration and has physical characteristics that are similar to the Clipper Liberty. Chapter 3 includes a discussion where differences in the wind turbines may make an analytical difference.

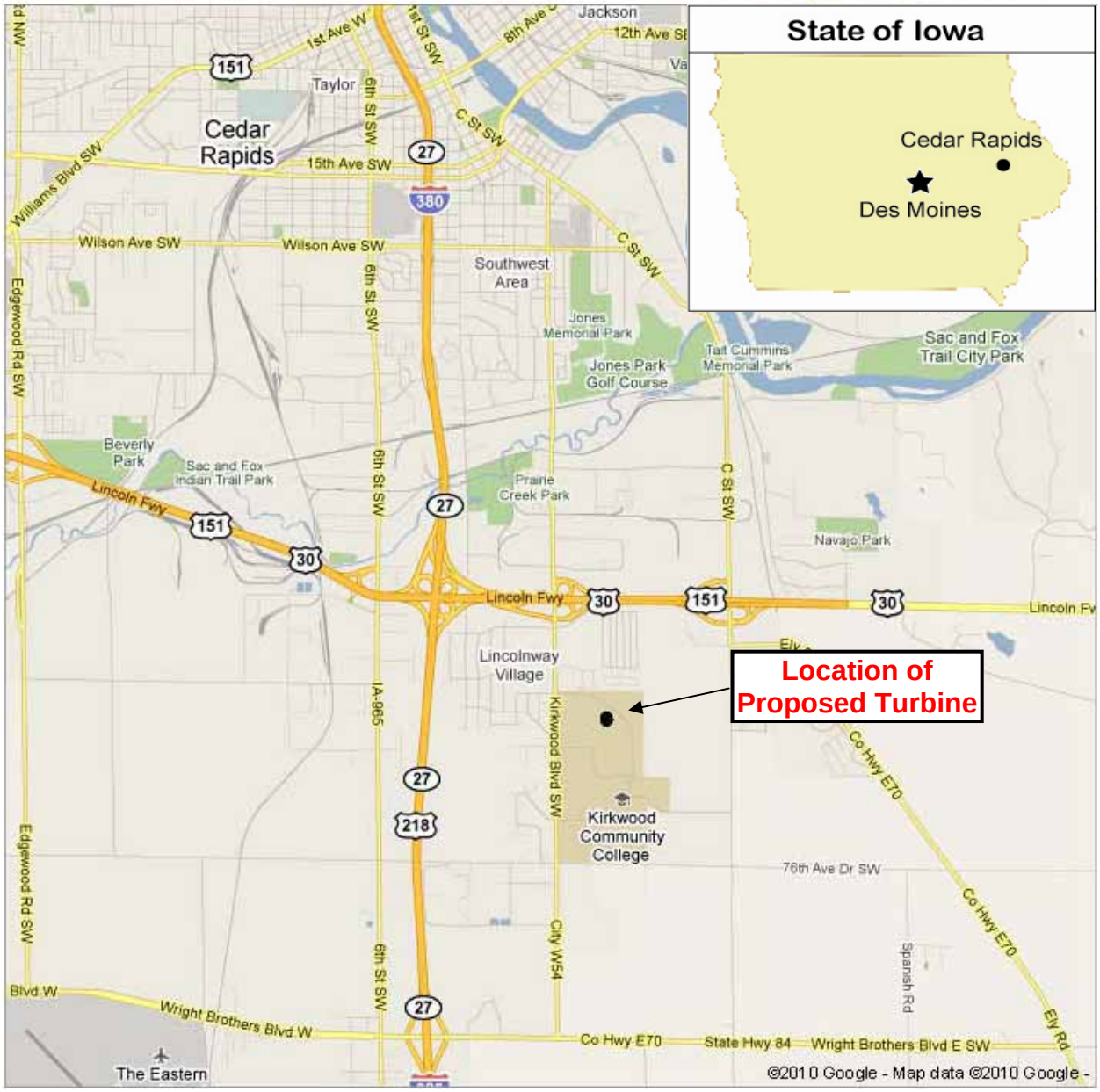

Figure 2-1. General Location Map

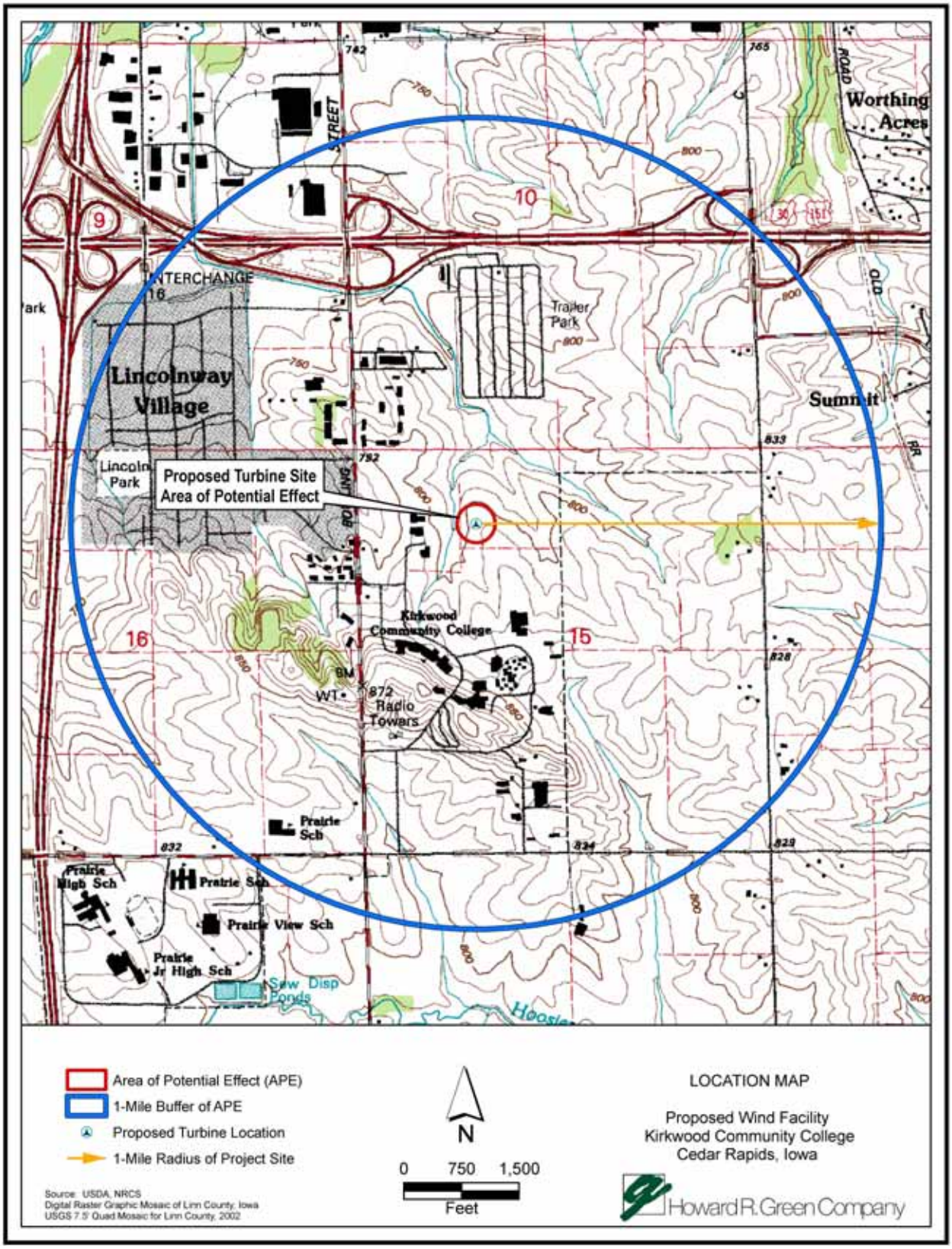

Figure 2-2. Location of Wind Turbine Project on Kirkwood Community College Campus

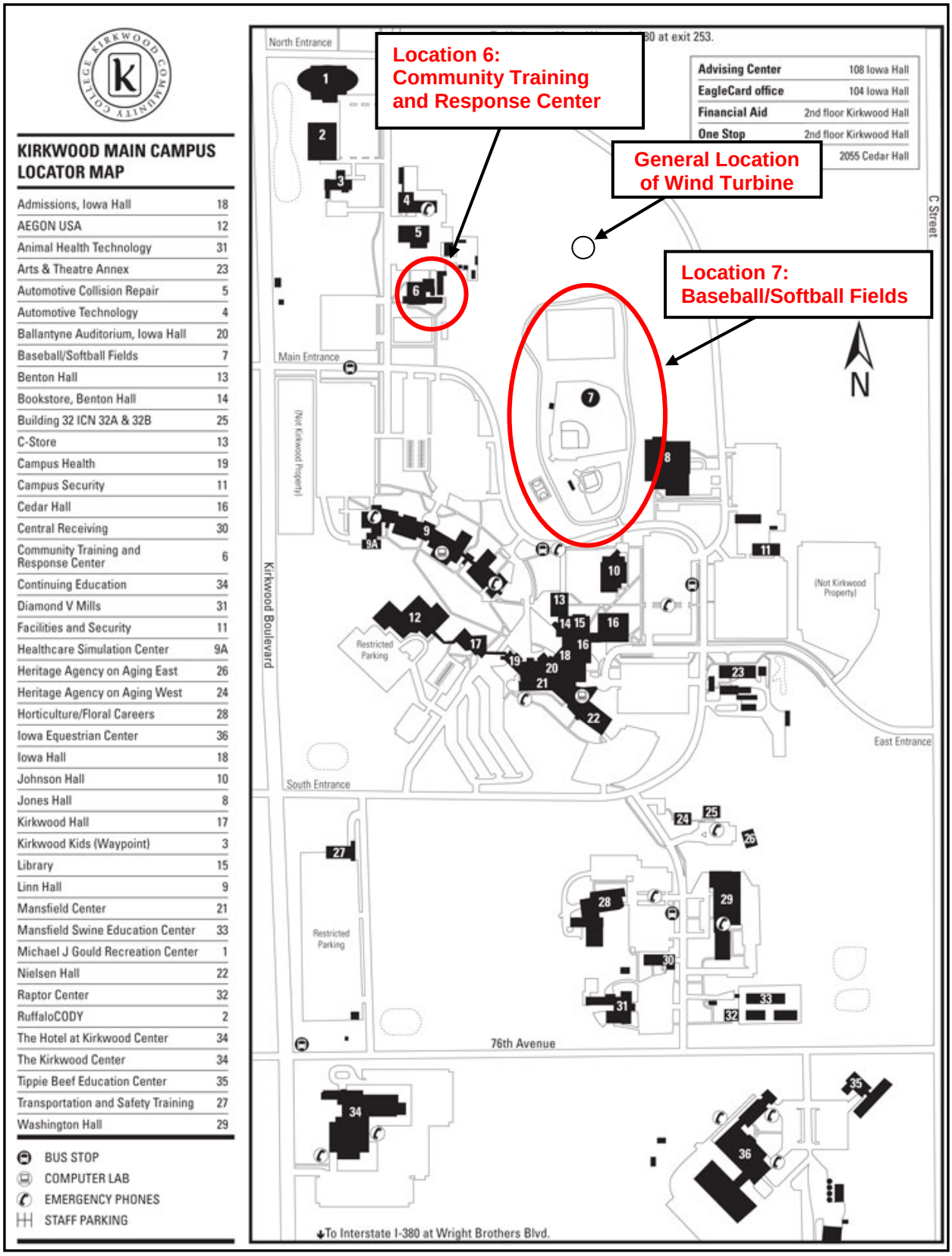

Figure 2-3. Kirkwood Community College Map

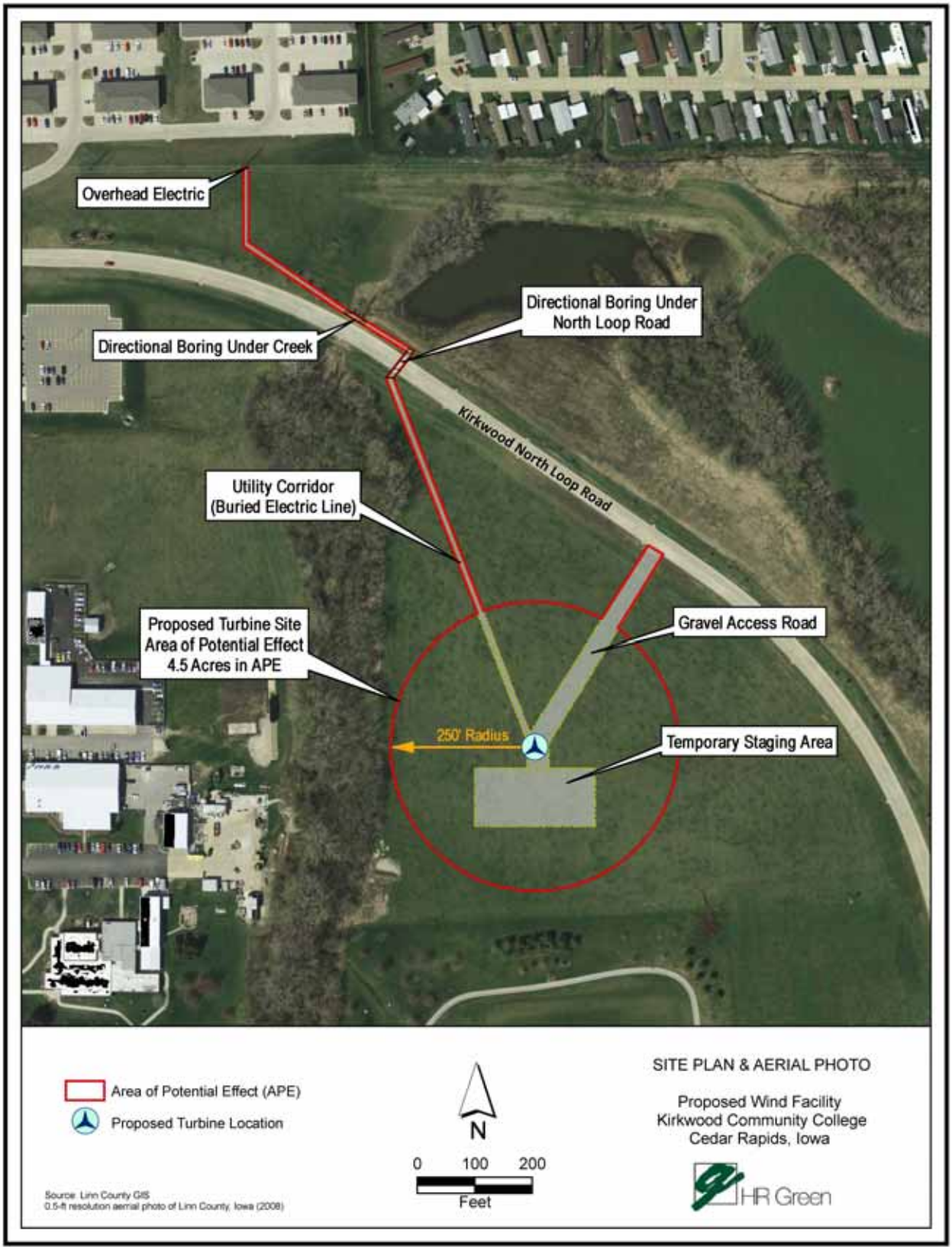

Figure 2-4. Kirkwood Community College Wind Turbine Project Site Plan

The tower and turbine would extend to a height of 427 feet above ground level. The base of the turbine tower would occupy an area of approximately 165 square feet. The buried concrete foundation would have a diameter of about 53 feet and would be approximately six feet in height. The foundation pedestal on which the tower would be mounted would be approximately 18 feet wide and 4.5 feet high, half of which would be below ground level. The turbine would be connected via an underground cable of approximately 1,120 feet to the distribution grid at the nearest point of interconnection. A gravel access road of approximately 400 feet would be constructed from nearby Kirkwood Boulevard Northeast. A temporary staging area would be created adjacent to the access road in the vicinity of the tower foundation.

2.2.3 CONSTRUCTION AND INSTALLATION

Construction of the wind turbine is anticipated to begin in 2011. The Wind Turbine Project would follow a progression that includes engineering, permitting, and detailed design; construction, and installation; commissioning; and operation. The anticipated timeframe from engineering to operations is approximately 1 year. All projects under DOE's award to Iowa SEP must be completed and operational by April 30, 2012.

Installation of the single turbine and required infrastructure would require the temporary disturbance of up to two acres of land that has been graded or otherwise previously disturbed. Trenchless technology would be used to install approximately 1,250 feet of buried electrical cable from the turbine to an existing overhead electrical line (Figure 2-4). Directional boring would be used to install the electrical cable under the North Loop Road and an adjacent creek. An approximately 400-foot-long gravel access road would be constructed from the existing Kirkwood North Avenue SW to the turbine tower. Once the wind turbine was constructed, the temporary staging area and the path of the buried electrical line would be restored to existing conditions. The wind turbine foundation and immediate area, which would be fenced, and the gravel access road would be the only long-term commitments of land. Use of the area is and would continue to be for institutional and public purposes as part of the College's property. The area surrounding the proposed wind turbine location and outside the fenced area would continue to be used for a variety of purposes, including commercial, office, residential, and agricultural uses.

Construction would be in accordance with an approved erosion and sedimentation control plan and in compliance with all other applicable requirements. The turbine tower would arrive on trucks in two or three pieces and would be assembled onsite. The turbine nacelle and blades would arrive separately on trucks. A large crane would be used to assemble the tower, place the nacelle on top of the tower, and attach the blades to the nacelle hub. Construction of the foundation, tower erection, turbine nacelle placement, and blade installation would be contingent on temperature and weather conditions (Figure 2-5).

2.2.4 OPERATION

The College would operate the Wind Turbine Project with Alliant Energy, the local electric power company, according to operating, maintenance, and safety procedures specifically recommended by the turbine's manufacturer. As part of operating the wind turbine, the College would properly train al workers for turbine maintenance and safety. Routine maintenance of the turbine would be necessary to maximize performance and identify potential problems or maintenance issues. The turbine would be remotely monitored daily to ensure operations were proceeding efficiently. All problems would be reported to Wind Turbine Project operations and maintenance personnel, who would perform both routine maintenance and most major repairs. Most servicing would be performed up tower without removing the turbine from the tower, thus greatly reducing the need for a crane. In addition, all access roads and the grounds around the wind turbine would be regularly inspected and maintained to minimize erosion.

Figure 2-5. Simulation of the Wind Turbine Project Installation

2.2.5 DECOMMISSIONING

Impacts evaluated with respect to the decommissioning of the turbine would be similar to those considered for construction of the turbine. The turbine and other infrastructure would be expected to have a useful life of at least 15 to 20 years. Retrofitting the turbine with upgrades might allow the turbine to produce efficiently for many years after the original useful life. When the Wind Turbine Project is terminated, the College will be responsible for decommissioning. The turbine and other infrastructure would be decommissioned and all facilities would be removed to a depth of approximately three feet below grade. The soil surface would be restored as close as possible to its original condition. Buried equipment would either be removed or safely secured and left in place. Salvageable items (including fluids) would be sold, reused, or recycled as appropriate; unsalvageable material would be disposed of at authorized and approved disposal sites. All decommissioning construction activities would be performed in accordance with the manufacturer's guidelines as well as all applicable Federal, State, and local regulations.

2.3 No-Action Alternative

Under the No-Action Alternative, DOE would not allow Iowa to use its SEP funds for the proposed project. For purposes of this EA, DOE assumes for the No-Action Alternative that the project, therefore, would not proceed without Federal funding. This assumption allows a comparison between the potential impacts of the project as proposed and the impacts of not proceeding with the project. Without the proposed project, the operations and energy usage of the nearby community would continue as otherwise

planned but without the proposed wind project; therefore, the community would continue to use electricity primarily generated using fossil fuels and the potential reduction in greenhouse gases would not be realized. The ability of the State of Iowa to use its SEP funds for energy efficiency and renewable energy activities would be impaired, as would its ability to create jobs and invest in the nation's infrastructure in furtherance of the goals of the Recovery Act.

2.4 Committed Measures

The College has committed to the following measure and procedure to minimize or avoid environmental impacts if the Proposed Action is carried forward:

The College will develop a joint monitoring effort and assign the project in a collaborative effort to faculty in the Industrial Arts (wind technology students), Horticulture (parks and recreation students), and, as required, Math (statistics) departments. The campus Environmental Committee will review the monitoring efforts annually and report findings to the DOE and USFWS.

If any of the residents in the shadow flicker area comes forward and says that the shadow flicker is causing annoyance, the College would pay reasonable costs to provide shading devices such as shades, blinds, or vegetation to mitigate the effect.

Per State regulations, the College intends to submit a Notice of Intent to the Iowa Department of Natural Resources prior to starting construction. This Notice would be for storm water discharges under a General Permit No. 2 for construction activities as part of the National Pollutant Discharge Elimination System Program.

The College would use standard best management practices for the construction industry to reduce risks to workers. This would include complying with Occupational Safety and Health Agency regulations at 29 CFR Part 1926, "Safety and Health Regulations for Construction."

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This chapter of the EA examines in detail the potential environmental impacts of the proposed Wind Turbine Project and of the No-Action Alternative for the following affected environmental resource areas:

- Land Use
- Visual Quality
- Noise
- Cultural Resources and Historic Preservation
- Biological Resources
- Water Resources – Surface Water
- Human Health and Safety
- Transportation
- Socioeconomics and Environmental Justice
- Air Quality
- Infrastructure and Energy

Other resource and subject areas commonly addressed in DOE EAs are identified in Section 3.2 along with a basis for excluding them from the more detailed analysis.

3.1 No-Action Alternative

Under the No-Action Alternative, DOE would not authorize the use of Federal funds for a portion of the cost of the wind turbine equipment under proposed project; therefore, there would not be any impacts to the resource areas analyzed in this EA. However, without the proposed project, approximately 35 percent of the College's average annual electrical power that could have been provided by the Wind Turbine Project would continue to be purchased from the Alliant Energy Corporation. Fuel sources for the electricity generated by Alliant Energy include coal (61 percent), natural gas (31 percent), oil (6.3 percent), wind (1.2 percent), and hydroelectric (0.6 percent). Therefore, fossil fuels represent the vast majority of the fuel sources used to provide electricity to the College. Thus, carbon dioxide emissions from electricity generation to serve the college would remain the same under the No-Action Alternative, and the college would not meet its objective of reducing its carbon footprint.

Additionally, the jobs created and retained by construction and operation of the wind turbine would not be realized and the local area would forego the economic benefit associated with these new jobs.

3.2 Environmental Resource Areas Not Carried Forward for Further Analysis

Consistent with CEQ and DOE NEPA implementing regulations and guidance, DOE focuses the analysis in an EA on topics with the greatest potential for environmental impacts. This sliding-scale approach is consistent with NEPA [40 CFR 1502.2(b)], under which impacts, issues, and related regulatory requirements are investigated and addressed with a degree of effort commensurate with their importance. DOE concluded that the proposed Wind Turbine Project would result in no impacts or minor impacts to the following resource areas and did not carry them forward for detailed description and analysis.

3.2.1 GEOLOGY AND SOILS

Construction would occur in an open, undeveloped area with loamy and sandy soils that overlie glacial till (Quade et al. 1998). Preliminary Wind Turbine Project plans indicate the construction of the turbine foundation would require 12 to 20 feet of below-grade excavation, depending on geotechnical considerations. The specific foundation system would be developed as part of the detailed project design using applicable and appropriate engineering criteria, but there should be nothing unique or unusual in the site's geology and soils that would hinder or adversely affect the proposed project. As described in more detail in the discussion of surface water, the College would take actions during construction to minimize soil erosion and, because the area has only a mild slope, there would be little potential for soil erosion. After construction is completed and the site revegetated, the potential for soil erosion should be no different than under existing, pre-Wind Turbine Project conditions.

The Wind Turbine Project site, like the rest of Iowa, is considered to be an area of low seismic risk (DNR 2010a; USGS 2010), and it is unlikely that earthquake activity would occur and result in adverse impacts to the proposed project. The Wind Turbine Project would not affect or be adversely affected by site geology.

3.2.2 WATER RESOURCES – GROUNDWATER

The College would use water, provided by the City of Cedar Rapids, as necessary during construction for soil compaction and dust suppression. Such water demand would be short term, approximately two months. The City of Cedar Rapids obtains its water from groundwater, specifically, the alluvial aquifer that is fed primarily from the Cedar River (Cedar Rapids 2010a). The Wind Turbine Project would require excavation to a depth of 12 to 20 feet for the wind turbine foundation. This area is known to be interspersed with clay lenses and perched water bodies, so groundwater could be encountered during construction. However, because excavation would involve a very small area (approximately 20 cubic yards or less), construction activities would not adversely affect such groundwater or deeper aquifers.

There would be no water needs during operation of the wind turbine, and there would be no storage of hazardous substances that could be released and migrate to groundwater. The College would handle, collect, transfer, and reuse or recycle the small amounts of oil and lubricants used during maintenance in accordance with applicable Federal, State, or local regulations.

3.2.3 WASTE MANAGEMENT

Solid wastes generated during installation include equipment packaging materials and construction-related material debris. Minimal solid wastes would be generated during operation of the turbine. Solid wastes that are anticipated to be generated during decommissioning include dismantled equipment and construction-related material debris. No hazardous wastes would be generated during installation, operation, or decommissioning. The College would handle, collect, transfer, and dispose of all wastes generated over the life of the proposed project in accordance with applicable Federal, State, and local regulations. Used oil (e.g., spent gearbox oil, hydraulic fluid, and gear grease) would be generated during operation of the wind turbine, but it would not be considered a waste because it can be reused and/or recycled. The College currently has an existing oil recycling program for used oil generated from its maintenance vehicles and would manage used oil from the wind turbine in accordance with this existing recycling program and with applicable Federal, State, and local regulations.

3.2.4 INTENTIONAL DESTRUCTIVE ACTS

DOE considers intentional destructive acts (that is, acts of sabotage or terrorism) in its EAs and environmental impact statements (DOE 2006). Construction and operation of the College Wind Turbine Project would not involve the transportation, storage, or use of radioactive, explosive, or toxic materials. The Wind Turbine Project would not offer any particular attractive targets of opportunity for terrorists or saboteurs to inflict adverse impacts on human life, health, or safety. In the unlikely event an attack were to occur, its consequences would be similar to those of an accident, such as those discussed in Section 3.3.7 of this EA.

3.3 Considerations Carried Forward for Further Analysis

3.3.1 LAND USE

3.3.1.1 Affected Environment

The proposed wind turbine would be located on the southern edge of Cedar Rapids, on the College campus. Land use in the vicinity of the proposed Wind Turbine Project is a combination of institutional, commercial, office, residential, and agricultural. The proposed project site is currently a maintained, vacant grass field on the college campus. The field is bordered to the north, east, and west by large deciduous trees and to the south by baseball and softball fields. The closest residences are about 1,040 feet to the north of the proposed wind turbine site. These residences are in a trailer park on the north side of the college campus. Two groups of apartments immediately west of the trailer park are only slightly further from the wind turbine site, with the closest apartment building about 1,080 feet away. The next closest residential areas are more than 1,600 feet to the west and would be separated from the wind turbine by a built-up portion of the college campus as well as Kirkwood Boulevard. The closest buildings to the proposed turbine site are part of the college, about 660 feet to the west. To the south and southwest of the Wind Turbine Project site, the nearest buildings are also college facilities, with the closest about 1,150 feet away. To the east, across a cultivated field and a grassy area are two commercial office buildings (about 2,300 feet away).

According to the Comprehensive Plan for Cedar Rapids (Cedar Rapids 1999), the proposed wind turbine would be located on land with a designated land use of “institutional/public” along with the rest of the college campus. Land use designations immediately surrounding the campus include: low-, medium-, and high-density residential; office; and commercial.

Because of the height of the proposed wind turbine, there are other land uses in the surrounding area that could be impacted. The wind turbine has the potential to interfere with air navigation and the operation of transmission towers. The Eastern Iowa Airport is slightly more than 3 miles southwest of the proposed Wind Turbine Project site. There are also several communications and cellular towers within a mile of the project site; the closest being the two 400-foot-tall communications towers in the southwestern part of the campus, about 3,000 feet from the Wind Turbine Project site.

In August 2010, the City of Cedar Rapids put into effect Ordinance No. 032-10, which is “an ordinance amending Chapter 32 of the Municipal Code of the City of Cedar Rapids, Iowa, the Zoning Ordinance, by adding a new Subsection 32.04.030.A.46 to allow the use of Wind Energy Conservation Systems as a conditional use of all land use districts.” This ordinance was subsequently revised by the City Council in February 2011 as the result of a request from College, primarily due to a very stringent shadow flicker requirement in the August 2010 version (Cedar Rapids 2011). A few of the key requirements identified in the most recent ordinance (issued as Ordinance No. 007-11) that would be applicable to the proposed Wind Turbine Project are summarized as follows:

- The distance from the wind turbine to the nearest property line must be no less than 110 percent of the wind turbine's height.
- All wires between the wind turbine and substations must be underground.
- Wind turbine sound (under normal operating conditions) as measured at the property line must comply with decibel limits set in Chapter 56 of the Municipal Code ("Motor Vehicle Noise and Noise Limits from Certain Sound Sources").
- Shadow flicker from the wind turbine may not exceed 30 hours per year on a residential property.

3.3.1.2 Direct and Indirect Impacts

Implementation of the proposed Wind Turbine Project would temporarily commit up to 2 acres of previously disturbed land. Once the wind turbine is constructed, the College would restore both the temporary staging area and the path, where the electrical line would be installed, to existing conditions. The wind turbine foundation and the gravel access road would be the only long-term commitment of ground, though the college plans to install a fence around the turbine. The general land use of the area is and would continue to be institutional/public since it is part of the college's property. The area surrounding the proposed wind turbine location would continue to be used for a variety of purposes, including commercial, office, residential, and agricultural.

Per the Cedar Rapids ordinance on Wind Energy Conservation Systems (Ordinance No. 032-10), the proposed location of the wind turbine would be consistent with the City's zoning for that area, provided requirements in the ordinance were met. Shadow flicker and sound level requirements are addressed in this EA in Sections 3.3.2 and 3.3.3, respectively. With regard to set backs from adjacent property lines, the height of the evaluated wind turbine would be approximately 427 feet from its base to the tip of the rotor blade at its highest point. According to the ordinance, the required set back is 110 percent of this height, which is 470 feet. The nearest property lines, which are to the north and the east, are approximately 1,000 feet from the proposed wind turbine site, well over the required 470 feet. As required by this ordinance, the College would bury electrical lines that would run from the wind turbine to the nearest existing transmission lines.

Once the wind turbine was constructed, it would present a possible risk to air traffic due to its total height of 427 feet. The College addressed this issue by requesting that the FAA conduct an aeronautical study with regard to the Wind Turbine Project. In its response to the College, the FAA stated the "study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities" (see Appendix B). This determination was contingent upon the following conditions: (1) the structure must be marked and/or lighted in accordance with specific FAA guidelines; and (2) the FAA must be notified if the project is abandoned or within 5 days of the construction reaching is greatest height. The letter further states the determination expires on April 20, 2012, two years after the date of issuance. Based on the FAA's determination, DOE concludes that the Wind Turbine Project would have no adverse impacts on air traffic of the area and, in that regard, would not present a conflict of land use.

Wind turbines have the potential to interfere with existing microwave systems and broadcast stations by physically blocking line-of-sight between transmitters and, in case of television signals, by reflecting signals that can result in "ghosting" in receptions. To address this potential issue, the College arranged for a private entity (Comsearch) with expertise in the subject matter, to perform an evaluation of the proposed Wind Turbine Project. The report from the evaluation (included in Appendix E) identifies several microwave paths that pass through an area of interest around the proposed turbine location; however, the

report concludes “the proposed turbine was not found to have a potential conflict with the incumbent microwave paths.”

3.3.2 VISUAL QUALITY

3.3.2.1 Affected Environment

Visual quality refers to the scenic or visual appeal of the landscape and includes all natural and manmade objects (moving and stationary) that are visible on the landscape (BLM 2005a). The visual character of the Wind Turbine Project site is that of a grassy, maintained area that is somewhat isolated from ground view from off-campus areas due to trees in the surrounding area. (Depending on the location of the observer, the trees would not obstruct the view of an installed wind turbine.) To the south, there is less tree cover; however, baseball and softball fields as well as the main portion of the campus separate the proposed project site from off-campus areas. The Kirkwood North Loop Road cuts through the open grassy area, making the proposed turbine site clearly visible from this road. Beyond the trees to the north and northwest are residential areas; to the west are college buildings and more residences beyond. Beyond the trees to the east are open fields; beyond the fields are large office complexes and associated vehicle parking.

The College and the proposed wind turbine site are at the southern edge of Cedar Rapids, with much of the surrounding area already developed or partially developed. The Wind Turbine Project area is also within the area designated as the Iowa City/Cedar Rapids Tech Corridor, with the Iowa City area representing the next largest community to the south. Large vertical structures already in the general area include two communications towers, two water towers, several cellular towers, billboards, and overhead utility towers within a mile of the proposed wind turbine site (H.R. Green 2010). This area, at the southern edge of Cedar Rapids, is not characterized with any specific scenic significance.

Shadow Flicker

Another potential visual impact associated with wind turbines is shadow flicker. Shadow flicker is defined as alternating changes in light intensity caused by a moving object (such as a rotating rotor blade) casting shadows on another object. Shadow flicker from wind turbines can occur when moving turbine blades pass in front of the sun, creating alternating changes in light intensity or shadows. These flickering shadows can cause an annoyance when cast on nearby “receptors,” such as residences, schools, and hospitals. The spatial relationship between a wind turbine and a receptor, the location of trees, topography, buildings, and other obstacles, and weather characteristics such as wind speed/direction, and cloud cover, are key factors related to shadow flicker impacts. The effect is most pronounced when the sun is at a low angle and shadows are long.

The farther the observer is from the wind turbine, the smaller the portion of the sun being blocked, allowing the distance to diffuse (weaken) the shadow. Efforts to model shadow flicker are generally limited to an area within about 1,000 meters (3,280 feet) of wind turbines and many references set 10 rotor diameters as the distance beyond which shadow flicker is of little concern. In the case of the proposed Wind Turbine Project, the wind turbine being evaluated (the Clipper Liberty 2.5 MW CW99 turbine) has a rotor diameter of 99 meters (325 feet), so the impact area of primary concern would lie within about 990 meters (3,250 feet) of the proposed turbine site.

To model shadow flicker for the Wind Turbine Project, DOE considered only those areas where the wind turbine blade would block more than 20 percent of the sun disk, which is based on the premise that the smaller the portion of the sun blocked by the blade, the less intense the shadow. The distance from the wind turbine encompassed by the 20 percent criterion is about 4,000 feet. The 4,000-foot distance includes residential areas to the north and west, the commercial area to the east, and the college campus

facilities to the west and south. [Note: The criterion of considering areas where 20 percent or more of the sun would be blocked by the turbine blade was an option in the computer model used in the evaluation. Literature for the model indicated the criterion is based on a German guideline (EMD 2010). It was selected because it conservatively provided results for locations further away than the "ten rotor diameters" often used as an informal guideline in shadow flicker evaluations.]

Because of the strobe-like effect of shadow flicker, there have been investigations into whether it might have the potential to produce epileptic seizures in individuals with photosensitivity. It has been determined that modern utility-scale wind turbines do not have the potential to cause these types of problems because of their relatively slow blade rotation. One study (Harding et al. 2008) reported that flickers with a frequency greater than 3 hertz could pose a potential for inducing photosensitive seizures; that is, a light flashing at a rate of more than 3 times per second. The American Epilepsy Foundation reports that lights flashing in the range of 5 to 30 hertz are most likely to trigger seizures and recommends that flash rates of visual alarms be kept under 2 hertz (Epilepsy Foundation 2010). A wind turbine with three blades would have to make a full revolution every second (or 60 revolutions per minute) to reach a frequency of 3 hertz. The Clipper 2.5 MW CW99 wind turbine being evaluated for this Wind Turbine Project operates within the range of 9.6 to 15.5 revolutions per minute (Clipper 2010). This would put the flicker frequency created by this wind turbine at 0.48 to 0.78 hertz; well below rates identified with photosensitivity issues.

Health or safety concerns aside, shadow flicker is often considered annoying by those exposed. For example, in rooms with windows exposed to sunlight, the rotating blades could cause a shadow in the room every one to two seconds and during certain times of the year, this could go on for up to about an hour (but could occur only once per day). The closer the room to the wind turbine, the more intense the shadow (that is, the more contrast there is between the dark and light intervals). The level of annoyance this might cause is very subjective and would depend on the individual and the activity being performed. Depending on the options available and the level of annoyance, the exposed individual might choose to move to an unaffected portion of the building, close blinds or drapes to block the sunlight (and the shadows), or change the activity being performed. If no such options were available or if the level of annoyance was low, the exposed individual would likely continue with ongoing activities.

The locations where shadow flicker would occur are dependent on the relative positions of the sun and the wind turbine. Impacts depend on the position of observers relative to the line of sight to the sun through the turning rotor. Once a wind turbine location is set, the changing position of the sun by time of day and time of year can be used along with geometric relationships to determine the locations and duration of shadow flicker under ideal conditions for flicker generation. These ideal conditions (or worst-case conditions in terms of impacts) include no cloud cover or fog (that is, the sun is shining), a continuously rotating turbine, and constant wind direction from the wind turbine directly into or away from the sun (so the turbine rotor would be facing directly into or away from the sun). The opposite or contrary situation to this last condition would be if the wind was blowing at a 90-degree angle to the sun's relative position; for example, if the sun was in the western sky and the wind was blowing from the south. In this case, the sun would shine on the narrow side or silhouette of the rotor, and very little moving shadow would be generated.

3.3.2.2 Direct and Indirect Impacts

Visual Effects

Construction of the wind turbine would involve the presence of heavy equipment, construction workers and their vehicles, trucks delivering large pieces of equipment, dust and vehicle exhaust emissions, and, for a 1 to 2 week period, a crane to lift the wind turbine components. All of these items would be in contrast to the normal visual landscape of the site. However, these actions would be of relatively short

duration and would occur primarily in an area that is somewhat shielded from ground view in much of the surrounding area. The crane would be the exception and would be visible for some distance when in the upright position, as would the wind turbine components as they were erected. Because there would be only one wind turbine involved, the duration of construction would be relatively short (estimated at about 2 months), and the overall size of the construction effort would be relatively modest. Decommissioning would require the same types of activities as construction and, similarly, would be expected to have minimal visual effects (other than the change of eliminating the visual impact of the wind turbine).

Once construction was complete, the Wind Turbine Project would result in a tall, narrow structure on the outer boundary of Cedar Rapids. The College commissioned a Visual Impact Assessment to evaluate the effect of the wind turbine's appearance on the surrounding area. This assessment, included in Appendix D of this EA, involved the use of commercial software to simulate views of the wind turbine from various locations in the surrounding area. Based on the simulations, the wind turbine would be visible from most areas adjacent to the campus. From the south entrance to the campus, however, the view of the turbine would likely be obstructed from view by trees. From the southwestern edge of the campus, the wind turbine would be visible; however, much of the tower would be obstructed from view by a hill or ridge that runs through the center of the campus. The wind turbine would be clearly visible from U.S. Highway 30 that runs east to west to the north of the campus. The wind turbine would not be visible from Palisades/Kapler State Park, approximately 11 miles to the east, or from the Amana Colonies, approximately 20 miles to the southeast. Both of these areas are recognized for their scenic and cultural significance.

The wind turbine would have pilot warning and obstruction avoidance lighting, but as identified in Section 3.3.5 of this EA, the College would use the minimum amount of FAA-required lighting to minimize the risk of birds and bats being attracted to the lights. There would be a single, dual-system light located atop the nacelle (the housing for the wind turbine's mechanical and electronic components at the top of the tower). The dual system would consist of a flashing white light of medium intensity during daytime and twilight, and a red flashing beacon during nighttime. The FAA Advisory Circular that provides the applicable lighting guidelines describes avoiding use of the flashing white light during nighttime as a measure that reduces environmental concerns (FAA 2007). The lights would be similar to those normally found on communication towers and, as a result, are familiar to most people. People generally would not find the lights to be intrusive when inside their residences or other buildings, or during outdoor activities.

Although the wind turbine would be a prominent feature in the landscape and one of the tallest structures in Cedar Rapids, the College has concluded that the presence of the wind turbine would be consistent with future development in the Iowa City/Cedar Rapids Tech Corridor and would provide a visual landmark for identifying the campus' location and that of surrounding areas of interest. A single wind turbine located within the campus would result in minimal impacts to the area's visual resources.

Shadow Flicker

The College commissioned a shadow flicker analysis to evaluate the impacts of the proposed Wind Turbine Project (Appendix D). The study used WindPro software to calculate the daily duration of shadow flicker during a year under ideal conditions in areas surrounding the proposed turbine. These ideal conditions, as described in Section 3.3.2.1, are those that would generate the longest duration of flicker. The study then incorporated representative meteorological data consisting of average values for monthly distribution of wind direction and for days per month of cloud cover. These were used to produce values by month and location for reducing shadow flicker due to (1) cloud cover, (2) the wind blowing from the wrong direction to cause shadow flicker at a location, and (3) the wind turbine operating less than 100 percent of the time (assuming an average operational rate of 80 percent, based on the wind characteristics of the area). The applicable reduction values were applied to the maximum possible shadow flicker values

based on the specific months (in the case of cloud cover and wind direction) the shadow flicker would occur at a specific location. Results of this effort are summarized in the shadow flicker contour map shown in Figure 3-1 (taken from the shadow flicker analysis report) in which the contours represent the expected number of hours per year the area would be exposed to shadow flicker. As can be seen in the figure, the contours extend predominantly east to west in response to the movement of the sun. The butterfly shape is caused by changes in the relative position of the sun during the year. Figure 3-1 also shows the locations, labeled A through L, of specific receptors, primarily residences, that were selected as possible worse-case receptors because they are representative of residences closest to the proposed wind turbine site. The model estimated shadow flicker durations for each of these receptors in addition to the general contour lines. Table 3-1 provides a summary of the maximum (potential) hours of shadow flicker that could be experienced at the residences with no reduction factors. The table also shows the reduction values applied to each of the maximum shadow flicker values and the results. The reductions are shown in three steps: 1) cloud cover, 2) wind direction attributed to meteorological conditions and 3) the average percentage of time the wind turbine would be operating. The estimated 20 percent for non-operational time includes downtime for maintenance as well as periods when wind would be too low or too high for the wind turbine to operate. Information in the table is presented in detail that includes the months in which the shadow flicker could occur at each site. As can be seen in the table, the cloud cover reduction varies by month; the wind direction reduction is based on an annual wind rose, so it does not vary by month, but does vary by location.

Also shown in Table 3-1, the residential locations that could be affected the most by shadow flicker could potentially experience as many as 65 to 70 hours of flickering over the course of a year. During the times of the year it could occur (that is, when the receptor location was lined up with the wind turbine and the sun), a specific location could be exposed to flickering events that could last just a couple of minutes per day to events that could last about an hour a day. It would occur in the mornings for the receptors on the west side of the wind turbine and in the evenings for receptors to the east. Appendix D of this EA identifies the times and days of the year that flickering could occur for each of the evaluated locations.

Although the maximum hours of shadow flicker exposure are considered possible, they would require a specific alignment of several variables to occur every time the sun and the wind turbine were in the right relative position. Given the natural variability of wind speed and direction and the distribution of cloudy days, it is unlikely that the maximum hours would be reached. Based on the reductions calculated in the shadow flicker study and summarized in Table 3-1, it is more likely that as a result of the variable meteorological conditions, the highest exposure of shadow flicker would occur to residences in the area of locations D and G (Figure 3-1 and Table 3-1) and those exposures would be in the range of 14 to 20 hours per year. Given the reduction factors were generated from averages of weather data, actual shadow flicker could vary from year to year, but over multiple years, average exposures would be expected to be consistent with the reduced values. DOE's evaluation of the potential effects of shadow flicker is based on the expected, reduced exposure values.

As described in Section 3.3.1, the City of Cedar Rapids has amended its zoning ordinance to address wind energy conservation systems (Ordinance No. 007-11, Chapter 32). The amendment includes a requirement for shadow flicker, which reads, "The shadow flicker from a Large Wind Energy Conservation System may not exceed 30 hours per year on a residential property." It is clear that the intent of the ordinance is to limit the amount of shadow flicker exposure to residences. Results of the shadow flicker analysis indicated that the proposed College Wind Turbine Project would be in compliance with the most recent version of the Cedar Rapids ordinance.

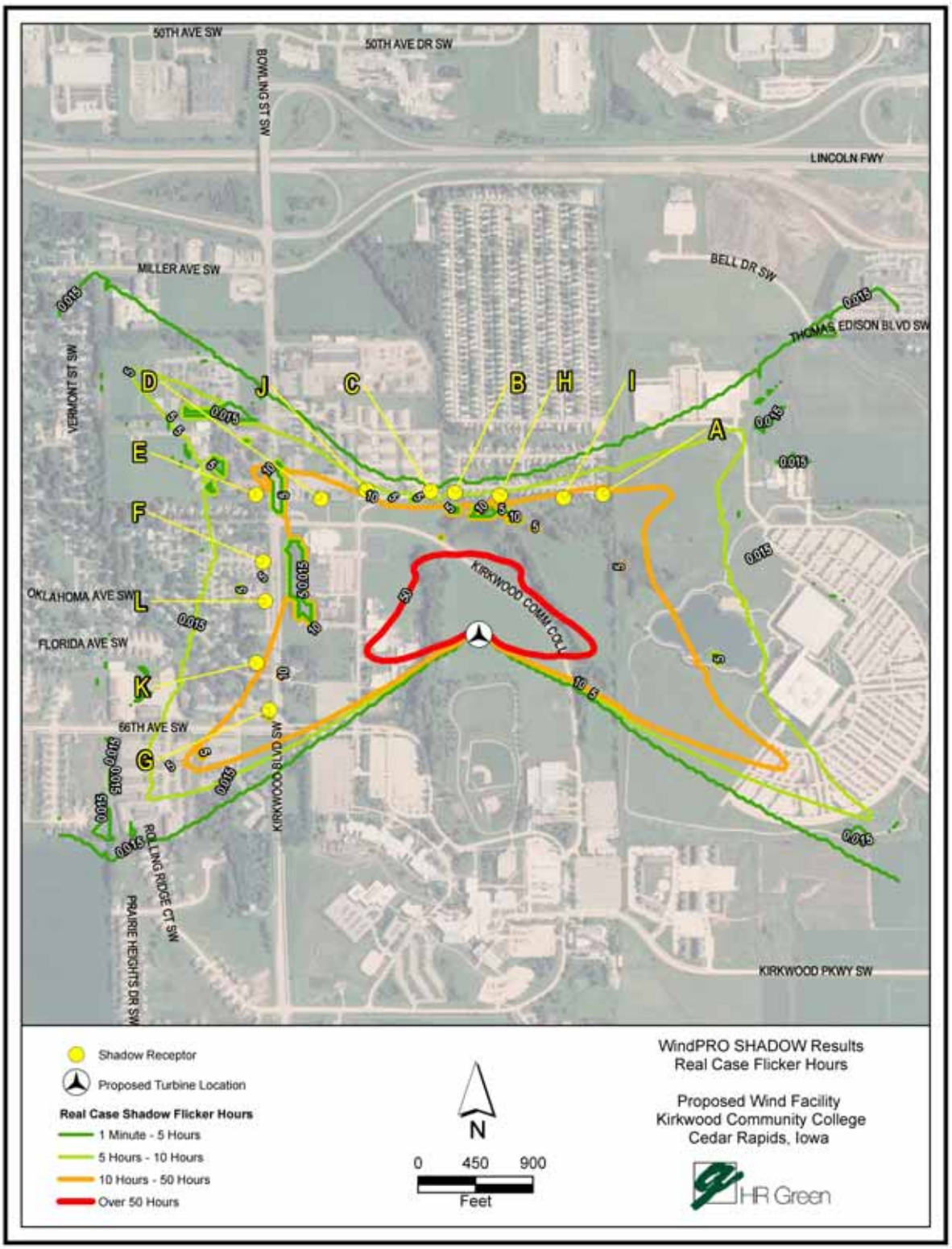

Figure 3-1. Shadow Flicker Contour Map [showing "real case" (anticipated) shadow flicker exposure contours labeled in hours per year. Specific locations (A through L) are labeled with both maximum and real case exposures.]

Table 3-1. Maximum and Expected Duration of Shadow Flicker

Receptor Location	Months of Occurrence	Maximum Shadow Flicker (hours)[a]	Reductions for Expected Conditions (percent)			Reduced Shadow Flicker (hours)[b]
			Cloud Cover	Wind Direction	Percent Operating	
A	January	24.6	47	55	80	5.0
	February	0.4	50	55	80	0.1
	November	15.1	37	55	80	2.4
	December	28.3	35	55	80	4.3
Yearly Total		**68.4**				**11.8**
B	January	4.1	47	69	80	1.0
	December	18.0	35	69	80	3.4
Yearly Total		**22.1**				**4.4**
C	January	0.1	47	70	80	0.0
	December	7.3	35	70	80	1.4
Yearly Total		**7.4**				**1.4**
D	January	23.5	47	71	80	6.1
	February	1.1	50	71	80	0.3
	November	15.6	37	71	80	3.3
	December	25.2	35	71	80	4.9
Yearly Total		**65.4**				**14.6**
E	January	11.5	47	70	80	3.0
	February	6.5	50	70	80	1.8
	October	0.9	49	70	80	0.3
	November	16.4	37	70	80	3.4
	December	0.7	35	70	80	0.1
Yearly Total		**36.0**				**8.6**
F	February	5.8	50	65	80	1.5
	March	9.2	50	65	80	2.4
	September	1.3	58	65	80	0.4
	October	14.0	49	65	80	3.6
Yearly Total		**30.3**				**7.9**
G	April	0.4	53	57	80	0.1
	May	21.2	59	57	80	5.7
	June	17.9	64	57	80	5.2
	July	21.9	65	57	80	6.5
	August	7.2	61	57	80	2.0
Yearly Total		**68.6**				**19.5**
H	January	8.5	47	63	80	2.0
	November	0.9	37	63	80	0.2
	December	24.9	35	63	80	4.3
Yearly Total		**34.3**				**6.5**
I	January	22.4	47	58	80	4.8
	November	11.6	37	58	80	2.0
	December	31.4	35	58	80	5.0
Yearly Total		**65.4**				**11.8**
J	January	9.5	47	72	80	2.5
	November	2.2	37	72	80	0.5
	December	22.7	35	72	80	4.5
Yearly Total		**34.4**				**7.5**
K	April	16.3	53	60	80	4.1
	May	1.4	59	60	80	0.4
	August	14.2	61	60	80	4.2
	September	3.7	58	60	80	1.0
Yearly Total		**35.6**				**9.7**
L	March	14.3	50	64	80	3.6
	April	1.5	53	64	80	0.4
	September	14.1	58	64	80	4.1
	October	2.0	47	64	80	0.5
Yearly Total		**31.9**				**8.6**

Table 3-1. Maximum Hours of Shadow Flicker (continued)

Receptor Location	Months of Occurrence	Maximum Shadow Flicker (hours)[a]	Reductions for Expected Conditions			Reduced Shadow Flicker (hours)[b]
			Cloud Cover	Wind Direction	Percent Operating	

Note: Maximum hours that could be experienced annually at nearby residences and the reduced hours when meteorological conditions and non-operational times are considered

a. These are the maximum values under ideal conditions for shadow flicker generation. These ideal conditions include no clouds; the wind turbine operating at all times; the wind direction being along the line formed by the sun, the turbine, and the receptor; and no obstacles between the wind turbine and receptor that would block sunlight.

b. Due to rounding of the reduction factors, monthly values shown here may differ slightly from those that would be calculated using the table's reduction factors. Values here are taken from the Shadow Flicker Assessment report in Appendix D.

Considering only the impacts to the human environment from exposure to shadow flicker, there are no firm criteria on what is acceptable or unacceptable. As noted previously there are no specific, identified health impacts associated with the exposures. The level of annoyance is very subjective and depends on how the exposed portion of the facility is being used, and on the individual observer. If an individual is annoyed by the phenomenon, a solution can be as simple as temporarily moving to an unaffected portion of the facility, hanging drapes or blinds, or planting screening vegetation. It is recognized, however, that such solutions may not always be available or practical and, in some cases, feeling the need to implement a solution just adds to the annoyance. There are some guidelines or reference points on what some might term acceptable levels of exposure to shadow flicker occurrences. The Danish Wind Industry Association identifies a court case in Germany in which a judge set 30 hours of actual shadow flicker per year as a tolerable level (DWIA 2003). The National Wind Coordinating Committee, a collaboration of U.S. industry and government groups, identifies shadow flicker of 20 to 30 hours per year as the threshold for concern (NWCC 2006). Based on this information, all of the residential locations in the vicinity of the proposed wind turbine would be expected to have average exposure levels deemed tolerable by the German court and considering just the meteorological reductions, would be at or below the threshold of possible concern based on National Wind Coordinating Committee criteria.

The map (Figure 3-1) from the shadow flicker study shows that some roads near the proposed wind turbine site would also be subjected to shadow flicker. The highest amounts, expected to be more than 50 hours per year, would be along Kirkwood North Loop Road, which borders the wind turbine site to the north, northeast, and east (but which includes no residences in proximity to the wind turbine site). Kirkwood Boulevard, running north-to-south to the west of the wind turbine site, would also experience some shadow flicker, possibly in the range of 10 to 20 hours per year. Drivers passing through these road segments during a shadow flicker event would have an experience comparable to driving late or early in the day while sunlight flickers through nearby trees, vegetation, or other tall structures; that is, conditions experienced often by most drivers. Although the roads would be subjected to shadow flicker events, individuals would be moving through the area and would be exposed to only short durations of the phenomenon.

A single wind turbine operating on the College campus in Cedar Rapids, Iowa would not be expected to generate shadow flicker impacts beyond which most guidelines define as acceptable. It is recognized, however, that some individuals might find any exposure to shadow flicker unacceptable and in such cases, those individual could be adversely affected, but there is no evidence to date that such individuals would be harmed by the low duration exposures expected in this case.

3.3.3 NOISE

Sound is a result of fluctuating air pressure. The standard unit for measuring sound pressure levels is the decibel. A decibel is a unit that describes the amplitude (or difference between extremes) of sound equal to 20 times the logarithm to the base 10 of the ratio of the measured pressure to the reference pressure,

which is 20 micropascals. Typically, environmental and occupational sound pressure levels are measured in decibels on an A-weighted scale (dBA). The A-weighted scale deemphasizes very low and very high frequency components of sound in a manner similar to the frequency response of the human ear. Using the A-weighting filter adjusts certain frequency ranges (those that humans detect poorly) (Colby et al. 2009). Typical indoor and outdoor sound levels are shown in Table 3-2.

Table 3-2. Common Outdoor and Indoor Sound Sources and Typical Associated Sound Levels (dBA)

Common Outdoor Sound Levels	dB(A)	Common Indoor Sound Levels
		Rock Band
Jet flyover at 1,000 ft	110	
	100	Inside Subway Train (New York)
Gas Lawnmower at 3 ft		
Diesel Truck at 50 ft	90	
Noisy Urban Daytime		Food blender at 3 ft
		Garbage Disposal at 3 ft
	80	
		Very loud Speech at 3 ft
Gas Lawnmower at 100 ft		
	70	
Commercial Area		Normal Speech at 3 ft
Heavy Traffic at 300 ft		
	60	Large Business Office
		Quiet Speech at 3 ft
		Dishwasher Next Room
	50	Small Theater, Large Conference Room
Quiet Urban Nighttime		(Background)
	40	
Quiet Suburban Nighttime		Library
	30	Bedroom at Night
Quiet Rural Nighttime		Concert Hall (Background)
	20	
		Broadcast and Recording Studio
	10	
	0	Threshold of Hearing

Noise is any unwanted, undesirable sound. It has the potential to interfere with communication, damage hearing, and, in most cases, is viewed as an annoyance. Noise can occur in different volumes and pitches depending on the type of source and distance from the source. It is important to consider the amount of noise that would be created during both the installation and operation phases of the proposed project to avoid inconveniencing people working or living in the surrounding areas (HUD 2009).

The U.S. Environmental Protection Agency (EPA) identifies noise levels necessary to protect public health and welfare against hearing loss, annoyance, and activity interference in its document, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). These noise levels are in terms of an average "24-hour exposure" and over long periods of time such as years. A cumulative 24-hour measure of noise accounts for the moment-to-moment fluctuations in A-weighted decibel levels due to all sound sources during 24 hours, combined.

A 24-hour exposure level of 70 dBA is indicated by EPA as the maximum level of environmental noise at which any measurable hearing loss over a lifetime may be prevented, and levels of 55 dBA or less outdoors and 45 dBA or less indoors are defined as preventing activity interference and annoyance to human receptors. For noise-sensitive areas such as where people sleep, EPA considered Day Night Average Sound Level (DNL) values. The DNL values represent energy averages over a 24-hour period, but a 10-decibel penalty is added to sounds that occur between 10 p.m. and 7 a.m. Accordingly, in residential areas, for example, EPA's guidelines for sound levels to avoid activity interference and annoyance are DNL levels of 55 dBA outdoors and 45 dBA indoors. At those levels (or less), spoken conversation and other daily activities such as sleeping, working and recreation, can occur without interference.

In 1981, the Federal government concluded that noise issues were best handled at the State or local government level. As a result, the EPA phased out Federal oversight of noise issues to transfer the primary responsibility of regulating noise to State and local governments. The EPA has an existing design goal of a DNL less than or equal to 65 dBA and a future design goal DNL of 55 dBA for exterior sound levels (EPA 1977). It is important to note that the EPA noise guidelines are design goals and not enforceable regulations. However, these guidelines and design goals are useful tools for assessing the affected environment.

3.3.3.1 Affected Environment

The Cedar Rapids noise regulations are set forth in the Cedar Rapids, Iowa, Code of Ordinances, Chapter 56, "Motor Vehicle Noise and Noise Limits from Certain Sound Sources." An ordinance amendment (Ordinance No. 032-10) to Chapter 32, Zoning, of the Cedar Rapids Code of Ordinances specifically addresses wind energy conservation systems. Although the Chapter 56 ordinance does not identify wind turbines as a regulated sound source, an amendment to Chapter 32, which added Subsection 32.04.030.A.46, stipulates that "sound produced by the turbine under normal operating conditions, as measured at the property line, shall comply with the decibel limits set forth in Chapter 56 of the Municipal Code." The applicable Cedar Rapids noise regulations are shown in Table 3-3. The regulations set maximum permissible sound levels from sources (noise generators) as measured at the boundary of the receiving property and, as shown in the table, the maximum sound levels vary depending on the nature of the receiving property's use. In the case of residential areas, the allowable sound levels also vary by time of day. Unlike the EPA noise guidelines, the Cedar Rapids noise regulations are enforceable.

Table 3-3. Maximum Permissible Sound Levels from Limited Sources by Receiving Land Use

Zoning Category of Receiving Land Use	Sound Level Limit (dBA) – At Boundary of Receiving Property
Resident District	
Daytime – 7 a.m. to 10 p.m.	60
Nighttime – 10 p.m. to 7 a.m.	50
Commercial District (at all times)	65
Industrial District (at all times)	75

Source: Cedar Rapids, Iowa, Code of Ordinances, Chapter 56, Motor Vehicle Noise and Noise Limits from Certain Sound Sources

The proposed location for the wind turbine is within a large grassy area on the College campus. The closest facilities to the site are the college buildings directly to the west. The closest off-campus buildings are the residential areas (homes and apartments) to the north. There is a commercial land use area to the east, residential areas to the southeast, and additional campus facilities to the south and southwest. However, these areas are farther from the proposed wind turbine site than the campus buildings and residential areas to the west and north, respectively. If the City's noise standards are met at the closer areas, they would be met at the more distant properties.

Considering the sound level limits in Table 3-3, those set for residential districts would clearly apply to the off-campus areas to the north. Application of sound limits to the campus facilities, however, is not as clear cut. According to the Cedar Rapids Comprehensive Plan (Cedar Rapids 1999), schools fit into an "Institutional/Public" land use category and are appropriate to be located within other land use categories. The implication is that although there is no "Institutional/Public" land use category in Table 3-3, it may be appropriate to apply the sound limit for the predominant surrounding land use, which is residential in this case. The evaluation in this EA assumes, as a matter of conservatism, that the daytime sound limit for residential areas of 60 dBA is applicable to the school facilities and, because the nearest school facilities do not include buildings where people would sleep, the lower nighttime sound limit does not apply. Figure 3-2 identifies the school facilities closest to the proposed wind turbine site, and there are no dormitories on the College campus (KCC 2011).

Existing Conditions

The College commissioned an ambient noise survey to measure baseline sound conditions in the area of the proposed wind turbine and to evaluate the impacts of the wind turbine's operation. This section includes a summary of the applicable findings; the survey report is included in Appendix C. To determine baseline conditions, three sound monitoring sites were selected (Figure 3-2) as representative of the residential receptor areas that would be the closest to the wind turbine.

Sound-measuring equipment was operated concurrently at the three sites to measure 24-hour sound levels from late afternoon on December 9, 2010, to late afternoon on December 10, 2010. There were equipment problems at two of the monitoring locations and, as a result, the intended 24 hours of monitoring data were not collected at those locations. The sound-measuring equipment at location #3 (outside the Kirkwood Kids Daycare facility) experienced a battery problem and shut down after collecting about 5 hours of data, ending at 10:18 p.m. At location #1 (outside a residence in the Kirkwood Estates trailer park), the equipment recorded 18 hours of usable data before experiencing a localized noise anomaly, which corrupted the remaining data after 11:30 a.m. No problems were experienced at location #2

Figure 3-2. Monitoring Sites for Measuring Baseline Sound Conditions

(outside the Kirkwood Courts apartment complex) and a full 24 hours of data were obtained. Table 3-4 provides a summary of the baseline sound monitoring results. Values shown in the table were taken or derived from the raw data collected during the monitoring effort (McCaslin 2010). The survey report in Appendix C provides additional information on the ambient noise monitoring effort, including graphs of measured sound levels over the entire monitoring period at each location.

Table 3-4. Summary of Baseline Sound Monitoring Results (in dBA)

Monitoring Location	Distance to Turbine Site (feet)	Hours of Data	L_{eq}	L_{min}	L_{max}	L_{50}	L_{90}
#1	1,000	18	69.3 (61.0)[a]	47.5	98.7	56.3	53.2
#2	1,100	24	63.1	47.2	84.5	57.9	54.1
#3	1,300	5	61.2	53.4	77.1	57.9	55.4

a. The value in parentheses represents the L_{eq} at location #1 without the two highest measurements of 98.7 and 86.7 dBA. The next highest measured value was 75.8 dBA. The two high values are outliers compared to the almost 1,100 data points collected and are not representative of ambient noise conditions. Leaving them in the equivalent sound level calculation results in an unrealistically high number.

L_{eq} = Equivalent A-weighted sound level over the given time interval. This is a single number that, if continuous during a specific period, would contain the same total energy as the actual time-varying sound. The L_{eq} is the energy-averaged sound level over the applicable time interval.

L_{min} = Minimum sound level (in dBA).

L_{max} = Maximum sound level (in dBA).

L_{50} = The sound level (in dBA) that is exceeded 50 percent of the time, frequently used as a measure of the median sound level.

L_{90} = The sound level (in dBA) that is exceeded 90 percent of the time, frequently used as a measure of ambient sound levels.

Although location #1 had the highest measured sound levels, unusually high sound levels were limited to only two measurements (a sound measurement was collected every minute of the monitoring period). As noted in the footnote to Table 3-4, it is reasonable to discard those two measurements as outliers in the calculation of the equivalent sound level. It was not necessary to remove those values from the calculation of L_{50} and L_{90}, as these designations are not affected by the magnitude of the outliers.

3.3.3.2 Direct and Indirect Impacts

Sound Levels Associated with the Proposed Wind Turbine Project

Noise produced during Wind Turbine Project construction (estimate to last about 2 months) would be a result of heavy equipment operating at the site. Sound levels from typical construction equipment (for example, bulldozers, rollers, or other heavy equipment with diesel engines and limited movement) are generally in the 80 to 90 dBA range at a distance of 50 feet (EPA 1974). Assuming two of the noisiest pieces of equipment were operating at the same time and that sound intensity decreases over distance as a result of geometric spreading of the sound levels (resulting in a decrease of about 6 decibels per doubling of the distance from the source), it is estimated that sound levels (occurring only during the daytime) would exceed the EPA guideline for a residential DNL of 55 dBA (EPA 1974) at locations within about 2,200 feet. Construction sound levels are compared with EPA guidelines because the City's noise ordinance (Table 3-3) is not applicable to construction activities. The private residences to the north, northwest, and west of the proposed wind turbine site are within this distance. Sound attenuation factors such as air absorption and ground effects from terrain and vegetation would decrease sound levels at those residences. Noise levels experienced at the residences would be similar to those of a normal office and from conversations (Table 3-2). In addition, the sounds would be relatively short term and would occur only during the daytime when they would be less likely to interfere with sound-sensitive activities such as sleeping. Thus, construction of the wind turbine would have minor noise impacts on nearby residents.

Noise produced during decommissioning of the wind turbine would be expected to be similar to, if not less than, that generated during construction. That is, with appropriate control of nighttime activities, noise impacts would be minor.

Operating wind turbines generate two types of sound: mechanical sound from components such as gearboxes, generators, yaw drives, and cooling fans, and aerodynamic sound from the flow of air over and past the rotor blades. Modern wind turbine design has greatly reduced mechanical sound and it generally can be ignored in comparison to aerodynamic sound, which is often described as a "swishing" or "whooshing" sound (BLM 2005b). The Clipper Liberty 2.5 MW CW99 has a hub height of 80 meters (262 feet), and rotor diameter of 99 meters (325 feet), and has several characteristics that reduce aerodynamic sound levels in comparison to older wind turbine designs. It is an upwind turbine, meaning the turbine faces into the wind and the wind encounters the rotor blades before the tower and the nacelle, making for quieter operations than a downwind turbine. It has relatively low rotational speeds and pitch control on the rotors, both of which reduce sound levels. The Clipper 2.5 MW wind turbine is also a variable speed design, which is quieter than a fixed speed turbine because it can operate at slower speeds in low winds, resulting in a quieter operation in low winds (BLM 2005a).

As described in Appendix C, the Clipper Liberty 2.5 MW CW99 wind turbine has a maximum sound power level of 107 decibels. This sound level is characterized as being plus or minus 2 decibels, which is typical of these reported values for wind turbines and is indicative of the accuracy of the measuring technique. The maximum sound level occurs at a wind speed of 18 miles per hour. The Clipper 2.5 MW wind turbine has a cut-in wind speed of about 8.9 miles per hour and a cut-out wind speed of 56 miles per hour. The wind turbine makes less noise at wind speeds lower than 18 miles per hour, and the noise levels do not increase at the higher wind speeds. The maximum sound level was used throughout this evaluation for the sake of conservatism. It should be noted that the College is also considering a General Electric 2.5-

megawatt wind turbine for the Wind Turbine Project. The General Electric wind turbine has a maximum sound power level of 105 dBA (GE 2009), very similar to the Clipper wind turbine after adjustments are made for the A-weighted scale.

WindPro, a standard sound propagation model, was used to estimate the distance at which specified sound levels would occur, and to calculate sound levels at nearby residential areas that would result from operation of the wind turbine at a wind speed of 18 miles per hour (Figure 3-3). The small circles (identified with letters A through F) in Figure 3-3 are the representative locations of nearby residential areas for which sound levels were calculated.

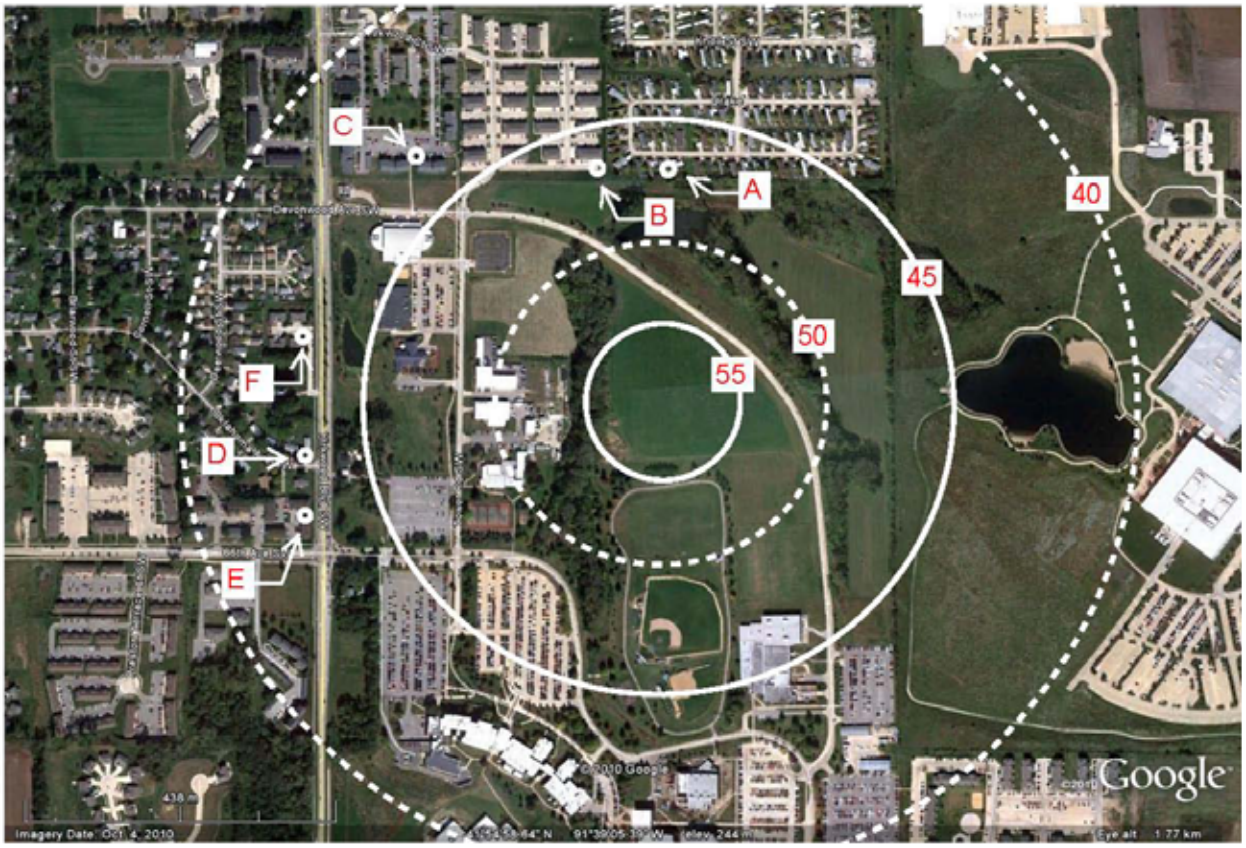

Figure 3-3. Predicted Noise Map with Rings Labeled (in dBA) [for the Clipper Liberty 2.5 MW CW99 Wind Turbine at Maximum Sound Levels]

Sound levels of 50 dBA [equivalent to quiet speech (Table 3-2)] or higher, would occur within 800 feet of the proposed wind turbine, and sound levels would diminish to 40 dBA or less by 2,300 feet (Figure 3-3). This is consistent with other wind turbines, the sound from which generally is between 40 to 50 dBA at 1,000 to 2,000 feet (Colby et al. 2009).

Predicted sound levels at nearby residences range from about 43 to 47 dBA, which is less than the applicable nighttime regulatory standard of 50 dBA specified in the Cedar Rapids Code of Ordinances (Table 3-5). Thus, operation of the wind turbine would comply with the local noise ordinance for residential areas.

Within the campus, a few of the buildings directly to the west of the proposed wind turbine site would experience sound levels of 50 to 55 dBA (Figure 3-3). This is less than the most conservative daytime standard of 60 dBA in the City codes (nighttime standards would not apply to these buildings as they are

not residential facilities). Thus, college activities at these and at more distant facilities would not be adversely affected by noise generated by the wind turbine.

Table 3-5. Predicted and Existing Wind Turbine Sound Levels at Nearby Residences

Location	Distance to Wind Turbine Site (feet)	Predicted Sound Level of Wind Turbine (dBA)	Existing Sound Levels at Nearest Monitoring Site (dBA)	
			Minimum (L_{min})	Ambient (L_{90})
A	1,040	47.2	47.5	53.2
B	1,080	46.9	47.2	54.1
C	2,220	40.2	47.2	54.1
D	1,670	43.0	53.4	55.4
E	1,690	43.0	53.4	55.4
F	1,680	42.9	53.4	55.4
Applicable Standard		**50**		

Note: In the sound assessment of Appendix C, locations A through F are shown as large areas representing housing areas or apartment complexes. In this table and in Figure 3-3, the locations are shown as individual receptor locations that are based on the coordinates identified in Appendix C that correspond to the apparent worst-case locations that were evaluated in areas A through F. In Appendix C, the areas associated with the letters are identified as follows:

A. Kirkwood Estates (trailer park)
B. Kirkwood Courts (apartments)
C. Apartments
D. Single Family Homes
E. Apartments
F. Multi-family Homes

Compliance with local noise standards would ensure that individuals would not be harmed by sound levels generated by the proposed wind turbine, and that routine sound-sensitive activities would not be hindered. However, it is recognized that some individuals are more sensitive to sounds than others, so DOE also compared sound levels at residential areas from the proposed wind turbine with ambient sound conditions in the area. As shown in Table 3-5, predicted sound levels from the wind turbine would be below the sound level recorded 90 percent of the time (L_{90}, which is frequently used as a measure of ambient sound levels) at the monitoring sites nearest to those residential areas. Thus, noise generated by the wind turbine, even at the loudest operating condition, would generally be below ambient sound levels in nearby residential areas and would be inaudible to individuals in those areas, even when outdoors. It can also be seen in Table 3-5 that the predicted wind turbine sound level would be at least 6 decibels lower than the comparable ambient sound level. Because decibels are based on a logarithmic scale, combining sounds with this great a difference adds very little (1 decibel or less) to the higher value (that is, the ambient noise levels). However, DOE recognizes that the monitoring effort to characterize existing sound levels was of limited duration and that different, slightly lower sound levels may occur at times. DOE also recognizes that wind turbine sounds can be relatively constant for long periods, during which ambient sound levels can fluctuate substantially and might drop below those of the wind turbine. Under those conditions, individuals outdoors would be able to hear the wind turbine. Further, some individuals are sensitive to the differences between the constant sound of a wind turbine and fluctuating sounds from other sources, even when the ambient and wind turbine sound levels are similar, and can distinguish wind turbine sounds from other sources. In summary, sounds that would be produced by the wind turbine would meet local standards, generally would be below ambient sound levels in the area, would not adversely affect sound sensitive activities in the nearest residences, and would not adversely affect residents other than, possibly, those most sensitive to the sounds of a wind turbine.

Low-Frequency Sounds

Wind turbines produce a broadband sound; that is, the sound occurs over a wide range of frequencies, including low frequencies. This EA briefly addresses low-frequency sounds because groups and individuals claim that such sounds cause numerous maladies in some people close to operating turbines.

The information on low frequency sounds is not presented in separate "affected environment" and "impacts" topics because it is a side issue with no impacts to the environment, but with recognized opposing viewpoints.

Low-frequency sounds are in the range of 20 to 100 hertz and infrasonic sound (or infrasound) is low-frequency sound of less than 20 hertz. Compared to higher frequency sound, low-frequency sound propagates over longer distances, is transmitted through buildings more readily, and can excite structural vibrations (for example, rattling windows or doors). The threshold of perception, in decibels, also increases as the frequency decreases. For example, in the frequency range where humans hear best (in the low kilohertz), the threshold of hearing is at about 0 decibel, but at a frequency of only 10 hertz, the threshold of hearing is at about 100 decibels (Rogers 2006).

Older designs of wind turbines, particularly those in which the blades were on the downwind side of the turbine tower, produced more low-frequency sound as a result of the blades passing through more turbulent air from the tower blocking wind flow. Modern, upwind turbines produce a broadband sound emission that includes low-frequency sounds, but not at levels that are audible once the receptor is away from the wind turbine. A primary cause for low-frequency sounds in modern turbines is the blade passing through the change in airflow at the front of the tower, which can be aggravated by unusually turbulent wind conditions. The University of Massachusetts at Amherst reported on broadband noise measurements made at four different wind turbines ranging in size from 450 kilowatts to 2 megawatts (Rogers 2006). The results indicated that at distances of no more than 387 feet from the turbines, all infrasound levels were below human perception levels. The proposed wind turbine at the College, at 2.5 megawatts, is larger than those evaluated in the University of Massachusetts study and, as a result, the distance at which all infrasound would be inaudible might extend farther than 387 feet. However, considering the infrasound audibility limit in the study increased from 328 for a 1.3-megawatt turbine to 387 feet for a 2.0-megawatt turbine, infrasound from the 2.5-megawatt turbine would not be expected to be at human perception levels beyond about 450 feet.

The University of Massachusetts at Amherst report further states that there is "no reliable evidence that infrasound below the hearing threshold produces physiological or psychological effects" (Rogers 2006). This lack of effects at levels below the hearing threshold was supported by a scientific advisory panel composed of medical doctors, audiologists, and acoustic professionals established by the American and Canadian Wind Energy Associations to review wind turbine sound and health effects (Colby et al. 2009). It was also supported by the findings from Canadian and Australian government reviews of available scientific literature (CMOH 2010; Australia NHMRC 2010).

Conclusion

DOE recognizes there are sound issues associated with the operation of wind turbines. Modeling and data collected for the Wind Turbine Project indicate expected wind turbine sounds would meet applicable City of Cedar Rapids' standards; generally would be less than ambient conditions; and would not be audible to most individuals. The predicted sound levels would be consistent with the residential and educational uses of the area, achieving EPA's recommendation of DNL levels of 55 dBA or less outdoors. With a normal 15-dBA reduction in sound level between indoors and outdoors (with partially open windows), predicted sound levels would easily be below the recommended level of 45 dBA indoors and even at the closest residences would be at or near an indoor nighttime noise level of about 30 dBA, which is a sound level generally recommended for sleep and consistent with World Health Organization guidelines (WHO 1999). For example, the wind turbine would generate sound levels of about 45 dBA at the closest residences (Table 3-5); with the 15-dBA reduction in sound level going from outdoors to indoors, indoor sounds from the wind turbine would be about 30 dBA. Noise generated from the wind turbine would result in no or minor adverse impacts.

3.3.4 CULTURAL RESOURCES AND HISTORIC PRESERVATION

3.3.4.1 Affected Environment

Regulatory Background

Cultural resources are archaeological sites, historical structures and objects, and traditional cultural properties. Historic properties are cultural resources that are listed in or eligible for listing in the National Register of Historic Places (NRHP) because they are significant and retain integrity (36 CFR 60.4). Section 106 of the *National Historic Preservation Act* (16 U.S.C. 470 *et seq.*) requires that Federal agencies take into account the effects of their actions on historic properties. Section 101(b)(4) of NEPA requires Federal agencies to coordinate and plan their actions to identify any unique historic or cultural characteristics of the geographic area (40 CFR 1508.27) of the proposed Wind Turbine Project and act accordingly. The first step of the process is for an agency to determine whether an action is an undertaking [36 CFR 800.3(a)]. The proposed Wind Turbine Project is an "undertaking" because it is "a project, activity, or program funding in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval" [36 CFR 800.16(y)].

The regulations at 36 CFR Part 800, "Protection of Historic Properties" describe the process for compliance with Section 106, including defining the area of potential effect (APE), steps to identify resources, evaluate effects, and consultation with interested parties including the SHPO and other concerned parties. The regulations state, "If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties are present, the agency official has no further obligations under Section 106, or this part" [36 CFR 800.3(a)(1)]. By definition, an "effect" is an "alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the National Register" [36 CFR 800.16(i)].

The following section describes the existing historic and cultural resource conditions in the area of the proposed Wind Turbine Project site. The APE considered for evaluation of direct impacts to cultural resources during construction of the wind turbine consists of a 250-foot radius around the proposed turbine location and associated access road and buried utility lines (Figure 2-4), which is the area that could be disturbed by construction activities. The APE is a 4.5-acre parcel entirely within previously disturbed and maintained grass fields. In addition, a 1-mile radius APE was considered to evaluate indirect impacts such as visual and noise intrusion on nearby historic properties (Figure 2-2).

According to regulations on the protection of historic properties [36 CFR 800.5(a)(2)(v)], an adverse effect can include "introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features." A project can have adverse visual effects by involving either a negative aesthetic or obstructive effect on historic properties. An obstructive effect is one that diminishes the historic property's integrity by blocking the property from view or by blocking the view from the property.

Status of Consultations

On August 2, 2010, a request was sent to the University of Iowa, Office of the State Archaeologist requesting a site records search within the APEs for direct and indirect effects. That record search indicated that no historic properties or archaeological sites were located within the APE for direct effects. However, the review did indicate the presence of three properties within 1 mile of the turbine site, consisting of two historic farms and a prehistoric scatter (Appendix B). The sites were either ineligible for listing on the NRHP or were not evaluated (Cedar Rapids 2010b). The State Archaeologist recommended

that the Iowa SHPO be contacted for additional input regarding cultural resource management associated with the proposed Wind Turbine Project.

On August 9, 2010, a request for SHPO Comment on the Wind Turbine Project was transmitted to the Iowa SHPO for input regarding archaeological sites within 1 mile of the proposed site. The Iowa SHPO responded by letter dated August 24, 2010 (Appendix B), and provided an opinion that the proposed Wind Turbine Project location was not eligible for inclusion on the NRHP and that no historic properties would be adversely affected by the Wind Turbine Project.

As part of scoping, a letter requesting input on the proposed Wind Turbine Project was sent to the Sac and Fox Tribe of the Mississippi in Iowa located in Tama, Iowa, approximately 50 miles west of the proposed site. To date, no comments have been received from the tribe.

Data Review and Evaluation

DOE conducted a separate review of the Iowa SHPO historic preservation database for the presence of previously identified cultural resources in or near the Wind Turbine Project area. The review identified approximately 40 sites listed on the National Register of Historic Places in the Cedar Rapids vicinity, consisting of historic homes, buildings, bridges, farms, archaeological sites, and historic districts. The review confirmed that none of the NRHP-listed properties are within 1 mile of the proposed Wind Turbine Project site. The majority of the historic properties are located closer to the downtown area of Cedar Rapids, more than 3 miles north of the Wind Turbine Project site.

3.3.4.2 Direct and Indirect Impacts

Construction

Because the site of the proposed Wind Turbine Project is relatively close to Prairie Creek (1.5 miles) and the Cedar River (2 miles), it is likely that American Indians used the area to some extent before the arrival of Europeans. However, the site is a 4.5-acre parcel consisting of previously disturbed, maintained grass fields. Site records indicate the absence of archaeological sites within the direct APE, and the presence of unknown archaeological sites is unlikely. If the College encounters archaeological resources during construction, ground-disturbing activities would immediately cease, and the College would contact the Iowa SHPO for resolution and further instruction regarding additional studies and/or potential avoidance, minimization, or mitigation measures in accordance with the NHPA.

Operations

Once in operation, the proposed Wind Turbine Project would be a vertical visual presence in the community (see visual simulations in Appendix D). The turbine would be visible from multiple locations surrounding the site. Other than possible indirect visual impacts to the two historic farm properties, no other impacts would occur. NRHP-listed historic buildings and other structures in Cedar Rapids are several miles away; therefore, DOE concluded that adverse visual impacts on these properties would be unlikely.

There are other tall structures visible in the area including two communications towers, two water towers, several cellular towers, billboards, and overhead utility towers within a mile of the proposed wind turbine site (H.R. Green 2010). Therefore, the proposed wind turbine would not represent a substantially different visual presence and would not further alter the historic context of or view from any historic properties.

As described in Section 3.3.3.2, sound generated by the turbine would decrease to ambient levels within 1,000 to 2,000 feet of the turbine and generally would not be detectable beyond those distances. Because all historic properties are located farther from the turbine, there would be no adverse auditory impacts to historic properties from the Wind Turbine Project.

Although there are some historic and cultural resources in the vicinity, the operation of the wind turbine would not cause an adverse effect to historic or archaeological resources in the Cedar Rapids area.

3.3.5 BIOLOGICAL RESOURCES

3.3.5.1 Affected Environment

The College is located between the Cedar and Iowa rivers in the eastern tallgrass prairie region of Iowa. The wind turbines would be installed on a maintained grass field. The site is surrounded by other maintained fields, college facilities and parking lots, and small stands of trees. Developed areas of Cedar Rapids are north of the campus. In all other directions, the college is surrounded by cultivated fields and low-density development.

Because the Wind Turbine Project site is in the middle of a college campus and periodically mowed, the only native wildlife commonly found are grassland and urban species. As described in Section 3.3.5.2, habitat loss and other direct impacts to biological resources during construction of the wind turbine and associated infrastructure would be minimal, and this section therefore focuses on birds and bats, which could be harmed during operation of the turbine, and other Federally and State-protected species.

The *Migratory Bird Treaty Act* (16 U.S.C. 703-7012; MBTA) implements four international conventions that provide for international protection of migratory birds. MBTA prohibits taking, killing, possessing, transporting, and importing migratory birds, their eggs, parts and nests, except when specifically authorized by the U.S. Department of the Interior. While MBTA has no provision for allowing unauthorized take, USFWS recognizes that some migratory birds may be harmed or killed during activities such as wind turbine operations even if all reasonable measures to avoid a take have been implemented.

The most abundant bird species along the two breeding bird survey routes conducted closest to the Wind Turbine Project site (Alice and Cedar Valley routes) are the red-winged blackbird (*Agelaius phoeniceus)*, house sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), western meadowlark (*Sturnella neglecta*), dickcissel (*Spiza Americana*), ring-necked pheasant (*Phasianus colchicus*), horned lark (*Eremophila alpestris*), American robin (*Turdus migratorius)*, common grackle (*Quiscalus quiscula*), song sparrow (*Melospiza melodia*), and mourning dove (*Zenaida macroura*) (Sauer et al. 2008). Many of these same species, plus Canada geese (*Branta canadensis*), rock pigeons (*Columbia livia*), dark-eyed juncos (*Junco hyemalis*), American crows (*Corvus brachyrhynchos*), mallards (*Anas platyrhynchos*), and northern cardinals (*Cardinalis cardinalis*) were commonly detected during Christmas bird counts in the Cedar Rapids area (National Audubon Society 2010). The bird surveys were conducted in areas with more agriculture and less urban development than the area surrounding the Wind Turbine Project site, and, therefore, the composition of the avian community within and near the Wind Turbine Project site might be somewhat different.

The Cedar and Iowa rivers are important flyways for birds migrating to and from the prairie pothole region of the north-central United States. The Cedar River is about 2 miles north of the Wind Turbine Project site, and the Iowa River is about 13 miles south of the site. Much of the section of the Iowa River south and southwest of the site has been identified by the Iowa Department of Natural Resources as a Bird Conservation Area (DNR 2010b) and by the National Audubon Society (2010) as an Important Bird Area. The Audubon Society has also identified portions of the Cedar River 12 to 16 miles northwest of the Wind Turbine Project site as Important Bird Areas.

Of the nine bat species that occur in Iowa, the five species that most commonly occur in the Cedar Rapids area are the little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), Eastern red bat

(*Lasiurus borealis*), hoary bat, and silver haired bat (*Lasionycteris noctivagans*). Other bats that might occur in the area include the northern bat (*Myotis septentrionalis*), evening bat (*Nycticeius humeralis*), and tri-colored bat (Perimyotis subflavus). The Indiana bat (*Myotis soladis*), a State- and Federally listed endangered species, is not known to occur in Linn County (DNR 2010c, 2010d, USFWS 2007a, 2007b); however, the USFWS has stated that this species may migrate through the Wind Turbine Project area (Nelson 2010).

There are two Federally-listed threatened or endangered species that occur in Linn County. The western prairie fringed orchid grows in wet prairies and sedge meadows, and the prairie bush clover grows in dry to mesic prairies with gravely soil (USFWS 2007a).

There are 2 amphibians, 2 birds, 8 fish, 7 freshwater mussels, 6 butterflies, 1 mammal, 47 plants, 4 reptiles, and 1 snail classified as endangered, threatened, or of special concern by the State of Iowa that might occur in Linn County (DNR 2010d). None of these species is found in upland maintained grass fields such as the location where the College proposes to install a wind turbine. Of the two bird species, Henslow sparrows (*Ammodramus henslowii*) prefers tall dense prairie grasslands; whereas, bald eagles (*Haliaeetus leucocephalus)* are found near water such as rivers, reservoirs, and lakes and nest in large trees, especially along riparian areas. The nearest habitat for bald eagles is about 2 miles north of the Wind Turbine Project site along the Cedar River.

3.3.5.2 Direct and Indirect Impacts

Preparation of the access road and staging area, construction of the foundation and wind turbine, and installation of the buried electrical cable would disturb up to 2 acres of mowed fields from which native trees and shrubs have been removed. Those areas have limited value for native plants and animals, and construction of the wind turbine and installation of associated infrastructure would, therefore, have negligible impacts on biological resources.

Migratory Birds and Bald Eagles

To minimize harm to birds and bats during operation of the wind turbine, ISEO through the College would ensure the proposed Wind Turbine Project would conform to the applicable site development and turbine design and operation recommendations in the *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003) and to the *Wind Energy and Wildlife Resource Management* recommendations provided by the Iowa DNR (Howell 2010; DNR 2011). For example, the proposed Wind Turbine Project consists of a single wind turbine to be located in an area already disturbed and urbanized; thus, the Wind Turbine Project would not further fragment wildlife habitat in the area. Only 2 acres or less of land would be disturbed and disturbed areas not required for operation of the turbine would be restored to their original conditions after construction was completed. The Wind Turbine Project site is not close to any known bird migration pathways or areas where birds are highly concentrated, areas or features in the landscape known to attract raptors, or important habitat for bats. It is also distant from any “areas of concern for wind farm sitings” identified by the Iowa DNR (DNR 2011). The proposed turbine tower is a monopole; no external features such as ladders or guy wires would be attached to the turbine, and all electrical cables would be buried. Finally, the College would conform to the interim guidelines by using one daytime white and nighttime red flashing hazard light the minimum amount of FAA-required pilot warning and obstruction avoidance lighting.

Nationally, wind turbines are responsible for 0.01to 0.02 percent of all avian fatalities due to human structures, averaging 0 to 3 birds killed per turbine per year (Erickson et al., 2002). Mortality rates at wind turbines in the Midwest, particularly those in open areas such as agricultural areas, are similar, generally averaging 1 to 2 birds killed per turbine per year (Erickson et al., 2002 and 2008). Because the Wind Turbine Project site is over 2 miles from the Cedar River and distant from identified Important Bird Areas

and other areas where large numbers of birds might migrate or congregate, DOE anticipates that a similar small number of birds would be killed as a result of the proposed Wind Turbine Project.

Bald eagles are not anticipated to be affected by the proposed Wind Turbine Project. The nearest habitat for bald eagles is over 2 miles away along the Cedar River.

Bats

The estimated average rate of bat fatalities at wind energy projects in the Midwest is between 0.1 and 8 bats per turbine per year (Arnett et al. 2008). Given the similarity of the proposed Wind Turbine Project site to other Midwest sites with minimal suitable bat habitat, bat fatalities for the Wind Turbine Project are likely to be at the lower end of this range.

Threatened and Endangered Species

There is no habitat within the Wind Turbine Project area for the two Federally-classified threatened plant species that occur in Linn County. DOE, therefore, concluded the proposed Wind Turbine Project would not affect those listed species. The USFWS has concurred with this determination (Nelson 2010).

Linn County is outside of the known summer and winter range of the Indiana bat (DNR 2010b, 2010c). The nearest known hibernacula to the Wind Turbine Project site are in Dubuque County to the northeast, and the nearest summer records are from Iowa County to the southwest (USFWS 2007b). The stands of trees to the east and west of the Wind Turbine Project site are not likely suitable roosting or foraging habitat because they are isolated from larger riparian-forested areas of the type where Indiana bats are typically known to roost and forage. Because the proposed Wind Turbine Project involves a single wind turbine in an area where Indiana bats are not known to occur; where there is no nearby summer roosting habitat, foraging habitat, or hibernacula; and where Indiana bats might only occasionally migrate, DOE concludes that the proposed Wind Turbine Project would not adversely affect this species.

There is no habitat within or near the site of the proposed Wind Turbine Project for any species classified as endangered, threatened, or of special concern by the State of Iowa; therefore, DOE concludes that the proposed Wind Turbine Project would not affect any of those species.

3.3.6 WATER RESOURCES – SURFACE WATER

3.3.6.1 Affected Environment

Surface Drainage

The College Wind Turbine Project site is within the drainage area of the Cedar River and, specifically, within the Lower Cedar Watershed as designated by the EPA and the U.S. Geological Survey (EPA 2010a). From the proposed project site, the Cedar River (at its closest) is about 2 miles to the northeast after it flows through the downtown area of Cedar Rapids. As shown in Figure 3-4, Prairie Creek, a tributary to Cedar River, is slightly closer to the project site, at about 1.5 miles to the north. Cedar River and Prairie Creek are the primary surface waters in the area of the proposed project.

A ridge of high ground runs through the main portion of the college campus such that ground to north, including where the wind turbine would be located, drains toward the north and land to the south drains to the south. The grassy area where the turbine would be sited has a slight downward slope (about 4 percent) to the north. There are small, wooded swales to both the west and the east that include drainage channels carrying runoff northward to where they converge at a small pond located about 700 feet directly north of the proposed wind turbine site. The outlet channel from the small pond flows to the north and west, under Kirkwood Boulevard, under U.S. Highway 30, then north through Prairie Creek Park (Figure 3-4) and

into Prairie Creek. From that point, the creek travels another 1.5 miles to the northeast, where it drains into Cedar River.

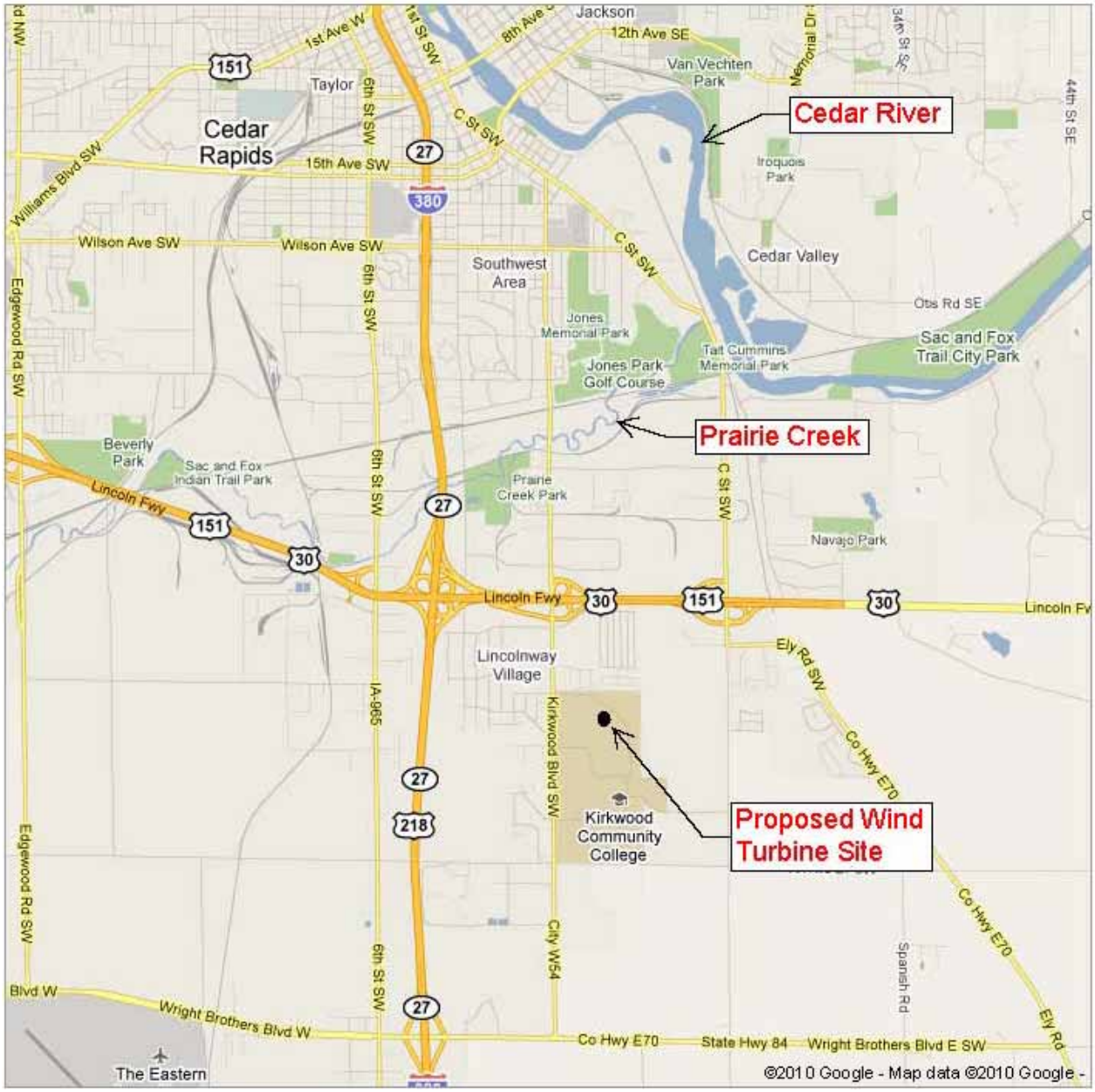

Figure 3-4. Surface Waters in the Vicinity of the Proposed Wind Turbine Site

Water Quality

The Iowa Water Quality Standards [Iowa Administrative Code, Environmental Protection (567), Chapter 61] designate waters of the State for specific uses. All perennial rivers and streams are designated for specific uses in addition to being protected for general use, which includes "livestock and wildlife watering, aquatic life, non-contact recreation, crop irrigation, and industrial, domestic, and other incidental water withdrawal uses." In addition to these general uses, Cedar River in the Wind Turbine Project area is designated as a Class A1 and Class B (WW-1) water (DNR 2010e), where the first designates its use for primary (prolonged and direct) contact recreation and the second for a warm water

habitat suitable for a variety of native fish and invertebrate species, including game fish. Prairie Creek, in the general area where it joins the Cedar River, is designated a Class A1 and Class B (WW-2) water (DNR 2010e). These designations indicate the same uses as the Cedar River except that the Class B (WW-2) indicates the water has limited potential for the maintenance of game fish populations. Specific, in-stream water quality criteria have been established for each of these classifications and the quality of these waters is gauged against the applicable water quality standards.

Section 305(b) of the *Clean Water Act* requires States to develop and periodically update an inventory of the water quality of all water bodies in the state. For each water body or applicable segment of stream, these inventories identify whether the water quality supports the applicable designated uses. Section 303(d) of the *Clean Water Act* requires States to develop and periodically update an inventory of water bodies that do not meet water quality standards. According to the Section 303(d) information reported by the State in 2008, the Cedar River is identified as an impaired water over its entire length in Linn County (DNR 2010f). The impairment over this long segment of the river is a result of water samples showing bacteria levels higher than allowed for primary contact recreational use (that is, per its Class A1 designation). The portion of the Cedar River downstream of U.S. Highway 30 (about 5 miles east of the Wind Turbine Project site) is also identified as an impaired water for not meeting all water quality standards for a warm water fishery [that is, per its Class B(WW-1) designation]. In this case the impairment has been made evident by a decline in mussel species and the potential causes include flow alteration, habitat modification, nutrients, and/or siltation. Other water quality standards applicable to a water with Class A1 and Class B (WW-1) designations are met for the Cedar River in Linn County. The State's Section 303(d) information lists Prairie Creek as having insufficient information to assess whether its designated uses are met (DNR 2010g).

Floodplains and Wetlands

The rivers and creeks in the Cedar Rapids area are occasionally subjected to flooding from periods of unusually high precipitation runoff or snow melts. However, according to the applicable flood insurance rate map published by the Federal Emergency Management Agency, neither the 100-year nor 500-year flood zones extend into the College campus area where the wind turbine would be located (FEMA 2010). The closest flood zone, or floodplain, to the proposed turbine site is about 0.6 mile to the northwest. This flood zone is on the west side of Kirkwood Boulevard and is associated with the same drainage channel that carries runoff from the Wind Turbine Project site to Prairie Creek. This narrow flood zone, centered on contributing drainage channels, extends to the north (downstream) to Prairie Creek, but extends up the channel to the east no farther than Kirkwood Boulevard.

DOE used the "Wetlands Online Mapper" tool available on the USFWS National Wetlands Inventory website (http://www.fws.gov/wetlands/Data/Mapper.html) to identify wetlands that might occur within and near the proposed turbine location. Figure 3-5, which was generated using that tool, shows five distinct wetlands areas of three different types near the proposed wind turbine site. The codes (for example, PUBHh) in the figure provide additional information on the types of wetlands as follows:

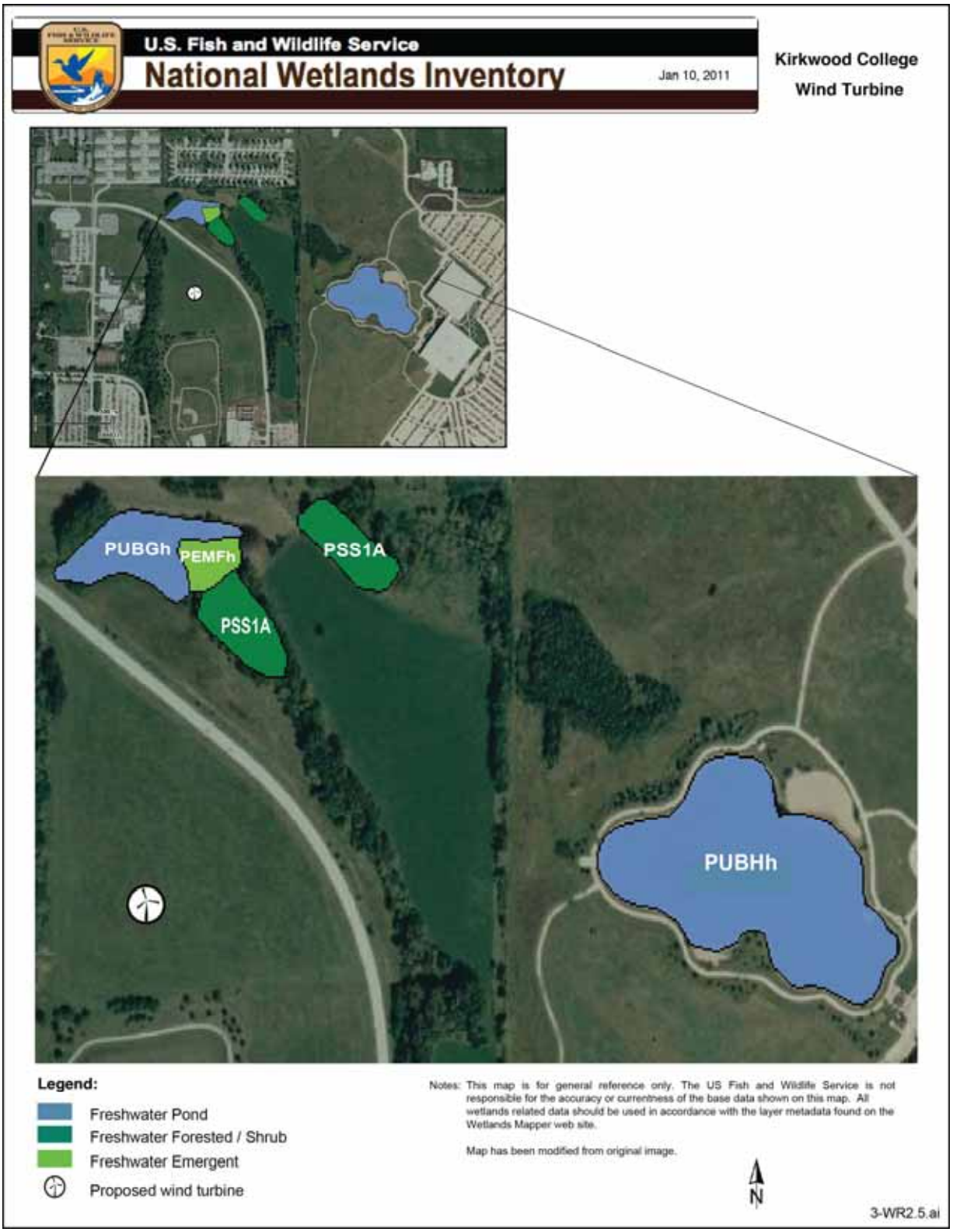

Figure 3-5. Map of Wetlands within the General Area of the Wind Turbine Project

1. Freshwater Emergent – PEMFh – Palustrine wetlands (wetlands that are non-tidal, not part of a large lake, and are characterized by the presence of vegetation) with emergent vegetation and is semi-permanently flooded as a result of being in a diked or impounded area.

2. Freshwater Forested/Shrub – PSS1A – Palustrine wetlands with scrub or shrub vegetation characterized as broad-leaved deciduous and is in a temporarily flooded area.

3. Freshwater Pond

   – PUBHh – Palustrine wetlands pond associated with a permanently flooded area as a result of being diked or impounded and having an unconsolidated bottom.

   – PUBGh – Palustrine wetlands pond with an unconsolidated bottom that is intermittently exposed and is in a diked or impounded area.

Both ponds to the north and east of the turbine location are manmade impoundments. The wetlands area with emergent vegetation is on the edge of the smaller pond and is likely flooded on occasions as a result of the pond increasing in size at times of heavy runoff. The two wetlands areas with trees and shrubs are associated with low spots or runoff channels.

The College also performed a preliminary wetlands identification effort (Appendix F). In addition to the potential wetlands areas identified above, the College identified an area of about 4.5 acres within the wooded area directly to the west of the proposed wind turbine site as wetlands. This wooded area runs along a small stream channel, and in the smaller, upper portion of Figure 3-5, is shown as the dark strip that separates the grassy, open area where the wind turbine would be located from the nearest College buildings farther to the west. The College identified these wetlands with a code of "PEMA," characterizing it as palustrine wetlands with emergent vegetation and subjected to temporary flooding.

3.3.6.2 Direct and Indirect Impacts

Neither construction, operation, nor decommissioning of the wind turbine would involve discharges that could contaminate surface water, and it is anticipated there would be no reduction in surface water quality or availability as a result of the Wind Turbine Project. However, there are issues of potential concern to surface waters that would have to be considered during implementation of the proposed project.

During construction, there would be an increased potential for storm water runoff to carry loosened soil from the site. Because the Wind Turbine Project would involve disturbing more than 1 acre of land (up to 2 acres of land disturbance is estimated), the construction action would have to be covered by a storm water discharge permit (DNR 2007). Per State regulations, the college intends to submit a Notice of Intent to the Iowa Department of Natural Resources prior to starting construction. This Notice would be for storm water discharges under a General Permit No. 2 for construction activities as part of the National Pollutant Discharge Elimination System Program. Under the General Permit, the College would be required to develop and implement a storm water pollution prevention plan for the construction site. This plan would describe the measures to be taken to reduce the pollutants in storm water discharge and the practices to be implemented to control erosion. Fuels and other petroleum products in construction equipment would be present at the site during construction; management of these materials and actions to minimize the potential for any releases would be addressed in the pollution prevention plan. As part of the Notice of Intent, the College would be required to certify that the plan was in place and ready to be implemented. Finally, terms of the General Permit include compliance with effluent standards or prohibitions established under Section 307(a) of the *Clean Water Act* for toxic pollutants and a "Duty to Mitigate" that requires "all reasonable steps to minimize or prevent any discharge in violation of this

permit which has a reasonable likelihood of adversely affecting human health or the environment" (DNR 2007). The nature of the site (mild slope with grassy vegetation) coupled with the permitting and planning requirements for construction activities should minimize the potential for surface water issues during construction.

Runoff from the constructed wind turbine foundation, compacted temporary staging area, and access road could have increased runoff compared to surrounding vegetated areas. However, the affected areas are relatively small and have a shallow slope; thus, the potential for runoff is low. The only hazardous materials to be used during operations are the lubricants in the turbine machinery and possibly other lubricants and cleaning materials required during maintenance. Decommissioning would be very similar to construction, in that fuels and other petroleum productions would be present in equipment and the same precautions would be taken to ensure there were no releases of hazardous materials. Once the wind turbine materials were removed, the area would be recontoured and revegetated, which would minimize storm water runoff.

The wind turbine foundation would be located away from identified wetlands (Figure 3-5) as would the temporary staging area and the access road, both of which would be near the wind turbine location and extend no farther than the existing road to the northeast. However, as shown in Figure 2-4 (Section 2 above), the buried electrical line that would extend northwest from the wind turbine to the existing overhead transmission lines would pass very close to wetlands associated with the small pond. The College obtained a determination from the Rock Island District (Illinois) USACE stating that the wind turbine location did not require a Section 404 (of the *Clean Water Act*) permit for discharge of dredged or fill materials in waters of the United States (including wetlands) (USACE 2010). The determination also addressed the access road, which, at the time, was not identified by a specific location, by stating "If this road will impact wetlands, a permit may be required. If it will not impact wetlands, then no permit will be required." Although the short access road is well removed from wetlands areas, the same requirement would be applicable to the buried electrical line. At the present, the College intends to route the electrical line under the road and under the small creek or drainage channel by using directional drilling. If this approach is used, no impact to wetlands would be expected; the creek is very small and pushing a drill underneath it is not expected to affect its flow. If some other approach were used that involved installation of the electrical line from the top down, then there would likely be some "dredging or filling" of the drainage channel involved, even if minor. This would trigger the need for a Section 404 permit, but the affected area would be so small that it probably could be covered under a nationwide permit.

The proposed Wind Turbine Project, as currently planned by the Kirkland Community College, would have no adverse effects on wetlands. Should plans during construction change such that wetlands could be affected, Kirkland may be required to pursue a permit with USACE. Such a permit would help ensure the potential for adverse impacts to wetlands was minimized and, possibly, would include requirements for affected wetlands areas to be restored or replaced.

3.3.7 HUMAN HEALTH AND SAFETY

3.3.7.1 Affected Environment

Occupational health and safety is concerned with occupational and worker hazards during routine construction and operations. The U.S. Department of Labor, Bureau of Statistics maintains information on workplace injuries, illnesses, and fatalities. These statistics consider the potential for total recordable cases; days away from work, days of restricted work activity or job transfer; and worker fatalities in the work environment. The incidence rates (cases per 100 full-time workers for nonfatality statistics and cases per 100,000 full-time workers for fatality statistics) the Bureau of Labor Statistics maintains are calculated separately for different industries based on the reported health and safety cases for that

particular industry. A full-time worker is assumed to work 2,000 hours per year. The health and safety incident categories are defined as follows:

- Total recordable cases – The total number of work-related deaths, illnesses, or injuries that result in the loss of consciousness, days away from work, restricted work activity or job transfer, or required medical treatment beyond first aid.

- Days away from work, or days of restricted work activity or job transfer – Cases that involve days away from work, or days of restricted activity or job transfer, or both.

- Worker fatality – Cases that involve the death of a worker.

In order to minimize the effect of industrial health and safety hazards, industries must comply with all applicable regulations that relate to industrial health and safety, including Occupational Safety and Health Administration requirements to have a health and safety plan in place before starting work.

3.3.7.2 Direct and Indirect Impacts

To understand the potential risks to workers, DOE used applicable data from the Bureau of Labor Statistics to estimate the number of injuries and fatalities that might occur during the Wind Turbine Project. For construction activities, DOE used the Bureau of Labor Statistics incidence rates from the category "heavy and civil engineering construction" for 2009 as a reasonable approximation for the work associated with constructing a foundation and putting up the tower for the wind turbine. The total recordable cases incidence rate for the year was 3.8 injuries per 100 full-time employees (each working 2,000 hours during the year), and the days away from work, days of restricted work activity or job transfer incidence rate was 2.2 injuries per 100 full-time employees (BLS 2010a). For evaluation purposes, DOE estimates that there would be 20 construction workers at the site at any given time during construction, which would take about 2 months. This is a conservatively high estimate of the labor required to construct the wind turbine. For example, the University of Delaware's Website (http://www.ceoe.udel.edu/Lewes Turbine/index.shtml) provides photographs of its 2-megawatt wind turbine being constructed and installed in a period of about one and one-half months. Assuming nine 40-hour weeks for 20 workers, DOE estimates there would likely be no total recordable cases (calculated at 0.14 case) and no days away from work (calculated at 0.08 day) during construction. Standard best management practices for the construction industry would be implemented to reduce risks to workers. This would include complying with Occupational Safety and Health Agency regulation at 29 CFR Part 1926, "Safety and Health Regulations for Construction."

The fatality incidence rate for private industry construction activities in 2009 (preliminary data) was 9.7 fatalities per 100,000 full-time employees (BLS 2010b). Assuming nine 40-hour weeks for 20 workers, a fatality during construction would be very unlikely because the calculated number of fatalities is about 0.00035 (or conversely, 1 chance in 2,900).

It is estimated that there would be two maintenance events each year and each would involve two workers for two days. That is, each event would require a total of 32 hours of labor, so there would be 64 hours of labor per year. To evaluate worker risks for these activities, DOE used the Bureau of Labor Statistics incidence rates from the category "other services, repair and maintenance" for 2009. The total recordable cases incidence rate was 3.8 injuries per 100 full-time employees, and the days away from work, days of restricted work activity or job transfer incidence rate was 1.8 injuries per 100 full-time employees (BLS 2010a). Assuming a 20-year working life for the wind turbine and 64-hours of labor per year, DOE estimates that there likely would be no total recordable cases (calculated at 0.024 case) and no days away from work (calculated at 0.012 day) during wind turbine operations. Other than the great heights

involved, there would be no unusual or potentially unacceptable hazards or risks to workers, who would be trained to operate under a safety program and procedures, which would account for the working heights involved.

The fatality incidence rate for wind turbine maintenance activities is assumed to fit into the category of "industrial machinery, maintenance and repairs workers, general." The reported fatality incidence rate for this category was 12.1 fatalities per 100,000 full-time employees (BLS 2010b) for 2009. Assuming a 20-year working life for the wind turbine and 64-hours of labor per year, a fatality during wind turbine operation would be very unlikely because the calculated number of fatalities is about 0.00008. There would be increased risks involved in the performance of these maintenance activities "at elevation." This increase, however, would likely increase the incidence rate by a few percentage points, which would still result in very low impact values.

Decommissioning would involve tasks similar to construction. Assuming decommissioning required the same size workforce, lasted for the same duration, and that incidence rates, some 20 years in the future, would be the same as at present, it can be concluded there would likely be no recordable incidents, no days away from work, and no fatalities during decommissioning.

There have been recorded incidents of wind turbines collapsing or throwing blades during operation. Video and photograph records of such events can be found on various Internet web sites (for example YouTube). One cause of such an event would be electrical or mechanical failures that allowed the rotor to gain too much speed during high winds. As would be expected, it is not practical to design either the electronics or the structure of a wind turbine to accommodate every rotor velocity. Accordingly, wind turbines are designed for a maximum rotor speed and include controls and brakes to prevent the maximum speed from being exceeded. Utility-scale wind turbines are now better designed, certified to meet international engineering standards, and, as applicable, include ratings for withstanding hurricane force winds and other criteria.

Here, in addition to safeguards included in the design of the wind turbine, the location of the proposed wind turbine would minimize the potential for public safety issues. The wind turbine would be positioned farther than its full tower height (that is, farther than 262 feet) from the nearest public road, which is the Kirkwood North Loop Road, and only the closest segment of this road to the northeast would be within the distance represented by the tower and an extended blade (that is, within 427 feet). There would no college or other buildings within the larger, 427-foot distance from the proposed wind turbine site. In the highly unlikely event of a catastrophic failure and collapse of the wind turbine, it is very unlikely that any member of the public would be in danger. In addition, the area around the turbine would be fenced and the campus security would regularly patrol the area near the turbine.

Video and photograph records of wind turbine fires can also be found on various Internet websites. The wind turbine nacelle houses powered electronic equipment, so there is both an energy source and some amount of combustible material, thus fires, although very rare, could occur. A unique concern with a wind turbine fire is that there is no effective method of extinguishing the fire from the ground. A response would be limited to maintaining a safe area around the turbine and responding to spot fires that might result from falling sparks or debris (NYSERDA 2005). Wind turbine components are required to undergo applicable certifications by groups such as the International Electrotechnical Commission and the National Fire Protection Association to reduce the potential for any electrical malfunctions, including fires. Further, the separation, or set back, of the wind turbine from any residence or building would minimize the danger to human health or safety should a fire ever occur.

Wind turbine blades also have the potential to accumulate and throw (or shed) ice under specific weather conditions. The stated isolation of the wind turbine would also prevent this phenomenon from being a

hazard to the public. The Clipper Liberty 2.5 MW CW99 and other modern turbines are designed to monitor ice buildup and shut down if buildup is sufficient to slow the turbine's rotation. Thus, ice that accumulates on the blades or other parts of the turbine would fall directly below the turbine into the field and would not be a hazard to the public.

3.3.8 TRANSPORTATION

3.3.8.1 Affected Environment

Primary access into the College area is via Interstate 380, which runs north-to-south through Cedar Rapids, and U.S. Highway 30 (also known as the Lincoln Freeway), which runs east-to-west (Figure 3-6). Both Interstate 380 and Highway 30 are classified as principal arterials by the Iowa Department of Transportation (IDOT 2004) and intersect about 1 mile to the northwest of the College. Roads of this classification are considered high traffic volume corridors that generally serve major centers of activity and urban areas. Other roads of note providing access to the

Figure 3-6. Road Map of Kirkwood Community College Area showing Iowa Department of Transportation Functional Classifications

college campus include Kirkwood Boulevard, running north-to-south on the west side of the college, and 76th Avenue Drive SW, running east-to-west through the southern portion of the campus. Kirkwood Boulevard is classified as a minor arterial and 76th Avenue Drive SW is classified as a collector. The minor arterial classification is for routes connecting to principal arterials and providing access to smaller developed areas. Collectors provide service to important community locations not served by higher-classification roads and that collect traffic from lower-classification roads for channeling to higher-classification roads. Kirkwood North Loop Road, which would provide access from Kirkwood Boulevard to the proposed project site, is classified as a local road.

As noted in Section 3.3.1, the Eastern Iowa Airport is just more than 3 miles southwest of the proposed project site. This is a commercial service airport with two runways, serving about 1 million enplaning and deplaning passengers per year (EIA 2010).

3.3.8.2 Direct and Indirect Impacts

Construction of the wind turbine would involve increased vehicular traffic, including heavy equipment, in the area of the College campus and specifically on Kirkwood Boulevard and Kirkwood North Loop Road. However, with only a single wind turbine involved, construction would be of relatively short duration (about 2 months) and the workforce small (about 20 workers at any given time). Possibly of more concern would be the traffic associated with delivery of the wind turbine components, not because of the volume of traffic but because of the size of the loads. The turbine blades, tower, and other large parts would be transported to the site in several large pieces for onsite assembly. This would be accomplished in several oversized loads, and performed by experienced haulers with appropriate State and local hauling permits. Having the principal arterials Interstate 380 and Highway 30 near the college campus should make it relatively easy to get the oversize loads to the Wind Turbine Project site. Therefore, transportation of the turbine blades and other large components to the project site would be limited to minor and temporary impacts on traffic in the Cedar Rapids area.

Once the wind turbine is constructed, it would present a possible concern to air traffic due to its total height of 427 feet to the tip of a vertical blade. As described in Section 3.3.1.2, the College has already addressed this issue and has received notification from the FAA that the proposed wind turbine would not be a hazard to air navigation (Appendix B).

Decommissioning of the wind turbine would require equipment similar to that present during construction and would be expected to result in similar minor and temporary transportation impacts. Depending on the condition of the removed wind turbine components, there could be actions taken at the site to cut up items to make them easier to remove from the area, which would even further reduce the minor potential for transportation concerns.

3.3.9 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Executive Order 12898 (February 11, 1994) directs Federal agencies to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." In 2009, the aggregate percent of all racial minorities (Black, American Indian or Alaskan Native, Asian, Native Hawaiian or other Native Islander, or persons of two or more races) was 10 percent in Linn County (USCB 2010a) and about 10 percent in Iowa (USCB 2010a). Persons of Hispanic or Latino origin made up about 2.5 percent of the population in Linn County (USCB 2010b), and about 4.5 percent of the population in Iowa (USCB 2010a). The proposed Wind Turbine Project site is in Cedar Rapids and had a 2006 population that was 92-percent white. About 3.0 percent of the Cedar Rapids population is of Hispanic or Latino origin (USCB 2010c). Hispanics may be of any race, so are included in applicable race categories. Neither racial

minority nor ethnic minority persons would experience adverse socioeconomic impacts from the proposed Wind Turbine Project.

Direct and Indirect Impacts

No potential for adverse impacts to human health or environmental effects have been identified as part of the proposed project. Therefore, there would be no disproportionately high and adverse socioeconomics- or environmental justice-related impacts on minority populations and low-income populations.

The construction of the proposed Wind Turbine Project is expected to generate a short-term and small increase in employment due to temporary construction related jobs for the wind turbine. A local engineering firm would be responsible for the design work, specification, and supervision work. The College would solicit bids for the turbine, including from a turbine vendor based in Cedar Rapids. The College would use its existing personnel and might hire a small number of contractors for the foundation and installation work. The equipment vendor would perform final checks and bring the turbine into operation. Therefore, new permanent direct or indirect jobs would be unlikely.

Operation of the wind turbine would be unlikely to create direct jobs, but it could help to preserve jobs or community resources.

3.3.10 AIR QUALITY

3.3.10.1 Affected Environment

The affected air environment can be characterized in terms of concentrations of the criteria pollutants carbon monoxide, sulfur dioxide, particulate matter, nitrogen dioxide, ozone, and lead. The EPA has established National Ambient Air Quality Standards for these pollutants. There are two standards for particulate matter: one for particulates with an aerodynamic diameter less than or equal to a nominal 10 micrometers and one for particulates with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers. According to the EPA's online air quality maps and monitoring data (http://epa.gov/oar/data/) Linn County is in attainment for all pollutants listed above.

The EPA has found that the "aggregate group of the well-mixed greenhouse gases (GHG)" constitutes an air pollutant that contributes to climate change. Carbon dioxide is a GHG, and the College Wind Turbine Project would have an indirect impact on reducing carbon dioxide emissions from fossil fuel sources.

Electricity for the College is currently supplied by the Alliant Energy Corporation. Fuel sources for Alliant Energy's power plants include coal (61 percent), natural gas (31 percent), oil (6.3 percent), wind (1.2 percent), and hydro (0.6 percent) (Alliant 2009). Therefore, the College's primary source of electricity currently is fossil fuels.

3.3.10.2 Direct and Indirect Impacts

The proposed Wind Turbine Project would be an emissions-free energy generation project that would not degrade air quality. Aside from temporary dust generated during construction and decommissioning, which would be minimized to the extent practicable (for example, by keeping gravel on roads and watering dry unpaved roads), this Wind Turbine Project would not result in any adverse impacts to air quality. The proposed project would not require any air permits.

Carbon dioxide is a GHG that contributes to climate change, which in turn causes harm to many physical and biological systems. The proposed Wind Turbine Project would reduce the College's carbon footprint by reducing reliance on fossil fuels. It is assumed if this wind energy project was not built, the College

would continue to receive the vast majority of the electricity it uses from fossil-fuel sources. At an estimated 30-percent capacity factor, the annual energy capture associated with the installation of a 2.5-megawatt wind turbine would be approximately 6,570 megawatt-hours per year. For the Iowa area and its predominant use of fossil-fuel in the generation of electricity, it has been calculated that about 1,822 pounds of carbon dioxide is emitted to the atmosphere for each megawatt-hour of electricity produced (EPA 2010b). Considering these figures, the proposed Wind Turbine Project would reduce the reliance on fossil fuel generated electricity and reduce the College's carbon footprint by about 11,970,000 pounds, or almost 6,000 tons of carbon dioxide per year.

3.3.11 INFRASTRUCTURE AND ENERGY

Discussions in this section are limited to the electrical energy associated with the College Wind Turbine Project. The Wind Turbine Project would not impact other utilities or utility services of the community. Water would be required during construction for activities such as soil compaction and dust suppression; however, this would not be expected to impact water supplies or the water distribution system. The Wind Turbine Project would not involve routine production of sanitary sewage or other wastewater, and other than the waste debris generated during construction (which would go to the local landfill), there would be no routine production of solid waste. Fabrication of the wind turbine components would involve the unavoidable commitment of various materials, but these materials represent a small fraction of those available in the world marketplace.

3.3.11.1 Affected Environment

Electricity at the College and the proposed Wind Turbine Project site is provided by Alliant Energy Corporation through its subsidiary Interstate Power and Light (IUB 2010). Alliant Energy provides electricity to more than 1 million customers in its three-state (Iowa, Minnesota, and Wisconsin) utility service area (Alliant 2010a). It operates 30 power plants across the upper Midwest with a total output capacity of over 5,000 megawatts (Alliant 2010b) and reports selling 32.9 million megawatt-hours of electricity in 2007 (Alliant 2010c). Assuming the electricity sold in 2007 was used evenly throughout the 8,760 hours in a year, this represents an average electrical load of about 3,760 megawatts, and Alliant Energy reported a peak electrical load of 5,750 megawatts (Alliant 2010c).

Alliant Energy's electricity generating capacity relies on several different energy sources, but the predominant sources are coal, providing 61 percent of the capacity, and natural gas, at 31 percent of the capacity. The remaining generating capacity includes 6.3 percent from oil, 1.2 percent from wind, and 0.6 percent from hydro (Alliant 2009).

At the state level, State of Iowa's capacity for generating electricity is 1.4 percent of the nation's capacity, with a summer production capacity of 14,580 megawatts (DOE 2010). Actual electricity production in August of 2010 was 5.35 million megawatt-hours (DOE 2010). Assuming this was produced evenly over a 24-hour day for 31 days in the month, this equates to an average production rate of about 7,190 megawatts. Peak production during the month was likely much higher than the 7,190-megawatt average.

3.3.11.2 Direct and Indirect Impacts

The proposed Wind Turbine Project would involve a peak electrical power production capability of 2.5 megawatts. Portions of this power not used by the College would be sent to the electrical grid. The wind turbine itself has minor electrical demands, such as the motors to control the pitch of the blades and to keep the face of the turbine into the wind. Over time, these electrical demands would be very small in comparison with the power production, and the power production would be a very small component of

the loads at the regional and state levels. The Wind Turbine Project would have a very minor positive impact on the electricity generating capacity of the region.

3.4 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments of resources are actions of a proposed Wind Turbine Project that would result in the loss of resources, whether those are natural or cultural, that consequently could not be recovered or replaced promptly in the original or current condition. The proposed project would result in no irreversible or irretrievable commitments of resources during the construction of operational phase. The proposed Wind Turbine Project property has been previously developed and environmental resources have already been impacted. Reuse of the property for the Wind Turbine Project would result in a temporary, but not irreversible use of that property for other projects. The amount of new construction materials required for the proposed project would be minimal relative to the availability of those materials or the raw materials could be replenished. There would be a negligible irretrievable commitment of manufacturing resources. Long-term or permanent use of other resources, such as landfill space or the use of transportation corridors would be negligible. Minimal consumption of raw materials or resources would be required for operation.

The expenditure of Recovery Act funding from DOE would also be irreversible.

3.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts associated with the proposed Wind Turbine Project include:

- Long-term loss of approximately 165 square feet of vegetation resulting from the construction of the tower foundation;
- Death or injury of about one to three, and possibly more, birds and bats per year struck or otherwise harmed by the spinning turbine blades;
- A minimal increase in noise during construction;
- Introduction of an additional vertical element into the existing viewshed;
- Minimal shadow flicker impacts for local residences and roadways; and
- A risk of tower collapse within 427 feet of the turbine tower.

The impacts from construction noise would be temporary; whereas, the other unavoidable adverse impacts could occur throughout the operational life of the wind turbine. Overall, impacts of the proposed Wind Turbine Project on the environment and human health would be minimal.

3.6 The Relationship Between Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Short-term use of the environment, as the term is used in this document, is that used during the life of the Wind Turbine Project, whereas long-term productivity refers to the period of time after the Wind Turbine Project has been decommissioned, the equipment removed, and the land reclaimed and stabilized. The short-term use of the Wind Turbine Project area for the proposed project would not affect the long-term productivity of the area. When operation of the turbine was no longer practicable, the turbine, tower, and foundation would be removed and the site reclaimed and revegetated to resemble the pre-disturbance conditions (vacant grassy field), and the site would be available for other uses.

4. CUMULATIVE IMPACTS

4.1 Introduction

The Council on Environmental Quality regulations stipulate that the cumulative impacts analysis within an EA consider whether the potential environmental impacts resulting from the "incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). Because the impacts of the proposed Wind Turbine Project generally would be minor and localized, DOE focused its evaluation of cumulative impacts of the proposed Wind Turbine Project and reasonably foreseeable future actions within the City of Cedar Rapids.

4.2 Reasonably Foreseeable Actions

The Cedar River Flood Risk Management Project is the largest project in the area that would be contemporaneous with the College Wind Turbine Project. The project is expected to cost just under $100 million (2010 dollars) and will primarily affect the area along the Cedar River with the exception of borrowing activities near the airport, which is approximately 3.3 miles from the Wind Turbine Project site. Other projects that will be contemporaneous are numerous road improvement projects for Cedar Rapids. No other wind power projects of similar size were identified in the area. However, Iowa has an ongoing wind farm initiative that includes approximately 35 wind farms statewide. The nearest wind farms are approximately 70 miles north of the Wind Turbine Project in Bremer County or 80 miles west in Marshall County.

4.3 Summary of Cumulative Impacts

4.3.1 CUMULATIVE GREENHOUSE GAS IMPACTS

While the scientific understanding of climate change continues to evolve, the Intergovernmental Panel on Climate Change Fourth Assessment Report has stated that warming of the earth's climate is unequivocal, and that warming is very likely attributable to increases in atmospheric GHGs caused by human activities (anthropogenic) (IPCC 2007). The Panel's Fourth Assessment Report indicates that changes in many physical and biological systems, such as increases in global temperatures, more frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental impacts are linked to changes in the climate system, and that some changes may be irreversible (IPCC 2007).

The release of anthropogenic GHGs and their potential contribution to global warming are inherently cumulative phenomena. It is assumed that the proposed Wind Turbine Project would displace fossil fuel electricity currently used by the College, resulting in a net decrease in emissions of approximately 6,000 tons of carbon dioxide equivalents for each year of operation. The proposed Wind Turbine Project in combination with the above-listed Wind Turbine Projects and plans for additional turbines in Iowa by 2025 would neither measurably reduce the concentration of GHGs in the atmosphere nor reduce the annual rate of GHG emissions. Rather, they would marginally decrease the rate at which GHG emissions are increasing every year and contribute to efforts ongoing globally to reduce GHGs and slow climate change.

4.3.2 VISUAL RESOURCES

The proposed Wind Turbine Project would affect the viewshed in the Wind Turbine Project area. The wind turbine would be a dominant vertical component in the landscape due to its height. Although there are several wind projects in the region surrounding the Wind Turbine Project, none of them are located within the likely viewshed of the proposed Wind Turbine Project. The closest communications towers are on the College campus and stand approximately 400 feet tall. These communications towers would partially be in the viewshed of the proposed Wind Turbine Project and therefore, there would be a small cumulative visual impact.

4.3.3 BIOLOGICAL RESOURCES

Operation of the single wind turbine would result in a very small incremental increase in the number of birds and bats killed by wind turbines in Iowa and the surrounding region. Because existing wind energy projects in Iowa are scattered throughout the State (DNR 2011) the Wind Turbine Project, in combination with these other wind energy projects, would not result in a concentration of bird or bat mortalities in the Linn County area.

4.3.4 NOISE

The reasonable foreseeable actions do not include any that are expected to change the local ambient noise patterns, which are partially driven by traffic. The noise impact from the wind turbine is expected to be small compared with the existing ambient noise (see Section 3.3.3.2 of this EA).

5. REFERENCES

Alliant (Alliant Energy Corporation) 2009. "Form 10-K, Annual Report Pursuant to Section 13 or 15 (d) of the Securities Exchange Act of 1934 for the fiscal year ended December 31, 2009." Submitted to the United States Securities and Exchange Commission by the Alliant Energy Corporation. Available online at: http://phx.corporate-ir.net/phoenix.zhtml?c=71431&p=irol-irhome (accessed December 14, 2010)

Alliant (Alliant Energy Corporation) 2010a. "Utility Service Territory." Available online at: http://www.alliantenergy/UtilityServices/UtilityRatesFacts/012545 (accessed December 2, 2010).

Alliant (Alliant Energy Corporation) 2010b. "Electric Power Generation." Available online at: http://www.alliantenergy/UtilityServices/UtilityRatesFacts/014819 (accessed December 2, 2010).

Alliant (Alliant Energy Corporation) 2010c. "Utilities at a Glance." Available online at: http://www.alliantenergy/UtilityServices/UtilityRatesFacts/014818 (accessed December 2, 2010).

Arnett, E.B.; Brown, W.K.; Erickson, W.P.; Fiedler, J.K.; Hamilton, B.L.; Hentry, T.H.; Jain, A.; Johnson, G.D.; Kerns, J.; Koford, R.R.; Nicholson, C.P.; O'Connell, T.J.; Piorkowski, M.D.; and Tankersley, R.D., Jr. 2008. "Patterns of bat fatalities at wind energy facilities in North America." *Journal of Wildlife Management* 72:61-78.

Australia NHMRC (Australia National Health and Medical Research Council) 2010. *Wind Turbines and Health – A Rapid Review of the Evidence, July 2010*. Available online at: http://www.nhmrc.gov.au/publications/synopses/new0048.htm (accessed on September 8, 2010).

BLM (Bureau of Land Management) 2005a. "Chapter 4. Affected Environment." *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States*. FES -5-11. June. U.S. Department of the Interior, Bureau of Land Management. Available online at http://windeis.anl.gov/documents/fpeis/maintext/Vol1/Vol1Ch4.pdf (accessed April 11, 2011).

BLM (Bureau of Land Management) 2005b. "Chapter 5. Potential Impacts of Wind Energy Development and Analysis of Mitigation Measures." *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States*. FES -5-11. June. U.S. Department of the Interior, Bureau of Land Management. Available online at http://windeis.anl.gov/documents/fpeis/maintext/Vol1/Vol1Ch5.pdf (accessed April 11, 2011).

BLS (Bureau of Labor Statistics) 2010a. "Table 1. Incidence rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2009." Available online at: http://www.bls.gov/iif/oshcfoil.htm (accessed December 1, 2010).

BLS (Bureau of Labor Statistics) 2010b. "Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries by civilian workers by selected worker characteristics, occupations, and industries, 2009." Available online at: http://www.bls.gov/iif/oshcfoil.htm (accessed December 1, 2010).

Cedar Rapids 1999. *Comprehensive Plan for Cedar Rapids, City of Five Seasons*. Adopted May 19. Available online at: http://www.cedar-rapids.org/government/departments/community-development/city_planning/Pages/default.aspx (accessed December 1, 2010).

Cedar Rapids 2010a. "Water Quality Report" (for calendar year 2009). Available online at: http://www.cedar-rapids.org/resident-resources/utilities/Pages/default.aspx (accessed December 27, 2010).

Cedar Rapids 2010b. P*hase IA Archaeological Assessment of the City of Cedar Rapids Emergency 911 Joint Communication Network Underground Telecommunications Network, Linn County, Iowa, Volume I: Text and Non-Confidential Appendices*. June. Available online at: http://www.cedar-rapids.org/government/departments/purchasing/Documents/2010/4th%20Quarter%20(10,11,12)/1010-078%20Archeological%20Services%20for%20JCN%20Project/1010-078%20attachment%20b.pdf (accessed January 18, 2011).

Cedar Rapids 2011. "Minutes of the City Council, City of Cedar Rapids, Iowa – February 22, 3011." http://www.cedar-rapids.org/city-council/citycouncilmeetings/AgendaPacketsMinutes/Pages/default.aspx (accessed March 3, 2011).

Clipper (Clipper Windpower, Inc.) 2010. "Facts & Specifications, Liberty 2.5 MW Wind Turbine." Company brochure.

CMOH (Ontario Chief Medical Officer of Health) 2010. *The Potential Health Impact of Wind Turbines*. Chief Medical Officer of Health Report, May. Available online at: http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.aspx (accessed on September 8, 2010).

Colby, W.D.; Dobie, R.; Leventhall, G.; Lipscomb, D.M.; McCunney, R.J.; Seilo, M.T.; and Søndergaard, B. 2009. *Wind Turbine Sound and Health Effects: An Expert Panel Review*. Prepared for American Wind Energy Association and Canadian Wind Energy Association. Available online at: http://www.awea.org/documents/AWEA_CanWEA_SoundWhitePaper_ExecSumm.pdf

DNR (Iowa Department of Natural Resources) 2007. "National Pollutant Discharge Elimination System (NPDES) General Permit No. 2, Effective Dates October 1, 2007 through October 1, 2012 for Storm Water Discharge Associated with Construction Activities." Available online at: http://www.iowadnr.gov/water/stormwater/forms.html (accessed December 14, 2010).

DNR (Iowa Department of Natural Resources) 2010a. "UBC Seismic Zones in Iowa." Iowa Geological & Water Survey, the Iowa Department of Natural Resources. Available online at: http://www.igsb.uiowa.edu/service/ubc_map.htm (accessed October 21, 2010).

DNR (Iowa Department of Natural Resources) 2010b. "Iowa Bird Conservation Area Program." Available online at: http://www.iowadnr.gov/wildlife/files/BCA_index.html (accessed January 7, 2011).

DNR (Iowa Department of Natural Resources) 2010c. "Iowa DNR Interactive Mapping Natural Areas Inventory. Linn County, IA Summary by Species Report." Available online at: https://programs.iowadnr.gov/naturalareasinventory/pages/Query.aspx (accessed January 9, 2011).

DNR (Iowa Department of Natural Resources) 2010d. "Living on the Edge: Endangered Species in Iowa Indian bat (*Myotis sodalis*)." Available online at: http://www.iowaagriculture.gov/livingOnTheEdge/IndianaBat.asp (accesses January 9, 2011).

DNR (Iowa Department of Natural Resources) 2010e. "Iowa DNR Water Quality Standards, Use Assessment and Attainability Analysis, Site 60-1 (Recreation) Prairie Creek." Available online from: http://www.iowadnr.gov/water/uaa.html (accessed December 8, 2010).

DNR (Iowa Department of Natural Resources) 2010f. "Watershed Monitoring and Assessment, Iowa Section 303(d) Impaired Waters Listings – Final, EPA-approved 2008 303(d) list of impaired waters (Category 5)." Available online at: http://www.igsb.uiowa.edu/wqm/ImpairedWaters/Year2008/Final2008Category5.pdf (accessed April 11, 2011).

DNR (Iowa Department of Natural Resources) 2010g. "Watershed Monitoring and Assessment, Iowa Section 303(d) Impaired Waters Listings – Final 2008 Category 3a; insufficient information to assess any use." Available online at: http://www.igsb.uiowa.edu/wqm/ImpairedWaters/Year2008/Final2008Category3a.pdf (accessed April 11, 2011).

DNR (Iowa Department of Natural Resources) 2011. Wind Energy and Wildlife Resource Management in Iowa: Avoiding Potential Conflicts. Iowa Department of Natural Resources, Des Moines, Iowa. Available online at: http://www.iowadnr.gov/wildlife/diversity/windwildlife.html (accessed January 19, 2011).

DOE (U.S. Department of Energy) 2006. Memorandum. Office of NEPA Policy and Compliance. Need to Consider Intentional Destruction Acts in NEPA Documents. December 1.

DOE (U.S. Department of Energy) 2010. "Iowa – State Energy Profile." Energy Information Administration. Available online at: http://www.eia.gov/state/state_energy_profiles.cfm?sid=IA (accessed December 2, 2010).

DWIA (Danish Wind Industry Association) 2003. "Shadow Casting from Wind Turbines." Available online at: http://guidedtour.windpower.org/en/tour/env/shadow/index.htm (accessed March 19, 2010).

EIA (Eastern Iowa Airport) 2010. "The Eastern Iowa Airport, Cedar Rapids – Annual Passenger Statistics." Available online at: http://www.eiairport.org/about/statistics.shtml (accessed December 23, 2010).

EMD (EMD International A/S) 2010. "WindPro Version 2.7, Service Pack 3." Denmark.

EPA (U.S. Environmental Protection Agency) 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. 550-/9-74-004, March 1974. U.S. Environmental Protection Agency, Office of Noise Abatement and Control.

EPA (U.S. Environmental Protection Agency) 1977. *Toward a National Strategy for Noise Control*. U.S. Environmental Protection Agency, Office of Noise Abatement and Control.

EPA (U.S. Environmental Protection Agency) 2010a. "Surf Your Watershed – Lower Cedar Watershed – 07080206." Available online at: http://cfpub.epa.gov/surf/huc.cfm?huc_code=07080206 (accessed October 25, 2010).

EPA (U.S. Environmental Protection Agency) 2010b. "Clean Energy – How Does the Electricity I Use Compare to the National Average?" Available online at: http://oaspub.epa.gov/powpro/ept_pack.charts (accessed December 26, 2010).

Epilepsy Foundation (American Epilepsy Foundation) 2010. "Photosensitivity and Epilepsy, Photosensitivity and Seizures." Available online at: http://www.epilepsyfoundation.org/about/photosensitivity (accessed March 20, 2010).

Erickson, W.G.; Strickland, D.; Young, D.; and Johnson, G. 2008. "A Summary of Avian and Bat Fatality at Wind Facilities in the U.S." In *Proceedings of the NWCC Wind Wildlife Research Meeting VII. Milwaukee, WI*. October 28-29, 2008, pp 14-18. Available online at: http://www.nationalwind.org/assets/research_meetings/Research_Meeting_VII_Proceedings.pdf (accessed April 14, 2011).

Erickson, W.; Johnson, G.; Young, D.; Strickland, D.; Good, R.; Bourassa, M.; Bay, K.; and Sernka, K. 2002. *Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments*. Prepared for Bonneville Power Administration. WEST, Inc. Cheyenne, Wyoming. Available online at: http://www.bpa.gov/power/pgc/wind/avian_and_bat_study_12-2002.pdf (accessed April 14, 2011).

FAA (Federal Aviation Administration) 2007. "Obstruction Marking and Lighting," Advisory Circular, AC 70/7460-1K, Change 2. U.S. Department of Transportation.. Available online at: http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/b993dcdfc37fcdc486257251005c4e21 (accessed February 17, 2011)

FEMA (U.S. Federal Emergency Management Agency) 2010. "FIRM – Flood Insurance Rate Map – Linn County, Iowa and Incorporated Areas, Panel 420 of 625." Map Number 19113C0420D, Effective Date: April 5, 2010. Available online at http://www.cedar-rapids.org/government/departments/public-works/engineering/Flood%20Protection%20Information/Pages/FEMAFIRM.aspx (accessed December 9, 2010).

GE (General Electric Energy) 2009. *Commercial Documentation Wind Turbine Generator Systems GE 2.5xl – 60 Hz, Product Acoustic Specifications*. Canada-specific, normal operation, according to IEC 61400-11.

Harding, G.; Harding, P.; and Wilkins, A. 2008. "Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them." *Epilepsia*, 49(6): 1095-1098.

Howell, D. 2010. Letter from D. Howell of Iowa Department of Natural Resources to T. McCaslin of Howard R. Green Company. July 16.

H.R. Green (Howard R. Green Company) 2010. *Visual Impact Assessment Kirkwood Wind Energy Facility*. July 2010, Howard R. Green Company, Cedar Rapids, Iowa.

HUD (U.S. Department of Housing and Urban Development) 2009. *The Noise Guidebook, A Reference Document for Implementing the Department of Housing and Urban Development's Noise Policy*. Prepared by the Environmental Planning Division, Office of Environment and Energy. Available

online at: http://www.hud.gov/offices/cpd/environment/training/guidebooks/noise/ (accessed November 1, 2010).

IDOT (Iowa Department of Transportation) 2004. "Federal Function Classification System: The Urban Area of Cedar Rapids, Iowa." Prepared by Iowa Department of Transportation, in Cooperation with the U.S. Department of Transportation, December 31, 1992, Revised 09-10-04. Available online at: http://www.iowadot.gov/systems_planning/fedfuncclass.html (accessed December 23, 2010).

IPCC (Intergovernmental Panel on Climate Change) 2007. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp. Available online at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm (accessed April 12, 2010).

IUB (Iowa Utilities Board) 2010. "Town Provider List." Available online at: http://www.state.ia.us/government/com/util/consumer_information/index.html (accessed December 2, 2010).

KCC (Kirkwood Community College) 2011. "Student Housing." http://www.kirkwood.edu/housing (accessed February 14, 2011).

Kunz, T.H.; Arnett, E.B.; Cooper, B.M.; Erickson, W.P.; Larkin, R.P.; Mabef, T.; Morrison, M.I.; Strickland, M.D.; and Szewczak, J.M. 2007. "Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document." *Journal of Wildlife Management* 71:2449-2486. Available online at: http://www.batsandwind.org/pdf/jwm_m&m.pdf (accessed April 14, 2011).

McCaslin, T. 2010. "24-Hour Ambient Noise Results." Email (with attachments) from T. McCaslin of H.R. Green Company to K. Davis of Jason Associates Corporation. December 17.

National Audubon Society 2002. "The Christmas Bird Count Historical Results." Available online at: http://birds.audubon.org/historical-results (accessed January 8, 2011).

National Audubon Society 2010. "Iowa Important Bird Areas." Available online at: http://iba.audubon.org/iba/stateIndex.do?state=US-IA (accessed January 8, 2011).

National Research Council 2007. *Environmental Impacts of Wind-Energy Projects (Summary)*. National Academy Press, Washington, D.C. Available online at: http://www.nap.edu/catalog.php?record_id=11935 (accessed April 14, 2011).

Nelson, R.C. 2010. Letter from R.C. Nelson (U.S. Fish and Wildlife Service) to T. McCaslin (Howard R. Green Company), August 24, 2010.

NWCC (National Wind Coordinating Committee) 2006. *Proceedings of the NWCC Siting Technical Meeting. Washington, D.C. December 1-2, 2005*. Prepared by Susan Savitt Schwartz, ed. March 2006. Meeting planned by the NWCC Siting Workgroup. Meeting facilitated by National Wind Coordinating Committee Staff c/o RESOLVE, Inc., Washington D.C.

NYSERDA (New York State Energy Research and Development Authority) 2005. "Power Naturally – Public Health and Safety." October. Report prepared by Global Energy Concepts for NYSERDA. Available online at: http://www.powernaturally.org/programs/wind/toolkit/18_publichealthandsafety.pdf (accessed February 17, 2011).

Quade, D.J.; Bettis, A.E. III; Ludvigson, G.A.; Giglierano, J.D.; and Slaughter, M.K. 1998. *Surficial Geologic Materials of Linn County, Iowa*. Geological Survey Bureau Open File Map Series 98-2. Energy and Geological Resources Division, Geological Survey Bureau, Iowa Department of Natural Resources.

Rogers, A.L., Ph.D. 2006. "Wind Turbine Noise, Infrasound and Noise Perception" Renewable Energy Research Laboratory, University of Massachusetts at Amherst. January 18. Available online at: http://www.windpoweringamerica.gov/ne_issues_sound.asp (accessed August 24, 2010).

Sauer, J.R.; Hines, J.E.; and Fallon, J. 2008. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2007*. Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, Maryland. Available online at: http://www.mbr-pwrc.usgs.gov/bbs/bbs2007.html (accessed April 14, 2011).

USACE (U.S. Army Corps of Engineers) 2010. Letter, dated July 14, 2010, Subject: CEMVR-OD-P-2010-816 from the Department of the Army, Rock Island District, Corps of Engineers to the HR Green Company *(on behalf of the Kirkwood Community College)*.

USCB (Bureau of the Census) 2010a. "State and County QuickFacts, Iowa and Linn County, Iowa." U.S. Department of Commerce, Washington, D.C. April 2010. Available online at: http://quickfacts.census.gov/ (accessed November 9, 2010).

USCB (Bureau of the Census) 2010b. "American FactFinder, Fact Sheet, Cedar Rapids, Linn County, Iowa." U.S. Department of Commerce, Washington, D.C. Available online at: http://factfinder.census.gov/ (accessed November 5, 2010).

USCB (Bureau of the Census) 2010c. "Population Finder, City Rapids city, Linn County, Iowa." U.S. Department of Commerce, Washington, D.C. Available online at: http://factfinder.census.gov/ (accessed November 5, 2010).

USFWS (U.S. Fish and Wildlife Service) 2003. "Service Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines." Letter to Regional Directors dated May 13, 2003. Washington, D.C. Available online at: http://www.fws.gov/habitatconservation/wind.pdf (accessed December 15, 2010).

USFWS (U.S. Fish and Wildlife Service) 2007a. *Iowa List of Federally Endangered, Threatened, Proposed, and Candidate Species by County*. U.S. Fish and Wildlife Service, Moline, Illinois. Available online at: http://www.fws.gov/midwest/endangered/lists/pdf/iowa11cty.pdf (accessed April 14, 2011).

USFWS (U.S. Fish and Wildlife Service) 2007b. *Indiana Bat* (Myotis sodalis) *Draft Recovery Plan: First Revision*. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

USGS (U.S. Geological Survey) 2010. "2008 United States National Seismic Hazard Maps, Revision III, January 2010." USGS Earthquake Hazards Program. Available online at: http://earthquake.usgs.gov/hazards/products/conterminous/2008/ (accessed October 25, 2010).

WHO (World Health Organization) 1999. *Guidelines for Community Noise.* Edited by Birgitta Berglund, Thomas Lindvall, and Dietrich H. Schwela. World Health Organization, Geneva. Available online at: http://www.wind-watch.org/documents/guidelines-for-community-noise/ (accessed April 14, 2011).