Winter 2009

Whatcom wind energy ordinance

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WESTERN WASHINGTON UNIVERSITY

Whatcom Wind Energy Ordinance

Environmental Impact Assessment

Huxley College of the Environment

Winter 2009

DIGITAL RELEASE

Environmental Impact Assessment
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Kurt Niemeyer

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Date 1/28/09

DEAR CITIZENS LETTER

Dear concerned citizen:

This environmental impact assessment (EIA) analyzes the probable impacts of Whatcom counties' ordinance 2008-043. This document is formatted to comply with the State Environmental Policy Act (SEPA), and adheres to the rules issued in Washington Administrative Code (WAC) 197-11-010-968. A team of students prepared this document as an exercise for Environmental science 436 under the supervision of Dr. Leo Bodenstiener. An EIA is an academic version of SEPA's Environmental Impact Statement, but is not to be used as an official document.

Ordinance 2008-043 proposes allowing small scale WESs to be installed without additional permitting. The proposal details the maximum tower height, energy production, noise, and sighting of SWESs that would be buildable without a specific permit. The intent of our study is to identify potential environmental impacts associated with the ordinance. In doing so, we have developed an alternative to the ordinance that could achieve the goals of the ordinance while reducing the impacts of stimulating small wind energy development. This document synthesizes scientific studies of environmental impacts associated with commercial wind farms, literature reviews of impacts on the built environment, and self designed models to forecast abated pollution and greenhouse gasses.

We hope you find this document an insightful and accurate assessment of the environmental impacts associated with Whatcom County's Wind Energy Systems ordinance.

Sincerely,

The wind energy EIA team
Derek Schruhl, Scott DeWees, Kim Popek, Kurt Niemeyer, Erica Bartlett

Western Washington University

Whatcom Wind Energy Ordinance

Environmental Impact Assessment

Environmental Science 436
Professor Leo Bodensteiner

Erica Bartlett
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Huxley College of the Environment
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FACT SHEET

Title: Whatcom Wind Energy Ordinance

Description of Non-project:

The Ordinance will amend the Whatcom County Zoning Code, adding to Title 20, Chapter 20.14 which permits Wind Energy Systems in all scales, from residential scale through utility size in the zoning code. It also permits SWESs up to 100 feet in all zones. The purpose of these systems is for on-site residential energy generation.

Proposal Entity: Whatcom County

Lead Agency: Bodensteiner and Carutthers, LLC.

Related Permits and Laws:

This non-project action contemplates amendments to the Whatcom County Code. No permits or licenses are required for such amendments. Future wind energy system projects developed under the amended code shall require county building permits and may require additional administrative review, conditional use review, or additional environmental review under SEPA.

Contributors:

Erica Bartlett: GIS, Health and Safety, Noise
Derek Schruhl: Editor, Land Use, Energy, GIS
Kimberly Popek: Vegetation, Wildlife
Kurt Niemeyer: Geologic and Water Resources, Electric and Magnetic Fields
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Washington State Department of Ecology

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Public Presentation:

Thursday, March 12, 2009, 6 pm
REI Community Room
400 36th St
Bellingham, WA 98225
(360) 647-8955

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GLOSSARY OF TECHNICAL TERMS, ACRONYMS AND ABBREVIATIONS

Aerodrome: Any location from which aircraft flight operations take place, regardless of whether they involve cargo or passengers or neither. A water aerodrome is an area of open water used regularly by seaplanes for landing and taking off.

Air Surveillance and Control System (ASACS): Developed by Digicomp Research, a system with a set of functions for use in air surveillance, ground control intercept, and area control operations.

American Wind Energy Association (AWEA): A national trade association formed in 1974 that promotes wind power growth through advocacy, communication, and education in the United States and around the globe.

Average Load: The average amount of power consumed.

Bald Eagle Protection Act of 1940 (BEPA): A law that provides bald eagle protection and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds.

Biodegradable: Waste material capable of decomposing by bacteria or fungi into elements found in nature, and is absorbed into the ecosystem within a reasonably short period of time after customary disposal.

Choice experiment: A sub method of contingent valuation where consumers relate the relative value or Importance among a group of different outcomes.

Collateral Damage: Unintended damage, injuries, or deaths caused by an action.

Coniferous: A cone-bearing tree or shrub, generally needle-leaved and evergreen such as pines, spruces, and firs.

Contingent valuation: A process for determining how individuals value non-market goods. Can include interview, surveys, and inferences from behavior.

Conventional pollutants: Includes air pollutants with localized impacts. Our study focuses on sulfer dioxide and nitrogen oxide compounds.

Critical Areas Ordinance (CAO): The purpose of the Critical Areas Ordinance is to carry out the goals of the Whatcom County comprehensive land use plan by identifying and managing environmentally critical areas and ecosystems. The Critical Areas Ordinance seeks to maintain harmonious relationships between human activity and the natural environment. This includes the protection of essential water resources, important fish and wildlife habitat areas, and general public safety and welfare.

Critical Habitat: Under the Endangered Species Act, (1) the specific areas within the geographic area occupied by a federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management considerations or protection; and (2) specific areas outside the geographic area occupied by a listed species when it is determined that such areas are essential for the conservation of the species.

Culminating: To reach the highest point or degree.

Decibel (dB): A unit used to express relative difference in power or intensity, usually between pressure caused by sound and the standard sound pressure, equal to ten times the common logarithm of the ratio of the two levels. The symbol **dB(A)** refers to noise effects on humans and animals, and are in used in the industry with regard to noise control issues, regulations and environmental standards.

Decommission: The process of actively removing, deconstructing and making safe and secure, engineered structures such as roads or wind turbines that are no longer needed after completion of operations.

Department of Ecology (DOE): An environmental regulatory agency for the State of Washington. The department administers laws and regulations pertaining to the areas of water quality, water rights and water resources, shoreline management, toxics clean-up, nuclear waste, hazardous waste and air quality. It also conducts monitoring and scientific assessments.

Deposition: The geologic process by which material is added to a landform or land mass. Fluids such as wind and water, as well as sediment gravity flows, transport previously eroded sediment, which, at the loss of enough kinetic energy in the fluid, is deposited, building up layers of sediment.

Echolocation: A sensory system in certain animals in which high-pitched sounds are emitted and their echoes are interpreted to determine the direction and distance of objects in the surrounding environment.

Electromagnetic Interference (EMI) or radio frequency interference (**RFI**): An unwanted disturbance that affects an electrical circuit due to either electromagnetic conduction or electromagnetic radiation emitted from an external source. The source may be any object, artificial or natural, that carries rapidly changing electrical currents, such as an electrical circuit, the Sun or the Northern Lights.

Electromagnetic Radiation (EMR): Radiation made up of oscillating electric and magnetic fields and propagated with the speed of light. Includes gamma radiation, X-rays, ultraviolet, visible, and infrared radiation, and radar and radio waves.

Electron: A fundamental particle, which means it cannot be broken into smaller particles. Electrons may be bound in the "electron cloud" surrounding an atomic nucleus, or may break free from the cloud as a "free electron," and are the primary charge carriers in electric current.

Endangered Species Act of 1973 (ESA): A law that protects plants and animals listed by the federal government as "endangered" or "threatened." It makes it unlawful for anyone to "take" a listed animal and applies to private parties and private land.

Environmental Impact Assessment (EIA): An academic imitation of a State Environmental Policy Act's Environmental Impact Statement.

Estuary: The lower region of a river where freshwater and saltwater mix as the river flows into a sea or ocean.

Federal Aviation Administration (FAA): An agency that adopted its name in 1967 when it became part of the United States Department of Transportation that regulates and oversees all aspects of civil aviation in the United States.

Fluvial process: All processes and events by which the configuration of a stream channel is changed; especially processes by which sediment is transferred along the stream channel by the force of flowing water.

Gearbox: Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1000 to 1800 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.

Geomorphology: The scientific study of landforms and the processes that shape them.

Growth Management Act of 1990 (GMA): Requires state and local governments to manage Washington's growth by identifying and protecting critical areas and natural resource lands, designating urban growth areas, preparing comprehensive plans and implementing them through capital investments and development regulations.

Habitat Fragmentation: Describes the breaking up of habitat into smaller patches, or a decrease in the size of an organism's preferred environment. Often caused by geologic processes or human activity.

Hazardous Waste: A solid waste which, because of its quantity, concentration, or physical, chemical, or infectious characteristics may pose a substantial present or potential hazard to human health or environment when improperly treated, stored, or disposed of, or otherwise mismanaged; or cause or contribute to an increase in mortality, or an increase in irreversible or incapacitating illness. Waste that meets EPA's "hazardous waste" characteristics as "ignitable hazardous waste," "corrosive hazardous waste," "reactive hazardous waste," or "toxic hazardous waste."

Hemorrhage: Excessive or uncontrollable bleeding often caused by trauma.

Humus: The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrology: The study of surface and subsurface water.

Kilowatt: A unit of power, roughly the draw of an electric heater at medium to high settings.

Leaching: The removal of soluble material from soil or other material by percolating water.

Loam: Soil material that is 7-27% clay particles, 28-50% silt particles, and less than 52% sand particles.

Megawatt: A unit of power equal to one thousand kilowatts.

Megawatt Hour (MwH): A unit of energy that describes the flow of one megawatt for one hour.

Metamorphic: A rock that has been changed from its original form by subjection to heat and/or pressure.

Meteorological Tower (MET Tower): Towers used to gather wind data (wind direction and speed) necessary for site evaluation and development of wind energy projects. A MET tower can also be equipped to record temperature, solar radiation and air pressure if necessary.

Microclimate: The climate of a small specific area due to factors such as wind, sunlight, regional temperature, etc.

Migratory: Traveling from one place to another at regular times of the year, often over long distances.

Migratory Bird Treaty Act of 1918 (MBTA): A statute that regulates the taking of wild birds ("migratory birds") and implements the provisions of four different bilateral treaties for bird conservation (with Canada, Mexico, Japan, and Russia). The statute does not discriminate between live or dead birds and grants full protection to any bird parts including feathers, eggs and nests.

Mitigation: Any measure(s) taken to avoid, minimize, or compensate for adverse impacts of the environment associated with a (project or non-project) land use action.

Muck: (sapric soil material) - Organic soil material in an advanced stage of decomposition making it impossible to identify plant parts with the unaided eye. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Nacelle: The housing or enclosure that sits atop the tower and contains the gear box, low- and high-speed shafts, generator, controller, and brake.

National Electric Code (NEC): Protects the public by establishing requirements for electrical wiring and equipment in virtually all buildings.

National Environmental Policy Act (NEPA): Requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions by preparing an Environmental Impact Statement (EIS).

National Oceanic and Atmospheric Administration (NOAA): A federal agency focused on the condition of the oceans and the atmosphere.

Net Metering: is a method of metering the energy consumed and produced at a home or business that has its own renewable energy generator, according to the AWES.

Noise: Any sound that is loud, unpleasant, unexpected, or undesired.

Pacific Flyway: A major north-south route of travel for migratory birds. This route Spans the length of the west coast of North America.

Parcels: The geographical bounds of individual properties.

Peat: (fibric soil material) - Unconsolidated material, largely non-decomposed organic matter, that has accumulated under excess moisture.

Physiographic regions: Portions of an area which are identified on the basis of bathymetric relief and composition. Similar to land terms such as coastal lowlands or interior highlands.

Raptors: A bird of prey such as a hawk, eagle, or owl.

Resource Conservation and Recovery Act of 1976 (RCRA): A federal law enacted as an amendment to the 1965 Solid Waste Disposal Act that established a regulatory system to track hazardous substances from their generation to their disposal. The law requires the use of safe and secure procedures in treating, transporting, storing, and disposing of hazardous substances, and is designed to prevent the creation of new, uncontrolled hazardous waste sites.

Revised Code of Washington (RCW): Compilation of statutory laws enacted by Washington state's legislature organized topically into volumes, containing chapters and sections.

Riparian: Relating to or inhabiting the banks of a natural course of water such as a river or stream.

Roost: A place where fowl or other birds sleep or rest.

Rotor: Includes the blades and the hub.

Rotor blades: Wind turbine blades that act as barriers to the wind, and when the wind forces the blades to move, it transfers some of its energy to the rotor.

Sand: As a soil separate, individual rock or mineral fragments from 0.0625-2.0 mm in diameter. Most sand grains consist of quartz. As a soil texture class, a soil that is 85% or more sand and not more than 10% clay.

Setback: The distance a structure must be from the edge of a lot.

Silt: Individual mineral particles that range in diameter from 0.004-0.0625 mm and are 80% or more silt and less than 12% clay.

Small Wind Energy System (SWES): Wind energy system that generates a total of 100 kW or less and is no taller than 100 feet in height.

Solid Waste: Any discarded material abandoned by being disposed of, burned or incinerated, recycled or considered "waste-like," and can physically be a solid, liquid, semi-liquid, or container of gaseous material.

State Environmental Policy Act (SEPA): A state policy that requires state and local agencies to consider the likely environmental consequences of a proposal before approving or denying the proposal.

Telecommunication: is the assisted transmission of signals over a distance for the purpose of communication.

Topography: The study or description of surface features of a region, such as its hills, valleys, or rivers.

Tower: A tubular steel tower, lattice tower, or concrete tower structure that carries the nacelle and rotor. Taller towers are able to capture more energy and generate more electricity due to increased wind speed correlated with height.

Variance: A requested deviation from the set of rules a municipality applies to land use known as a zoning ordinance, building code or municipal code.

Vascular: plants composed in part of vascular tissue (xylem and phloem) which conducts water and synthesized foods. Ferns, flowering plants and coniferous species all contain vascular tissue.

Viewscape: The visual landscape, encompasses scenic resources and the view from a given point.

Washington Administrative Code (WAC): Current administrative regulations created by state agencies to carry out the laws passed by the state legislature.

Whatcom County Code (WCC): Compilation of the county's rules and regulations.

Whatcom County Comprehensive Plan: County-wide planning policies to guide plan adoption with the count and to establish urban growth areas (UGAs).

Whatcom Public Utilities District (Whatcom PUD): A water and electricity provider in Whatcom County.

Wind Energy System (WES): A wind energy conversion system, consisting of: wind turbine, tower, base and associated control or conversion electronics, as well as all anchors, guy cables and hardwire.

Wind resource: The amount of wind typical of a given area.

Zoning: A legal mechanism for local governments to regulate the use of privately owned property by specific application of police power to prevent conflicting land uses and promote orderly development. All privately owned land within the jurisdiction is placed within designated zones that limit the type and intensity of development permitted.

CHAPTER 1. EXECUTIVE SUMMARY OF PROPOSED NON-PROJECT ACTIONS

Source: http://blog.mlive.com/chronicle/2008/01/03windworkers.jpg

1.1 BACKGROUND

Whatcom County Planning and Development Services, along with Christina Reeves, the County's Conservation Resource Analyst, have been working with local renewable energy builders who have expressed interest in seeing Small Wind Energy Systems (SWES) become a permitted use in the Whatcom County's Title 20 Zoning Ordinance. Working with these local individuals, county staff began understanding what types of systems are available, and what systems would be most beneficial for Whatcom County residents. County staff also worked with the renewable energy builders in creating zoning text language that would be effective and conducive for the development of SWES, but that also takes into consideration the interests of other residents of Whatcom County.

Washing State has policies in place supporting the development of renewable energy production. RCW 80.60 is Washington's Net Metering Policy, allowing users of renewable energy sources to connect their system to their utility service provider's grid and sell back excess generated energy. WAC 458-20-273 is Washington's Renewable Energy Production Incentive program which will pay users for the production of energy from renewable sources. The program pays users a base rate but if the products used are manufactured in Washington the kilowatt per hour of electricity generated is multiplied by an economic development factor listed in WAC 458-20-273.

1.2 PURPOSE AND NEED FOR ACTION

The purpose of this ordinance is to create zoning text language that facilitates the installment and construction of wind energy systems (WES) within Whatcom County for private landowners, taking into account interests expressed by residents. This action is needed, because current height limitations of underlying zoning districts unduly restrict the installment of these systems. This action responds to the goals and objectives outlined in the Whatcom County Comprehensive Plan and Washington State Growth Management Act. The action helps move the project area towards desired conditions described in that plan by placing a high priority on healthy air quality and environmental protection of the community. It also helps support the plan's goal to promote renewable energy systems, such as SWES, within Whatcom County and the greater Puget Sound area.

Whatcom County has had numerous inquiries and building permit applications for SWES's which are currently permitted as an accessory use within the zoning code, but the height limitations of the underlying zoning districts are not practical for a windmill.

1.3 PROPOSED ACTION

The action proposed by Whatcom County Planning and Development Services to meet the purpose and need is to add a chapter to Title 20 of the Whatcom County Zoning Code that would permit WES in all scales and outright permit SWESs, up to 100 feet, in all zones of Whatcom County.

The created chapter, 20.14, allows for SWES up to 100kw in all zones; WES with a rated output of 101kw to 500kw in Rural, Agricultural (AG), Commercial Forestry (CF), Rural Forestry (RF), and High Impact Industrial (HII) zones with an administrative permit; Multiple SWES on a site up to 100kw in all zones with an administrative permit; WES with greater than 500kw or multiple WES per parcel with cumulative rating above 100kw in AG, CF, RF, HII zones with a conditional use permit.

1.4 DECISION MATRIX

Positive Impact (+1 to +5)
No Impact = 0
Negative Impact (-5 to -1)

Natural Environment	*Proposed Action*	*Alternative Action*	*No Action*
Air			
Air quality(benefits)	+4	+4	+3
Geology			
Soils	-1	-1	-1
Geologic Hazards (Landslides/Erosion)	-2	-1	-2
Water Resources			
Shallow/Subsurface Water Flow	-1	-1	-2
Vegetation	-3	-3	-1
Wildlife	-4	-2	-3
Built Environment	Proposed Action	Alternative Action	*No Action*
Visual & Cultural Resources			
Historical & Cultural Preservation	-1	-1	0
Aesthetics/Visual Degradation	-3	-1	0
Light & glare	-1	-1	-1
Land Use			
Current Land Use/Zoning	-1	-1	0
Transportation	-1	0	-1
Public Health & Safety			
Hazardous Substances	-2	-1	-2
Blade Throw	-2	-1	-2
Tower Collapse	-1	-1	-1
Fire Hazard	-1	0	-1
Lightning Strike	0	0	0
Shadow Flicker	0	0	-1
Electric & Magnetic Fields	-2	-1	-2
Noise	-2	-1	-2
Energy & Natural Resources	+2	+3	+1

Total	**-22**	**-10**	**-18**
Relative Score	**-4**	**+8**	**0**

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Source:http://www.facelift.co.uk/images/piclibrary/hi-rez/Red-Nose-Wind-Turbine-Bronto-Skylift (2).JPG

2.1 INTRODUCTION

This chapter describes and compares the alternatives considered for the Whatcom Wind Energy Ordinance. It presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental, social and economic effects of implementing each alternative.

2.2 ALTERNATIVES CONSIDERED IN DETAIL

Bodensteiner and Carruthers, LLC. and Whatcom County developed 3 alternatives, including the No Action and Proposed Action alternatives, in response to issues raised by the public.

2.2.1 PROPOSED WIND ORDINANCE

The proposed wind ordinance amends the Whatcom County Code Title 20 adding a new chapter to permit WES in all scales, from residential through utility size in the zoning code. The ordinance would apply to all lands under the jurisdiction of Whatcom County. The proposed code in the newly created chapter, 20.14, would outright permit SWES up to 100 feet in all zones intended for onsite residential energy generation. The proposed ordinance aims to reduce the regulatory impact on individual citizens who desire to install a wind turbine on their property.

This is accomplished through a matrix based on the size of the WES and is detailed in figure 2-1.

Figure 2-1. Zoning table for proposed wind turbine ordinance.

System Type	Required Permit	Zones
Met Tower	Outright	All - for up to 24 Months
One SWES	Outright	All
WES with a rated output of 101 kW up to and including 500kW	Administrative	Rural, AG, CF, RF, HII
Multiple SWES per parcel with a cumulative rated output of including and up to 100 kW	Administrative	All
WES greater than 500 kW	Conditional Use	AG, CF, RF, HII
Multiple WES per parcel with a cumulative rated above 100 kW	Conditional Use	AG, CF, RF, HII

1 - WES and MET towers are required to be in compliance with but not limited to Whatcom County Code Title 15 Buildings and Construction and acquire the necessary building permit.

2 - Administrative Permit WCC 20.84.235

3 - Conditional Use Permit WCC 20.84.200

The ordinance specifies that a WES can be considered either a primary or accessory use. In other words, it can be the initial use of the land or in addition to an existing use.

Any WES that has already obtained a required permit prior to the effective date of the ordinance will not be required to meet the requirements of the ordinance. Pre-existing WESs that have not produced energy for a continuous period of 12 months will be required to meet the requirements of this ordinance prior to recommencing operation.

The ordinance provides general requirements for WESs including in the areas of visual appearance, lighting, and power lines; setbacks and height limits; sound levels; safety; and additional federal, state, and local requirements.

For visual appearance, lighting, and power lines the ordinance requires wind turbines to be painted a non-reflective, non-obtrusive color. For larger WES projects, design shall blend into the surrounding environment as best as possible. It also requires that all FAA requirements are followed with respect to siting and lighting. All electrical controls, wiring and power lines must be wireless or underground.

The ordinance requires that all towers are setback no less than 1.2 times the tower height from the property line up to a maximum of the tower height plus 20 feet. If the system doesn't exceed the existing height limit of the underlying zone then it is exempt from the setback requirement except within AG, CF, and RF. WES's must also be set back from the nearest above ground public or private non-participating utility a distance no less than 1.2 time the tower height up to a maximum of the tower height plus 20 feet. Setbacks are determined from the outer edge of the base of the WES structure excluding guy cables and other accessory support structures.
The height limit designated by the ordinance is 100 feet or the maximum allowed by the zoning except in the AG, RF and CF zones. Any tower over 100 feet must obtain an administrative permit, except in the AG, RF and CF zones. In addition, any system taller than 100 feet must provide in writing the demonstrated need that the height requested is the minimum height necessary for the WES to operate efficiently and that this height is required in order to rise 30 feet above any obstruction within 500 feet.

The ordinance requires that sound from any WES operation may not exceed 55 dBA for any period of time as measured from an adjacent property line with the exception for short term power outages and storm events.

The safety requirements of the ordinance include requiring 15 foot minimum ground clearance for wind turbine blades, no accessible bolts or ladders within 10 feet of the ground, and electrical equipment must be enclosed by fencing or cabinetry. The ordinance also requires warning signage must be placed on wind turbine towers and electrical equipment, WES must have over speed controls and any turbine found to be unsafe by a building official must be fixed or removed within three months.

The ordinance requires that all other current Whatcom County Codes & Ordinances, FAA regulations, Washington Department of Labor & Industries, National Electrical Code, and RCW Ch. 80.60 requirements for Net Metering are complied with if applicable.

2.2.2 Alternative Zone Based Wind Ordinance

The alternative wind ordinance approaches the regulation of wind turbines based on the underlying zoning and the locality of the area where a turbine can be placed. In commercial and residential zones wind turbines will be outright permitted for one tower up to 35 feet. Wind

turbines will also be outright permitted in the rural and agricultural zones with additional conditions detailed in the figure 2-2. For commercial forestry, rural forestry, and industrial zones an administrative permit is required with additional conditions detailed below. For all other zones an administrative permit is required at which time particular conditions are determined.

Figure 2-2. Alternative action zoning detail table.

Zones	Permit Process	Tower Height	Tower Count	Conditions
Commercial	Outright	Max 35 ft	1	
Residential	Outright	Max 35 ft	1	
Rural	Outright	2-9 acres: up to 100 ft 10 + acres: max 150 ft	Max fit per parcel (Radius of 1.5x Tower Height to other tower location)[3]	Min. Setback from Critical Areas 1.5x Tower Height; Min. Setback from Property Line 2x Tower Height
AG	Outright	2-9 acres: up to 100 ft 10 + acres: max 200 ft	Max fit per parcel (Radius of 1.5x Tower Height to other tower location)[3]	Min. Setback from Critical Areas 2x Tower Height; Min. Setback from Property Line 3x Tower Height
CF	Administrative	2-9 acres: up to 100 ft 10 + acres: max 200 ft	Max fit per parcel (Radius of 1.5x Tower Height to other tower location)[3]	Min. Setback from Critical Areas 2x Tower Height; Min. Setback from Property Line 3x Tower Height
RF	Administrative	2-9 acres: up to 100 ft 10 + acres: max 150 ft	Max fit per parcel (Radius of 1.5x Tower Height to other tower location)[3]	Min. Setback from Critical Areas 2x Tower Height; Min. Setback from Property Line 3x Tower Height
Industrial	Administrative	2-9 acres: up to 100 ft 10 + acres: max 200 ft	Max fit per parcel (Radius of 1.5x Tower Height to other tower location)[3]	Min. Setback from Critical Areas 2x Tower Height; Min. Setback from Property Line 3x Tower Height
All Other	Administrative	Case-By-Case	Case-by-case	Case-by-case

1 - WES and MET towers are required to be in compliance with but not limited to Whatcom County Code Title 15 Buildings and Construction and acquire the necessary building permit.

2 - Administrative Permit WCC 20.84.235.

3 - See diagram below for further details.

Setbacks

The alternative ordinance relies on the underlying zoning requirements for setbacks in the commercial and residential zones. In the other listed zones above there are two setback requirements. The first is an additional critical areas buffer that shall be used if greater than the existing buffer under the critical areas ordinance. A setback is also required from all property lines. Towers must also be setback from communications and electrical lines. Setbacks are measured

from the base of the tower excluding guy cables and other accessory support structures. The tower heights specified above are the maximum allowed unless a conditional use permit is acquired.

The setback requirements for commercial and residential are aligned with the underlying zoning due to the lower tower height and insignificance of their impact. The greater setbacks around potentially larger towers in other zones are to address potential safety risks and additional biological impacts from larger turbines.

Height and Clustering

Tower height in the alternative is limited to 35 feet for commercial and residential zones. In all other zones there is a two-part height limit based on the size of the parcel or adjacent parcels under single ownership. More than one tower may be placed on appropriate parcels if they meet the proximity guidelines between towers. The diagram below provides an example of the setback and proximity guidelines. The split requirements for tower height are aimed at tailoring the requirements of the ordinance to the need required by the varied impact of the tower allowed for the zone. The goal of clustering is to concentrate areas of impact reducing the significance of impacts to vegetation, wildlife and humans.

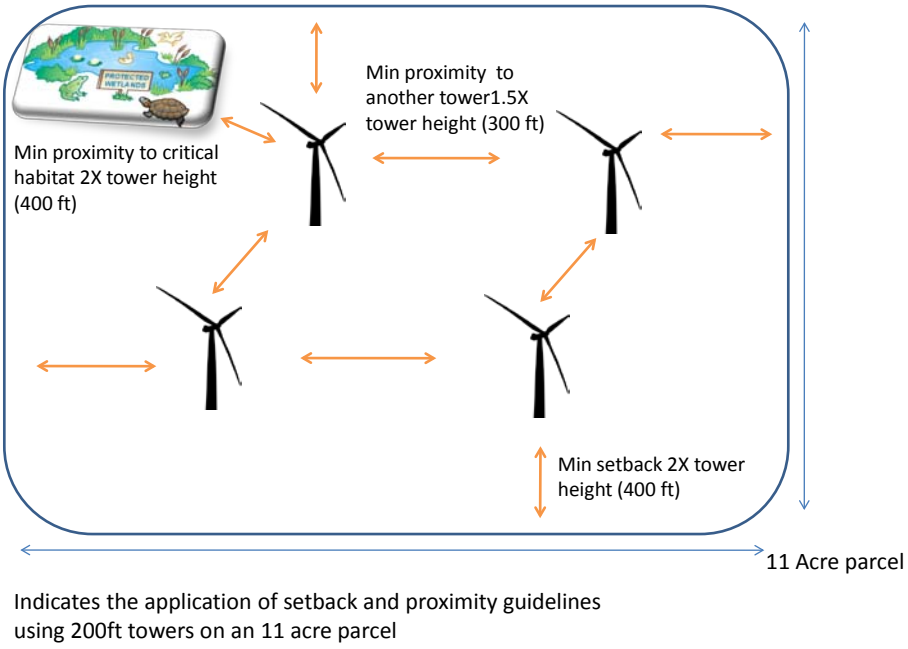

Figure 2-3. Sample application of agricultural setback and clustering proposal.

Noise

The alternative will require that sound levels due to WES operations shall not exceed 55 dBA for any period of time as measured from an adjacent property line except for short periods such as utility outages and /or severe windstorms. This is consistent with the requirements of state law and the proposed ordinance.

Safety

The alternative ordinance incorporates all the safety requirements of the proposed ordinance. Additional safety requirements in the alternative, to further reduce potential safety impacts of wind turbines, include the required use of non-toxic biodegradable lubricants, a summary log for all hazardous materials used or stored on site be maintained and available to local fire departments and emergency service providers, a cold weather package for areas susceptible to temperatures of -40F, spacing between turbines of 1.5 times tower height, additional signage related to weather hazards, training for owners on recognizing weather hazards, new wind turbine placements must be newly manufactured, must have a designated first responder to locate the turbine and be trained in tower rescues and to notify neighbors and have a fire extinguishers near each turbine and associated facilities.

Existing Regulation

The alternative ordinance requires that all other current Whatcom County Codes & Ordinances, FAA regulations, Washington Department of Labor & Industries, National Electrical Code, and RCW Ch. 80.60 requirements for Net Metering are complied with if applicable.

2.2.3 No Action

Under the No Action alternative, current zoning regulations would continue to guide the acceptable placement and siting requirements for WESs. Whatcom County's zoning code as it stands has no provisions for WESs.

Under current zoning codes a WES would be considered an accessory use which must be located on the same lot as the permitted primary use unless specifically permitted otherwise.

The accessory use is still subject to standard height restrictions of the underlying zone, established minimum setbacks in chapter 20.80.200 and any specific setback for the specific underlying zone, designated sound level limits, and any applicable existing safety standards.

It must also comply with all other current Whatcom County Codes & Ordinances, FAA regulations, Washington Department of Labor & Industries, National Electrical Code, and RCW CH 80.60 requirements for Net Metering are complied with if applicable.

CHAPTER 3. AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES AND MITIGATIONS

Source: http://www.windpowerworks.net/12_case_studies/lake_ostrowo_poland/birds_and_wind_turbines_live_in_harmony.html

3.1 AIR

Existing Conditions

Air Emission Avoidance and Small Wind Energy Systems

Wind energy is the fastest growing sector of alternative electricity generation (Worldwatch 2006). Wind generation is an attractive solution to expanding energy generation as it has no fuel costs, towers have a relatively short construction time, and they produce very little conventional pollutants. Interest in wind power generation is growing as turbine technology and financial incentives have made it cost competitive with conventional alternatives. With the appropriate wind resource, wind generation is now cost-competitive with other generation sources (RAND 2002).

Addressing the potential benefits associated with small wind generations systems is key in our assessment of Whatcom County's Small Wind Energy ordinance. We expect the negative impacts associated with wind energy generation to be moderate compared to the benefits of zero fuel electricity generation. There are several environmental benefits from wind energy generation outside of reduced stack emissions. They include the absence of the emissions from coal and natural gas harvesting and processing (lifecycle emissions), and decreased solid waste from the energy generation process. While these are notable environmental benefits, it is beyond the scope of this assessment to track the lifecycle of fossil fuel extraction and enrichment as well as the impacts associated with waste generated from fossil fuel.

Emissions offsetting

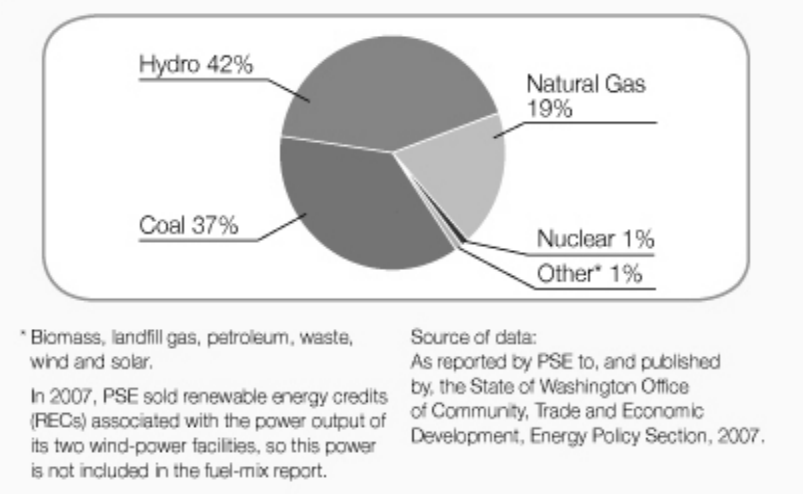

Figure 3-4. Puget Sound Energy's type of fuel used by percent of total.

The above chart indicated Puget Sound Energy's (PSE) fuel mix for 2007. As noted, wind power produces no significant emissions compared to natural gas and coal. In modeling the expected benefits of small wind energy production we will be assuming a reduction in the demand for other sources of power available to PSE. Of the above mix we assume that coal and natural gas generation are likely to be offset from increased wind energy. Hydropower production is not likely to be reduced as there is no fuel cost, unlike coal and natural gas. Its production may be reduced in the face of competing water demands, but these are electricity generation-independent factors. Nuclear

power production will also remain constant in the face of additional wind generation as its fuel costs are very low relative to total operating costs. Thus, for every megawatt hour (MwH) of locally produced wind generation, we will assume one less MwH is demanded of the grid. At base load conditions PSE draws 19% of its power from natural gas 37% from coal. From a temporal perspective these values are not constant, hydro power output will vary seasonally, as will the proportion of coal and natural gas derived power will vary with prices and other fuel supply variables. Our model simplifies this variability by averaging the proportion of un-demanded conventional energy per unit of wind power produced. As noted coal and natural gas are likely to be the marginal producers and therefore are assumed to be offset with generation from wind sources. Thus we assume that coal and natural gas is offset at a 3:2 ratio as wind generation increases.

To estimate the potential demand offsetting by wind turbines we have adopted the American Wind energy Associations formula for estimating power production potential.

$$P[watts] = .5 \bullet rho \bullet A \bullet Cp \bullet V^3 \bullet Nq \bullet Nb$$

Where:
P= power in watts
Rho= air density (1.225 Kg/ M^3 at sea level)
A= rotor sweep area
Cp= rotor design performance coefficient
V= wind speed in meters/sec
Ng= generator efficiency (65% efficiency is our midpoint estimation)
Nb= gearbox efficiency (95% percent for small wind generation)

Using the above formula we can calculate the potential output of a SWES in Bellingham. For this model we have chosen the Entegrity EW50 wind turbine as my reference design. This is one of the largest turbines feasible to be installed under the Whatcom County ordinance. Its output is rated at 50Kw, only half of what the ordinance allows for, yet any turbine in this power class or above is typically matched with a tower exceeding 100 feet, thus it is effectively the largest turbine that is outright permitted.

Our modeling exercise shows scenarios of varying: tower density, annual wind speed, and emission rates for conventional power production. In a study prepared by Paulina Jaramillo, Michael Griffen, and Scott Matthews, they compare greenhouse gases and local air pollutants from different generation sources. Coal and natural gas plants have varying efficiencies, and pollution per unit of electricity can be quite different among plants. This is especially true of coal plants as some are quite old and employ obsolete plant designs. To incorporate the range of reduced pollution emissions from conventional sources we will have a lower and upper bound scenario of avoided air pollution.

Expected Impacts

Proposed Ordinance

Figure 3-5 shows the results of multiple model runs. The runs included a low wind and high wind scenario and depict the range of abated pollution we could expect. In doubling the wind from 7mph to 14mph average annual wind, we see wind energy generation grow by nearly 9 times. We chose to run the model with 5,000 turbines. The results of our GIS analysis concluded that approximately 20,000 parcels could erect 100 foot towers based on the setback requirements of the ordinance.

While we feel it is unlikely that 5000 turbines would be installed, this was chosen to depict the impact a *substantial* number of towers would have on pollution abatement, and equates to one quarter of the maximum legally permitted. Whatcom County will have wind speeds around 7MPH at 100 feet from the ground. A small number of sites in Whatcom County experience wind speeds up to 14 MPH (WDOE 2002).

Figure 3-5: Results of modeling pollution avoidance from wind energy production.

Turbines	**5,000**	**5,000**	**19,000**
Wind speed (mph)	7	14	7
Wind energy generation MW	3.6	28.6	13.6
Total SOx reduction range (tons/year)	15.9-268.8	127.5-21,157	60-10,027
Total NOx reduction range (tons/year)	26.8-120.8	214.4-966.9	102.1-281.5
Total GHG reduction (tons/year)	27,392	219,372	108,405

Alternative Action

The intent of our alternative is to promote wind turbine installation outside of populated areas. It is unknown what the net effect of total generation would be from our alternative proposal. The alternative reduces the potential for generation in residential, commercial, and light industrial zones by limiting tower height (the limiting factor in wind energy capture). However, our alternative increases the potential for generation in rural and agricultural zones by allowing for taller towers and multiple towers in appropriate parcels. The results of the model indicate total tower count has a less dramatic effect on generation than wind speed. With both the original and alternative proposal we expect significant reductions in air emissions.

No Action

In the event that Whatcom County had not passed the Small Wind Energy ordinance there would still be potential for wind turbine installation. Individuals would need to acquire a variance to the height requirement in the zone in which they intend to build a WES. Therefore the expected benefits of turbine installation would remain. It is likely that fewer total turbines would be installed due to the additional permitting requirements.

3.2 NOISE

Existing Conditions

Noise may be defined, for the purpose of permitting proposed development projects, as any unwanted sound (Rogers 2002). If unwanted sound interferes with normal activities and the natural environment, that noise can be considered a nuisance (Klickitat County Energy Overlay, 2004). Potential noise generated from wind turbines is an important public concern to address; however, wind turbines technology has reduced noise output (Rogers 2002). Whether a noise is objectionable varies, depends on its type (tonal, broadband, low-frequency or impulsive) and the circumstances and sensitivity of the individual (or "receptor") (AWES). Because of the wide variation in levels of individual tolerance for noise, there is no completely satisfactory way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction (Rogers 2002).

However, it is possible to objectively measure how loud a noise is. Noise is measured in decibels (dB), a logarithmic ratio between pressure caused by a given sound and the standard sound pressure (Klickitat County Energy Overlay, 2004). Figure 3-6 shows loudness ("sound pressure level") of some common noises (CCOHS 2008).

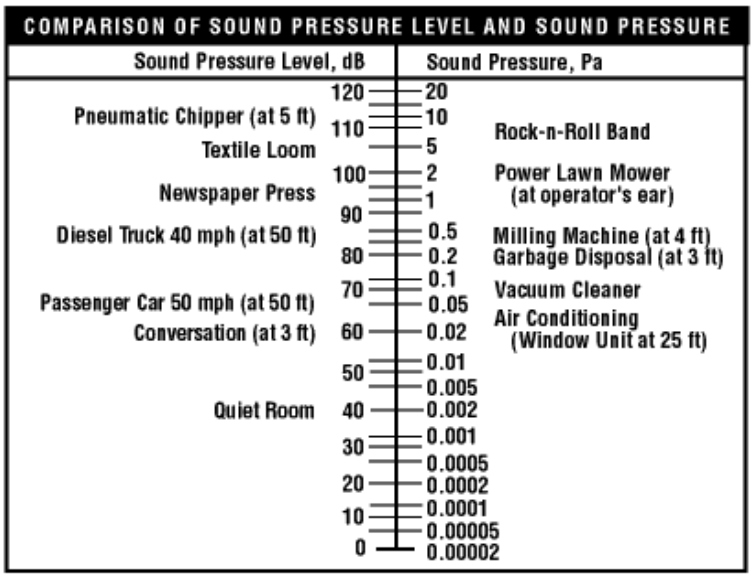

Figure 3-6: Loudness and sound pressure of common noises.

Department of Ecology regulates noise levels according to the property classification (residential, commercial or industrial) and time of day (Klickitat County Energy Overlay, 2004). Washington Administrative Code (WAC) 173-60 establishes maximum permissible environmental noise levels resulting from new facilities, and Whatcom County's Code agrees with environmental noise levels stipulated by Ecology (20 WCC 66.705.1991). Figure 3-7 shows Ecology noise regulations (173 WAC 60.040.1975).

Figure 3-7: Washington State Department of Ecology's noise regulations.

Noise Source	Maximum Permissible Receiver Environmental Noise Levels (dBA)			
	Residential		Commercial	Industrial
	Day	Night (1)	All Hours	All Hours
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70

Note: In rural locations, new noise sources cannot produce nighttime (10pm to 7am) levels that exceed 50 dBA at the receiving site, and for residential receiving properties noise limitations are reduced by 10dB (A) (WAC 173-60).

Operating wind turbines emit noise as either mechanical or aerodynamic categorical sources. Mechanical noise is associated with the rotation of mechanical and electrical equipment, generated from its gearbox, generator, cooling fans, etc., and is usually a tonal (common frequency) type of noise. Mechanical noise is transmitted along the structure of the turbine and is radiated from its surfaces. Aerodynamic noise is produced by the flow of air over the blades that create a broadband type of noise, which is typically the largest source of wind turbine noise (Pedersen 2007).

Study Methodology

Noise generated by small wind turbines may be more important than for large turbines, because of their potential for installation near residences and proximity to other turbines (NREL 2004). Noise is a concern for people who live near potential energy development sites.

Wind turbine noise is a function of wind speed and other aspects of the design (Pedersen 2007). In a study done by the British Wind Energy Association, wind turbine sound pressures were measured from varying distances from the turbine and the levels were recorded. At a distance of 40 meters, the sound pressure level was about the same as conversation speech (50-60 dB(A)), and at 500 meters sound levels were 25-35 dB(A). Ten wind turbines sited 500 meters away creates an expected noise level of 35-45 dB(A) when measurements are taken in the same direction as the wind, and is about 10 dB(A) lower when the wind blows in the opposite direction (Roger 2002).

The apparent noise level estimated from a 100kW wind turbine system is less than 50 dB(A) when measured at 40 meters distance, with a wind speed rate of 31mph (Evolve Green 2008). People experience a much different acoustic environment inside than they do outside, and comparably the level of noise heard would be significantly less behind insulated walls (Hubbard 1990).

Human noise is positively correlated with one's individual sensitivity and attitude toward the source. People's perception on wind turbine noise is influenced by weather conditions, time of day, and visual aspects (related to site location) that may result in increased feelings of annoyance or intrusion of privacy (Pedersen 2007).

Expected Impacts

Proposed Ordinance

Residences surrounding wind turbines would experience temporary heightened noise levels (above 55dB) during construction that are typical of construction projects. However, SWESs are not likely to produce noise levels greater than Department of Ecology noise limitations of 55dB during normal operations. Noise levels may increase during short-term events, such as utility outages and/or severe windstorms; however, in these cases, the background noise of wind storms tends to overpower any sounds that might be produced by operating wind systems (AWES).

Increased noise levels could increase neighbors' annoyance levels and sense of intrusion to privacy, especially if the exceeded noise levels occur at nighttime and if the turbine causes visual degradation. The expected impacts associated with wind turbine noise levels on neighboring residencies are seen as non-significant.

Alternative Action

Wind turbines may be sited further away from neighbor's property boundaries to ensure safe low sound levels and may decrease neighboring perceptions on potential negative impacts that the turbine may cause, such as impacting visual aspects and thereby reducing levels of annoyance (See Visual Degradation Section for more information). Wind turbine noise may be an issue of "out of sight, out of mind" for some who feel wind turbines are best placed not in their backyard or where they can hear it.

The alternative increases setback requirements from property lines and encourages larger wind turbines to be located in less densely populated areas. This mitigates potential health impacts, such as reported dizziness and headaches that can be affected by one's individual sensitivity and attitude toward wind turbines sightings (Pedersen 2007). Therefore, expected impacts are similar to proposed action and are seen as non-significant.

No Action

The no action alternative does not facilitate the siting of wind turbines in zones that violate the current height restrictions or setback distances from neighboring properties. Landowners, however, could still install larger (and taller) wind systems in residential areas if they seek a variance and conditional use permit. Noise levels must still be in compliance with State regulated noise levels (173 WAC 60.040.1975). Expected noise levels under the no action alternative are determined as non-significant.

Mitigation Measures

Proposed Mitigation

Chapter 20 of the Wind Energy Systems Ordinance clearly states that the "audible sound… shall not exceed fifty five (55) dBA for any period of time, when measured at the property line of any abutting property containing an occupied building on the date of approval of any WES Siting Permit" (Whatcom County Council Agenda Bill 2008).

3.3 GEOLOGIC RESOURCES

Existing Conditions

The geomorphology and soils of Whatcom County reflect a sequence of depositional and erosional events resulting from glacial and fluvial processes (Goldin 1992). These processes have laden Whatcom counties special extent with over 100 different kinds of soils.

Whatcom County can be divided into two distinct physiographic regions. These regions are the Cascade Range and the Whatcom Basin. The Whatcom Basin ranges in elevation from sea level to about 600 feet above sea level. It consists of hummocky glacial marine drift plains; nearly level glacial fluvial terraces that have large bogs; and rolling, drift-capped uplands overlooking the broad flood plain of the Nooksack River. The Whatcom Basin consists of seven significant upland plateau areas and three lowland terraces. The Cascade Range rises abruptly from the floor of the Whatcom Basin, culminating in the snowfields and glaciers of Mount Baker, Mount Shuksan, and the Twin Sisters Mountain. The topography is extremely rugged and it consists of pre-Tertiary metamorphic and Tertiary sedimentary rocks with a mantle that is dominantly Vashon till and some outwash (Goldin 1992).

Expected Impacts

The proposed action will require that large holes ranging from 4'- 8' deep be dug for the foundations. During the construction of the foundation there could be a potential for erosion and landslides. The increased slope of the construction site will considerably increase the potential for both soil erosion and landslides. Whatcom counties critical areas ordinance specifies hazard areas for both landslides and erosion. Since wind turbines will not be built in these areas the potential for erosion and landslides is not significant. The proposed action will also require ditches be dug for power lines or any other monitoring cables that connect the wind turbine to the power grid. These ditches are usually 3-4 feet in depth and will only be exposed for a short periods of time during the construction process. There is a possibility for compaction of soils surrounding the construction site but it will be insignificant. It is important to note that impacts on geography and soil composition will be site and project specific. The excavation process for the foundation will have the most impact and will vary with the size of the wind turbine being constructed. This will also vary on whether or not a professional contractor or the home owner is building the wind turbine foundation. After construction most elements of the environment related to geology and soil composition should return to preexisting conditions.

Alternative Action

The alternative would help mitigate the effects of erosion and landslides in urban and commercial areas because it limits the size of wind turbine towers to 35 feet. Consequently, less excavation will be needed during the construction process of the foundation. On the other hand in agricultural areas where the height limit was lifted to 200 feet the excavation site for the foundation would be much larger. The affects on geography and soils will only be affected during the construction phase. After construction most elements of the environment related to geography and soil composition should return to preexisting conditions.

No Action

The frequency and intensity of soil disturbance due to the construction of wind turbine foundations would be much less.

3.4 WATER RESOURCES

Existing Conditions

Whatcom County has a total area of 2,504 square miles, of which, 2,120 square miles of it is land and 384 square miles of it (15.34%) is water, including Lake Whatcom, which empties into Bellingham Bay by way of Whatcom Creek. Whatcom County has an extensive and diverse web of hydrologic systems within its boundaries. To give some scale to the extensive network of hydrologic systems in Whatcom County, there are 113 lakes, 295 streams and rivers, 24 reservoirs, four canals, and ten channels with in the 2,504 square miles that compose Whatcom County.

Expected Impacts

Proposed

The proposed action would require large amounts of lubricant for the turbines. Because of the increasing amount of impervious surfaces in Whatcom county lubricants will have a higher potential to leak into the Whatcom counties water systems. During the construction phase shallow subsurface ground water flows might be diverted for a short period of time while the foundation is poured and the ditches are dug for the electrical lines. Surface flow will most likely be diverted into ditches and into the holes dug for the foundation. Shallow subsurface ground water flow and surface run-off will be affected by the construction of wind turbine foundations in some capacity but it is not significant. Shallow subsurface ground water flow might also be diverted around the wind turbine foundation after construction but generally shallow sub-surface water flow, and surface run-off should return to preexisting conditions. It is important to note impacts on hydrologic flow will be site and project specific. This is due to the fact that wind turbines from 35-200 feet may be constructed and the impacts will vary according to the method of construction, size, and depth foundation.

Alternative

The alternative would lessen the chance of wind turbine lubricant leaking onto impervious surfaces by limiting construction in urban and commercial areas. This helps prevent grease and oils from being directly deposited into streams, rivers, and lakes. But in the areas where the wind turbines can be built to the maximum height the chance of lubricant leakage into the environment will be higher. This is because the larger turbines require a lot more grease and oil than small turbines.
The impact is less if wind turbine lubricant is leaked into an impervious service, because it has more chance of being filtered out by a wetland. These oils may undergo some microbial transformation but the majority will be trapped and integrated into the soils.

No Action

Without action the possibility of wind turbine lubricant getting into Whatcom counties water supply would be very low. The alternatives increase the chance of wind turbine lubricant getting into the environment

3.5 VEGETATION AND WILDLIFE

Whatcom County is home to a wide variety of species living in a large range of habitat types. The western edge of the county is characterized by marine environments, estuaries, and wetlands. Further inland, pastures and grasslands dominate the landscape mixed with agricultural lands, lakes, and ponds. To the East, the landscape changes to coniferous forests and alpine environments. This wide variety of habitats provides the county with a large diversity of plant and animal species, many of which depend on the continued existence of naturally occurring habitats for survival.

3.5.1 WILDLIFE

This section outlines the impacts of the proposed, alternative, and no action plans in relation to wildlife. Associated regulations are described including affected, listed, and candidate species for Washington State and Whatcom County.

Existing Conditions

Applicable Regulatory Framework

Migratory Bird Treaty Act of 1918 (MBTA)

The Migratory Bird Treaty Act makes it unlawful to "take" any bird, its nest or eggs. This includes capturing, killing, collecting, hunting, or selling of bird species. Migratory, non-migratory, and local birds are all protected under this act and live and dead birds are considered equally. Clearing of vegetation is also a violation of the act if habitat containing nests, eggs, or young is destroyed in the process.

Endangered species Act of 1973 (ESA)

The Endangered Species Act was created to protect threatened species from extinction due to human impacts. This act provides a design for the conservation of plants and animals which are endangered or threatened as well as protecting the habitats in which they are found (Figure 3-8). Federal agencies are required to ensure that any actions they carry out or fund are not going to cause the degradation of habitat in any critical habitat areas or endanger any listed species. The Endangered Species Act prohibits the "taking" of any listed species which includes importing and exporting.

Figure 3-8: Threatened and endangered species in Washington State. (Washington Department of Fish and Wildlife 2004).

State Endangered Species

Common Name	Scientific Name	Federal Status
Birds:		
American white pelican	*Pelecanus erythrorhynchos*	none
Brown pelican	*Pelecanus occidentalis*	FE
Sandhill crane	*Grus canadensis*	none
Snowy plover	*Charadrius alexandrinus*	FT
Spotted owl	*Strix occidentalis*	FT
Streaked horned lark	*Eremophila alpestris strigata*	FC
Upland sandpiper	*Bartramia longicauda*	none
Butterflies/Moths:		
Mardon skipper	*Polites mardon*	FC
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	FT
Taylor's checkerspot	*Euphydryas editha taylori*	FC
Mammals:		
Black right whale	*Balaena glacialis*	FE
Blue whale	*Baleonoptera musculus*	FE
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	FE
Fin whale	*Baleonoptera physalus*	FE
Fisher	*Martes pennanti*	FC
Gray wolf	*Canis lupus*	FE
Grizzly bear	*Ursus arctos*	FT
Humpback whale	*Megaptera novaeangliae*	FE
Killer whale	*Orcinus orca*	FE
Pygmy rabbit	*Brachylagus idahoensis*	FE
Sea otter	*Enhydra lutris*	FCo
Sei whale	*Baleonoptera borealis*	FE
Sperm whale	*Physeter macrocephalus*	FE
Woodland caribou	*Rangifer tarandus*	FE
Reptiles:		
Leatherback sea turtle	*Dermochelys coriacea*	FE
Western pond turtle	*Actinemys marmorata*	FCo

Key:	
FE: Federal Endangered	**FC: Federal Candidate**
FT: Federal Threatened	**FCo: Federal Species of Concern**

Whatcom County Critical Areas Ordinance (CAO)

The Whatcom County Critical Areas Ordinance helps to protect species listed as threatened or endangered and their habitats. This ordinance strives to find a balance between human activity and the protection of the natural environment. Habitat fragmentation is avoided, especially in riparian areas. For an area to be considered for protection it must show declining population numbers, sensitivity to habitat alterations, recreational, cultural, or commercial value, or importance in connectivity between habitat areas.

Bald Eagle Protection Act of 1940 (BEPA)

The Bald Eagle Protection Act was created to protect bald and golden eagles. This act prohibits the taking, possession and commerce of such birds with a few limited exceptions. Criminal and civil penalties are imposed on any violators of these laws.

Species of Concern

Whatcom County provides habitat for many species, but for the purposes of this study the two most impacted species are birds and bats. In the presence of wind turbines, their ability to fly puts them in danger of collision with the turbine blades, leading to injury and possible death.

Birds

Over 320 bird species use Whatcom County as habitat at some point during the year (Meche 2008). Many of these birds are permanent residents, while others are merely migrating through the region on their way to another location. A few of the listed bird species through the ESA which are known to occur in Whatcom County are the Peregrine Falcon, listed as endangered, the Bald Eagle, Marbled Murrelet, and Northern Spotted Owl, listed as threatened, and the Harlequin Duck listed as a candidate species (Washington Department of Fish and Wildlife 2009).

Whatcom County is located within the Pacific Flyway (Figure 3-9). The Pacific Flyway is a main migration route for birds on their flight between British Columbia and Northern California. This corridor is very important to the continued success of these species by providing an important variety of habitats and helping to maintain population size (Kremen 2008).

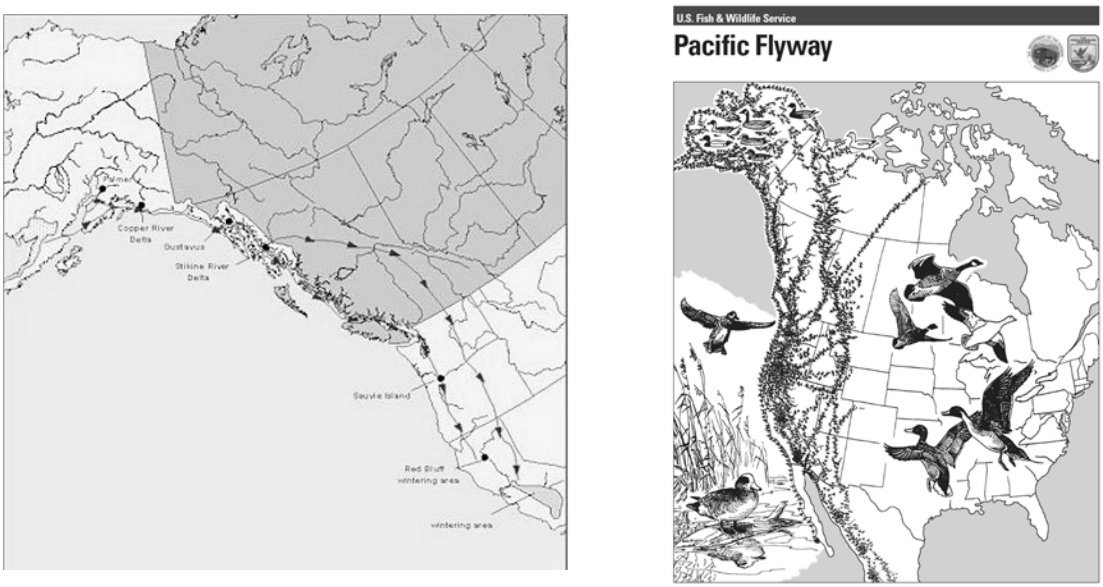

Figure 3-9: Two graphical representations of the Pacific Flyway. (Alaska Department of Fish and Wildlife 2009, and National Conservation Training Center 2001).

Bats

More than 15 species of bat live in Washington State, most of which can also be found in Whatcom County. Townsend's big eared bat is found near Bellingham and is a candidate species for listing on the ESA. Most commonly it has been found near Chuckanut Mountain. Other more common species include the little brown bat and the Yuma myotis. (Washington Department of Fish and Wildlife 2009)

Bats depend primarily on their system of echolocation to find insects to consume, and to navigate through their environment in the dark. Echolocation works by the bat emitting high frequency sounds and listening for those sounds to bounce back to them. By listening to these echoes, a bat is able to "see" objects in its surroundings. Echolocation can be used to detect features up to 100 meters away (Griffin 1970).

Study Methodology

Studies done nationwide on wind turbine impacts were used to supply information used in this report. Preferably these studies were taken from Washington State or Whatcom County to ensure accuracy of information. Many studies have been conducted on the number of bat and bird deaths inflicted by the presence of turbines, and the results vary with the environment in which the turbines are found.

Expected Impacts

Proposed Ordinance

The proposed action could have varying degrees of impact depending on the number of wind turbines installed in Whatcom County. If few turbines are installed, impacts will be minimal, but if many turbines are installed the impacts could be very extensive.

Construction impacts

The construction of wind turbines creates noise through clearing the land and erecting the tower. These construction sounds can keep wildlife away from the site. Construction also destroys habitat through the removal of vegetation, and causes fragmentation. Burrowing animals could potentially be killed or displaced as soils are dug up by heavy equipment to make way for a wind turbine foundation (Klickitat County 2004).

Construction can also introduce contaminants into the environment though machinery leaks, and material spills. The turbines themselves use lubricants which may be potentially toxic to animals coming in contact with, or ingesting these substances.

Operational Impacts

After a wind turbine is constructed and in place, noises continue to be produced by the general working of the turbine. This increased noise level in an area can disrupt predator-prey interactions, and cause certain animals to forgo reproduction near turbines (Klickitat County 2004). Birds which normally overwinter in Whatcom County could avoid their normal roosting locations due to the presence of wind turbines (Klickitat County 2004).

Deaths due to impact with a wind turbine are one of the main threats concerning wildlife. Based on a species' varying behaviors, we see differences in impacts depending on the type of bird. The largest percentage of bird deaths occurs in smaller song birds (Klickitat County 2004). Owls and raptors, although generally flying high above where the turbine blades reach, do tend to fly in low light conditions, increasing their risk of impact (Klickitat County 2004). Migrating birds are also known to fly at night, increasing the chances of collision. Studies show that bird deaths range from between 0.01 to 23 deaths per wind turbine per year depending on location and height (Drewitt 2006).

Bat deaths are also caused by the presence of wind turbines. Although some deaths can be attributed to impact with a turbine, a more recent study has shown that most occur through lung hemorrhaging. As the bats fly near a turbine, the pressure drops dramatically causing small blood vessels to break around the lungs. So, although the bats use echolocation, providing them with an excellent advantage in avoiding objects, simple proximity to the turbines can actually cause death (Gramza 2008).

Alternative Action

The alternative action provides a buffer around Wildlife Habitat Conservation Areas (Figure A-3). This buffer would help protect habitats associated with priority species and other important wildlife regions. The alternative action plan would reduce the impact of the proposed action by protecting these critical habitat areas and encouraging grouping of turbines instead of widespread dispersal.

Construction impacts for the alternative action would remain similar to construction impacts of the proposed action. The use of heavy machinery and associated noise levels would deter wildlife from entering the affected areas and destroy habitat. In residential areas, construction impacts would be lessened slightly by the reduced size of the turbines being installed. Construction impacts would be increased in the event of multiple turbines being installed in a non-residential zone due to a larger land area being cleared. Wind turbines at least 200 feet tall would require lighting, potentially increasing the number of bird and bat impacts at night (Federal Aviation Administration 2005, Klickitat County 2004).

No Action

Under the no action alternative there would be similar adverse impact to wildlife as with the proposed and alternative actions. Birds and bats as well as threatened, endangered, and species of concern would be impacted depending on the number of turbines installed.

3.5.2 VEGETATION

Vegetation types vary widely through Whatcom County due to the diversity of habitats. This section outlines the impacts of the proposed, mitigation, and no action plans in the context on vegetative impact. Rare and threatened plant species are highlighted.

Existing Conditions

Whatcom County contains many plants ranging from marine to alpine species. These are found in wetlands, agricultural fields, forests, and many other habitat types. As of march 1990, 27 vascular plants were listed as sensitive in Whatcom County. A few of these are Lance-leaved grape fern, Water Lobelia, Moonwort, Russet Sedge, and Southern Mudwort. Pygmy water-lily is a possibly extinct species, and thickglume reedgrass is a threatened species (Florea 1994). Many sensitive species can be found in wetland areas, and in riparian zones. The Endangered Species Act of 1973 provides protection for listed plant species.

Expected Impacts

Proposed Ordinance

The impacts on vegetation from the proposed action could be large or small depending on the number of turbines installed, and their locations. The main impact to vegetation would be during the construction phase of the wind turbine installation process. During this phase, vegetation would be killed or displaced to make way for heavy machinery and the wind system itself. Listed plants are more prone to losses because they are less recognizable (due to their rarity) and generally depend on specialized habitats or unique interspecies interactions (Klickitat County 2004).

In forested areas, removal of trees and shrubs creates new openings in the canopy which alters the microclimate and increases the amount of forest edge. An increase in forest edge can cause shade-tolerant species to decrease in abundance, and sun-tolerant species to increase in the cleared region. Disturbances and vegetative removal can also result in an increase in number of invasive

species being established, thus preventing the reestablishment of native plant species (Whatcom County Planning and Development Services Department 2008).

Alternative Action

The alternative action would affect plants on a smaller scale in residential areas than the proposed action because site disturbance would be lessened by smaller wind turbines. Construction would be less invasive, and fewer plants would be killed. In non-residential areas, the impact to vegetation could potentially be greater in some areas. In the event of a multiple turbine installation, a larger area of land would need to be cleared, and more plants would be destroyed in that region. Pressure for turbines to be build outside of residential areas could lead to increased loss of agricultural lands throughout the county.

No Action

There would be no impact to vegetation under the no action alternative. Site disturbance would not occur and there would be no adverse affects on plants in Whatcom County.

3.6 VISUAL AND CULTURAL RESOURCES

3.6.1 VISUAL DEGRADATION AND AESTHETICS

Existing Conditions

Visual landscape (viewscape) degradation is a common concern of wind energy development that must be addressed in the consideration of any wind energy proposal. Of the different impacts associated with wind energy, visual disturbance is the most subjective, and a hotly debated issue of wind energy. In considering Whatcom County's Wind Energy System ordinance, one must consider the visual impacts of stimulating SWES installations.

Visual impacts from wind farm installations will be subject to consumer preferences for renewable energy, property values, citing near scenic resources, and other socio-economic factors (Farizo and Hanley, 2001). Several of these factors are at odds in Whatcom County, as local residents have shown a strong preference for renewable energy production, but enjoy scenic property enhancing views particularly of Bellingham bay, and Mt Baker.

Currently, there are very few small scale wind generation systems in Whatcom County. This is thought to be a result of marginal annual wind speed and WES has only recently become economically viable in such conditions. It is the consensus of the authors of this assessment that the ordinance would not significantly stimulate windmill installation. However, in considering the impacts of the ordinance we must consider worst case scenarios as well as our best guess scenario. Due to the flexibility of the ordinance it is feasible that wind farm density could significantly impact visual resources.

Wind Turbine Aesthetics

A similar concern to viewscape degradation resulting from wind turbine installation is the aesthetic impacts of wind turbines. Whatcom County's Wind Energy System ordinance stipulates that SWESs should be painted an unobtrusive color, and to the extent reasonably possible, be matched to the

décor of surrounding structures. The zoning administrator may require a photo of the site to insure that the tower is aesthetically matched to its surroundings.

Study Methodology

Surveys conducted in European communities of groups that live in proximity to commercial wind energy farms indicated an increase in approval after the installations have been completed (Farhar 2001). This result has been constant with multiple samples where commercial installations have been constructed. Farhar (2001) infers that individuals in these communities who are opposed to WESs base their opinion on second hand information that is dispelled after the individual has firsthand experience with commercial wind farms. Specifically, concerns over visual impacts of wind farms decreased in all European polls after the farms had been constructed. A poll conducted in 1996 in Vermont investigated individual's preferences for wind generated energy and their willingness to site a generating facility within their community. The poll found a 73 v. 76 percent approval for citing a generating facility within the local community versus another, indicating an insignificant *not in my backyard* attitude towards wind generating facilities (O. gray 2001).

Using contingent rating and choice experiment analyses, Alvarez-Farizo and Hanley (2002) studied the perceived impacts of a commercial wind farm development in La Plana, Spain. Their results show significant impacts perceived by residents in the proximity to the farm development. The results of both of their study methods conclude; impacts on flora and fauna are deemed more substantial than impacts of viewscape even on the geologically-rare cliff sites. The authors caution that these results are very site specific and may not represent the general public's attitude on the costs of wind farm development. It should be noted that this site was of significant natural heritage, and exemplifies an otherwise undeveloped area. Farizo and Hanley (2002) also conclude one of the most difficult to quantify of environmental costs is visual impacts; they find that such costs are likely to be highly case specific.

In a recent study conducted by Groothuis, et al. (2008) they investigated the link between environmental concern and compensation required for building wind generating facilities in the mountains of North Carolina. Using contingent valuation to determine willingness to accept compensation, they estimate a value of $23 per year per household would compensate the residents of Watagua County. Of particular importance the group found that those who participated in the local voluntary green power program required significantly less compensation for the viewscape degradation. These results are significant for our study of Whatcom County as residents have a very popular green power program.

Expected Impacts

Proposed Ordinance

In estimating the visual degradation this ordinance could cause we have developed a map that indicates the total potential sites for tower installation. The results show there are 20,000 parcels in Whatcom County that could legally build 100 foot wind turbines. The landscape and wind resource render many of these sites unsuitable for an economically viable installation. Despite the marginal wind resource, we note that consumers may choose to install turbines for non-economic reasons. We conclude that the potential for viewscape degradation is large.

Attempting to estimate an aggregated disturbance to viewscapes is beyond the scope of this analysis. Our literature review suggests that significant impacts do exist from viewscape degradation. The magnitude of the impact is subjective to consumers' preferences for the view, education, residence time, preferences for renewable energy, and numerous site specific variables. These unknowns compounded with the difficulty of estimating the number of towers likely to be installed makes quantifying this impact unrealistic. We conclude that limiting the height and or number of towers permitted to be installed in populated areas would substantially reduce the potential impact. We note that greater public involvement in individual installations could also reduce the risk of visual impact. Yet, because of the subjectivity of viewscape degradation it is not likely that an alternative permitting approach with public involvement would result in a fluid process for addressing viewscape impacts.

Alternative Action

In an attempt to minimize viewscape degradation our alternative has incorporated more restrictive allowances in areas where visual degradation is most likely to occur. We have adopted the standard building permit limitation of 35 feet for residential zones. Additionally commercial zones are limited to 35 feet wind towers to minimize impacts from commercial zones adjacent to residential zones. Our alternative allows more flexible wind turbine systems in agricultural and rural zones. This allows multiple towers to be installed at a maximum height greater than the original ordinance. We recognize this could have a greater impact on viewscapes then the original proposal, to mitigate this we have made maximum installation height relative to parcel size. Furthermore, we have increased the minimum setback from the property line to allow only large parcels to be candidate for large tower installations. This should reduce viewscape degradations by limiting tower installations in close proximity to densely populated areas.

No Action

The expected aesthetic impacts would be less dramatic with a no action alternative. The Whatcom County Small Wind Energy ordinance allows for easier implementation of turbines, creating a potential visual disturbance. Wind turbines could still be installed with a variance of the height limitation of a building permit. Thus, the potential for visual impact with a no action alternative exists.

3.6.2 Historical And Cultural Preservation

Existing Conditions

Whatcom County has a rich history. It is believed that Indian tribes have settled in the area for up to 12,000 years. The Nooksack River supported several villages and fishing weirs ranging from Bellingham bay to Sumas. The town of Bellingham was established when entrepreneurs built a sawmill near Bellingham bay to make use of hydro power from Whatcom Falls. By 1900 Bellingham had the largest saw mills and salmon canneries in the state. Bellingham also has many buildings described as historically significant. Nearly all of the sites are currently in use as commercial, private, or park facilities (Scott, McDowell, 1994)

Expected Impacts

Proposed Ordinance

Wind power installations have the potential of degrading culturally and historically significant sites. This impact is similar to, but less pronounced than the impacts of redevelopment on culturally and historically significant sites. Individual interpretation of historic culture and the extent it is compromised by modernization is highly variable, making it difficult to quantify. Some cultural sites may be suitable for a wind generating system, where others would be degraded by modern devices. In the event that a historic site was to utilize alternative energy and not be aesthetically impacted, they may choose to use offsite renewable generation. With the adoption of green tags and voluntary green power purchases, individuals need not produce their energy locally to receive the benefits of renewably generated energy.

Sites adjacent to a cultural location could install of a SWES and aesthetically impact a cultural site. The authors of this impact assessment feel the potential impact is within a threshold of tolerance as WES do not uniquely degrade historic sites, as any modern development could detract from the site. It is noted that a SWES could be up to 100 feet tall, and will exceed the standard height limitations of residential and commercial development (typically limited to 35 feet). This may lead to unique viewscape degradation that other development is restricted from.

Native American heritage sites are protected under specific laws. RCW 27.53 prohibits the unauthorized disturbance of Native American archaeological sites. Identified sites are monitored by the Washington State Office of Archaeology and Historic Preservation. In the event that a property owner would want to install a SWES on a Native American Site, the office of Archaeology and Historic preservation would need to issue a permit to allow the modification of the site. It is unlikely the permit would be issued in the event that the SWES would degrade the significance of the site.

Alternative Action

Our alternative proposal is not likely to have a net impact on cultural resources. The design of the alternative does not attempt to mitigate any cultural or historical site degradation. The intent of the alternative action is to promote wind development outside of populated areas. The distribution of cultural resources is not spatially consistent; therefore it is difficult to estimate the effect our alternative will have on this element of the built environment.

No Action

The impact associated with the no action alternative is similar to that of the proposed action and the alternative action. As with all options there is a potential for wind turbine installation, thus cultural preservation may be negatively impacted with the installation of wind turbines.

3.6.3 LIGHT AND GLARE

Existing Conditions

The Federal Aviation Administration (FAA) requires all structures over 200 feet to be equipped with FAA approved hazard lighting. Structures less than 200 feet high can also be required to have hazard lighting based on proximity to the public or airports. For wind turbines, if painted white, lighting is not necessary during the day. Flashing red lights are recommended when using a lighting arrangement because they have been shown to be most effective. (Federal Aviation Administration 2005)

Expected Impacts

Proposed Ordinance

The proposal will potentially increase levels of light and glare in areas throughout Whatcom County. Lighting of turbines at night and increased glare from rotating turbine blades during the day both have the potential to attract birds and bats (Klickitat County 2004). Taking these impacts into consideration, light and glare impacts on neighboring properties are expected to be minimal. During the day, potential glare impacts will be minimized because of the planned use of non-reflective earth-toned or white paint.

Alternative Action

Glare would potentially be reduced in residential areas by the alternative requiring smaller wind turbines. As the turbine blades are reduced in size, glare would be reduce also by a decrease in surface area. If groupings of wind turbines were to be installed or a wind turbine above 200 feet in height, lighting would be required by the FAA, increasing light impacts in the area.

No Action

The no action alternative would cause no adverse impacts in relation to light and glare and no changes in current light and glare levels in Whatcom County.

3.7 LAND USE

Existing Conditions

Current Land Use and Zoning

Whatcom County hosts a wide variety of land uses. Of the 1,377,645 acres that make up Whatcom County 877,000 acres are under federal management. The Cities of Bellingham, Ferndale, Nooksack, Blaine, Everson, Lynden, and Sumas cover 29,063 acres. The remaining 470,241 acres is under Whatcom County authority and it's subject to its land use regulations. Whatcom County's land area is utilized by a variety of land uses, predominately forestry and agricultural practices summarized in Figure 3-10 (Whatcom County Comprehensive Plan June 2008).

Figure 3-10: Land Use on Non-Federal Lands in Unincorporated Whatcom County.

Land Use	Total Acres	Percent of County
Forestry	231,352	49.2
Agriculture	116,120	24.7
Residential	53,008	11.3
Vacant	29,323	6.2
Mining, Fishing & Related Uses	2,177	0.5
Public & Utilities	10,729	2.3
Industrial & Manufacturing	2,987	0.6
Commercial & Services	8,856	1.9
Lummi Nation Trust Lands	7,100	1.5
Property with no Assessor's Land Use Code	8,589	1.8
TOTALS	470,241	100

Source: Whatcom County Planning and Development Services, 2003

Agricultural land use predominates throughout the western lowlands of the county in the lower Fraser valley and the South Fork Nooksack valley while Forest land is concentrated in the uplands of the county.

The next most predominant land use in Whatcom County is residential. This includes single family and multi-family residences. Much of this is concentrated around cities and in the more intensely developed rural portions of the county. The rest is distributed widely over the lowlands and in the river valleys.

A number of other related uses including public lands, utilities, commercial and services, industrial and manufacturing, Lummi Nation trust lands, vacant lands, and mining and other resource extraction lands are present in Whatcom County. Public lands, utilities and vacant land are generally scattered throughout Whatcom County. Lummi Nation Trust land is located on Lummi Island. Much of the commercial land use is adjacent to residential land use or major transportation routes. Concentrations of commercial uses are located mainly within urban growth. Industrial and manufacturing uses are located around the Cherry Point industrial area.

Land Use is currently guided by the Whatcom County Comprehensive Plan, originally created in 1994, that is required by the Growth Management Act. It categorizes and defines the various types of land uses and areas of Whatcom County targeted for their use. The comprehensive plan generally reflects the existing land use characteristics in Whatcom County and is supported by the underlying zoning regulations incorporated into the Whatcom County Code. The Whatcom County Code also contains all county regulations that pertain to activities undertaken in Whatcom County.
Under current Whatcom County code SWESs are considered an accessory use (SWES Staff Report 2008). They are subject to all existing requirements for the given zone in which they may be sited. The current height limits of the zoning districts are summarized in Figure 3-11 below.

Figure 3-11: Current Height Limits of Zoning Districts in Whatcom County.

Zone Abbr.	Zoning Name	Height Limit
UR	Urban Residential	Maximum height shall be limited to 35 feet for single-family development and 45 feet for multifamily development.
URM	Urban Residential Medium Density District	Maximum height shall be limited to 45 feet.
UR-MX	Urban Residential Mixed District	Maximum height shall be limited to 35 feet
RR	Residential Rural	Max 35 feet.
RR-I	Rural Residential-Island	Max 24 feet.
EI	Eliza Island District	Max 25 feet within 100 feet of marine shoreline; 30 feet elsewhere.
R	Rural	Max 35 feet.
TZ	Point Roberts Transitional Zoning District	Max 25 feet.
APO	Agriculture Protection Overlay	
AG	Agricultural	
RF	Rural Forestry	35 feet except barns and silos.
CF	Commercial Forestry	
ROS	Recreation and Open Space	Max 25 feet.
NC	Neighborhood Commercial	Max 25 feet.
STC	Small Town Commercial	45 feet except; 70 ft for spires and decorative towers on public/ community buildings, schools, and churches.
GC	General Commercial	Max 35 feet.
TC	Tourist Commercial	Max 40 feet.
RC	Resort Commercial	35 feet; except conditional use permit up to 75 feet.
GI	Gateway Industrial	Max 35 feet; with exceptions up to 75 feet.
LII	Light Impact Industrial	No max height established; setbacks required above 35 feet.
GM	General Manufacturing	No max height established; setbacks required above 35 feet.
HII	Heavy Impact Industrial	No max height is established; setbacks required above 50ft.
AO	Airport Operations	Subject to Federal Aviation Regulations (FAR) Part 77
	Water Resource Protection Overlay District	
	Point Roberts Special District	25-45 feet
MRL	Mineral Resource Lands Special District	
CP	Cherry Point Industrial District	
PUD	Planned Unit Development	

Setback requirements in Whatcom County are determined by Chapter 20.80 of the Whatcom County Code. The specific setbacks differ greatly depending on the type of zoning and spatial relation to other land uses.

Transportation

Whatcom County administers 974 county road miles and 151 county bridges (WC Public works website). Whatcom County's major thoroughfare is Interstate-5 which crosses the lowlands of Whatcom County. I-5 receives as many as 79,000 vehicles a day while lesser roads around Whatcom County receive as little as a hundred vehicles a day. (2000 Annual Traffic Report Washington State Department of Transportation)

Other transportation services in Whatcom County include ferry service, off-street bikeways, harbor facilities, three airports, and two north-south freight rail lines. Ferry service is provided for Lummi Island and access to Alaska and cruise services. The three airports serve general aviation, charter and Bellingham International Airport provides services to outside of the region (Whatcom Transportation Plan). Cities and counties are required to protect these facilities from incompatible development. Rail services are conducted over 150 miles of track, owned by Burlington Northern Santa Fe Railway, and provide passenger and freight transportation opportunities for intra/inter - Whatcom County needs.

Study Methodology

Information used in this section includes the Whatcom County Comprehensive Plan, Whatcom County EIS Documents for the Comprehensive Plan, Washington State Office of Financial Management (www.ofm.wa.gov/localdata/what.asp), Whatcom Transportation Plan, Washington State Department of Transportation Annual Traffic Report, and other EIS documents submitted for projects in the area.

Expected Impacts

Proposed Ordinance

SWESs are relatively small, less than 100 feet, and create a small footprint. This will have little impact on existing land uses with respects to land utilization as a SWES can easily be placed as an addition to most current land uses. Based on an analysis, graphically represented in Figure A-6, of the extent of parcels in Whatcom County that are eligible for the placement of a small wind turbine based solely on required setbacks of the proposed ordinance allows for approximately 19,143 potential sites.

Alternative Action

The alternative limits the development of wind turbines in more heavily populated areas. It also encourages greater development of wind turbines in less populated areas, including provisions for clustering, where it is less likely to change the ultimate land use in the underlying zone. Figure A-7 shows an analysis for land parcels suitable for wind turbine placement under the alternative ordinance.

No Action

Since the no action alternative does not encourage development of wind turbines there will be an extremely limited impact to existing land use.

Additional Mitigation Measures

Proposed Ordinance
Wind Turbines are also limited by all other existing Whatcom County codes and therefore will be limited in a number of sensitive areas. To further reduce the potential number of wind turbines additional restrictions on placement of wind turbines in particular zones may be required.

3.8 PUBLIC HEALTH AND SAFETY

Potential human health and safety issues related to construction and operation of typical WESs are described in this section. Although public concerns regarding WESs are high, actual safety incidents associated with wind turbine operations are extremely rare. Wind energy, compared to other forms of energy production are more safe, but because they are generally more accessible to the public, it is still nonetheless important to describe potential risks to public health and safety (Searchlight Wind Energy 2008).

Provisions required by governmental agencies and private employers under the Occupational Safety and Health Act of 1970 (29 USC 651 et seq.), and the Washington Industrial Safety and Health Act (Ch. 49.17 RCW) make them responsible for the safety and health of others (173 WAC 340.810. 2001). Occupational hazards can be minimized when workers adhere to these safety standards and through the use of appropriate protective equipment; however, fatalities and injuries from on-the-job accidents can still occur (FPEIS 2005). The ordinance makes clear that "any wind energy system found to be unsafe by the building official shall be required by the landowner to meet federal, state, and local safety standards or removed within 3 months" (Whatcom County Council Agenda Bill 2008).

The issues discussed under this section are (1) handling of hazardous substances, (2) blade throw/ice shedding, (3) tower collapse, (4) fire hazard, (5) lightning strike, (6) shadow flicker, and (7) electric and magnetic fields.

3.8.1 HAZARDOUS SUBSTANCES

Background
Hazardous materials are those substances that may be toxic, reactive, corrosive or flammable (Whatcom County Comprehensive Plan EIS 1994). During the construction, operation and maintenance of WESs it results in temporary use and storage of small amounts of hazardous materials that would include lubricants (grease, ethylene glycol), hydraulic and insulating fluids, and paints. For large WESs, gearboxes can contain between 50 to 70 gallons of oil that would not be routinely replaced, but its system bearings and control gears would be greased and the hydraulic oil checked and renewed every 5 years with 5 gallons of oil. The cooling system (made up of water and ethylene glycol) would be tested annually, and lubricating oils would be checked quarterly and filled as needed (Mountain View EIS 2007). Any amount of oil and grease stored in the operations and maintenance on site must be in special containers, and all special waste (contaminated rags, waste oils, etc) must be removed from site using a controlled waste manifest. All waste materials would be disposed of through a licensed waste carrier and delivered to a licensed waste disposal

site. All production, use, storage, transport, and disposal of petroleum base materials as hazardous materials are subject to strict governmental regulations and guidelines at the Federal, State, and Whatcom County levels to protect human health and the environment (Searchlight Wind Energy 2008). Washington State's Emergency Management Act, under Ch. 38.52 RCW, and Whatcom County Code, Ch. 8.15, outlines procedures to be implemented and followed to prevent release of hazardous substances into the environment.

Expected Impacts

Proposed Ordinance

Small amounts of hazardous materials would be used during construction, operation and maintenance of WESs. These materials, if not handled correctly under federal, state and local laws, could create adverse effects on public health and the environment. However, oil spills are extremely rare. Therefore, the risk of hazardous materials or toxic lubricant in the proposed action is seen as non-significant (See "Geology" for more information on contaminated groundwater flow).

Alternative Action

The alternative minimizes the potential for causing adverse environmental effects and human health risk if an accident occurred on-site due to the increase in setback requirements from the property line and related land use zoning laws. By creating more strict guidelines as to where WESs can be located in relation to adjacent properties and designated critical habitat areas, lessens the risk of potential adverse effects if hazardous material were to infiltrate groundwater. Also, by setting strict maximum height regulations in higher populated areas, the potential volume use of hazardous or toxic materials related to system size would be lessened, which further reduces the chance of risk to humans.

No Action

The no action alternative must still comply with all federal, state, local guidelines and regulations regarding the project's affect on the environment, which includes building, construction, and occupational public health and safety. Small amounts of hazardous materials would be used during construction, operation and maintenance of WESs, but they would be transported, stored, and discarded in accordance with all law. The no action alternative presents expected impacts that are non-significant.

Additional Mitigation Measures

Proposed Mitigation

The ordinance complies with all current adopted Whatcom County Codes & Ordinances, including but not limited to Whatcom County Code, Title 15 (Buildings and Construction), Title 16 (Environment), and Title 23 (Shoreline Management Program). Any hazardous wastes generated during construction, operation and decommissioning wind energy projects must be accumulated, collected, transported and disposed of in accordance with RCRA. Contractors and maintenance workers must perform actions that are in accordance to the law, which minimizes any potential for harm to occur. In case of a petroleum spill (and possible contamination of groundwater resources), or other form of emergency, contractors are required to respond by following the emergency response plan.

Alternative Action

Lubricant used in the operation and maintenance of a WES shall be made non-toxic and biodegradable to avoid the potential of causing an adverse effect to the environment, such as Bio Gear Oil (United Bio Lube 2007). Only licensed personnel shall work with these systems, which have undergone careful safety planning, regular safety training and are required to use appropriate safety equipment on the job. Any use or storage of hazardous materials on site shall be marked and maintained in a summary log that will be continuously updated throughout the operational phase and during decommissioning. This log should be available to local fire departments and emergency service providers (Searchlight Wind Energy 2008).

3.8.2 BLADE THROW AND ICE SHEDDING

Existing Conditions

The potential for rotor blade breaks and parts thrown off a wind turbine, referred to as "blade throw," is one of the primary safety hazards of these energy systems. Blade throw can occur as result of the rotor speeding too fast or if the blades are worn too much, also called "material fatigued." It is difficult to predict the trajectory of a broken rotor blade, which makes the quantitative determination of safety risk somewhat uncertain (Mountain View EIS 2007). These types of cases are understood as extremely rare and if such an event were to occur, the probability of a fragment hitting a person are even lower (FPEIS 2005).

Modern turbine designs have fail-safe, redundant braking mechanisms, slower rotational speed (20 rpm), and heavier blades (6,100 – 7,100 lbs/each) to eliminate possibility of blade throw. They include a safety system to ensure the wind turbine stops rotating its blades at a safe speed, once a mechanical error is detected, and stays immobile until the cause of the disorder has been identified and removed by a licensed operator or maintenance crew (Mountain View EIS 2007). The brake system in the turbine operates by two independent brake systems; an aerodynamic brake affected by blade pitch control and a mechanical brake. The aerodynamic brake functions as the primary system, braking first to keep fatigue stresses to a minimum, followed then by the mechanical brake. That way if one system fails to stop the blades from rotating, then the other brake system functions as backup to safely bring the rotating blades to a halt.

The possibility of "ice shedding" occurs if the WES is placed under certain climatic conditions that allow for ice to accumulate on its blades, which may be released during blade rotation. However, severe ice buildup on the blades causes the turbine to automatically shut down until conditions improve. Modern turbines can be equipped with cold weather packages that makes them adaptable to temperatures as low as -40 Fahrenheit, which reduces the risk of ice accumulation. These packages coat the blades with a thermostat-controlled resistive element, strategically place heat instruments and operating components along its blades, which prevents formation and adherence of ice and low-temperature lubricants during cold weather conditions (Wind Powering America 2008).

Study Methodology

A study by the U.S. Department of the Interior Bureau of Land Management reports that a blade or turbine part rarely travels farther than 1,640 feet from the tower and usually most pieces land within 328 and 656 feet. Again, this usually results from rotor over speed or due to material fatigue (FPEIS 2005). Older turbine designs use light weight blades and rotate and much higher speeds (up to 100 rpm) than modern WESs (closer to 20 rpm), and allow the rotor to "run away" under certain conditions that could result in a significant part being thrown (Mountain View EIS 2007). A study by the KPFF Consulting Engineering suggests a safety setback greater than 625 from wind turbines is sufficient to provide protection of people and facilities from the possibility of blade throw, tower failure and ice throw. "Beyond this safety setback, no impacts from these hazards are expected" (KPFF 2006). However, these adequate setbacks are subjective to turbine dimensions, rotational blade-frequency, and other factors and may vary.

Currently, no studies have been conducted in the United States concerning ice shedding from wind turbine blades, but in a 1998 European study called, "Assessment of Safety Risks Arising from Wind Turbine Icing" that developed a risk assessment methodology to demonstrate the risk of being struck by ice from a turbine (Wind Powering America 2008). Due to local climatic conditions, however, ice shedding is unlikely to occur so setbacks of this distance are unnecessary (Woodlawn Wind Farm EIS 2004).

Expected Impacts

Proposed Ordinance

Ice shedding and blade throw are primary safety issues of concern regarding WESs; however, the expected impacts of wind turbines installed and operated within Whatcom County are seen as minor non-significant. Sufficient safety measures have been adopted in the installment and operation of modern turbine design, which minimizes the possibility of such an occurrence beyond "rare." Monitoring systems would detect potential failure and shut-down the equipment before occurrence (Woodlawn Wind Farm EIS 2004). The ordinance supports these measures by creating a mandate requires "all wind energy systems… be equipped with over speed controls to limit rotation of blades to a speed below the designed limits of the system. No changes or alterations from the certified design shall be permitted unless accompanied by a licensed professional engineer's statement of certification" (Whatcom County Council Agenda Bill 2008). Blade throw and ice shedding is non-significant.

Alternative Action

The alternative must still comply with all federal, state and local guidelines and regulations regarding the project's affect on the environment, building and construction, and occupational and public health and safety. Only licensed personnel are subject to maintenance and system monitoring, and landowners must equip WESs with over speed controls to limit rotation of blades below the designed limits of the system (Whatcom County Council Agenda Bill 2008).

The alternative recognizes the need for "safe distances" greater than the ordinance's safe zone of 1.2 times the tower height and adopted a more strict standard of 1.5 times the sum of the hub height and rotor diameters. This "safe distance" is recognized through GE Energy, a major manufacturer of wind turbines, which would minimize potential harm or injury caused by ice shedding or blade throw to neighboring properties. But, GE also notes that the actual "safe distance" depends on turbine dimensions, rotational speed and other factors (WTSG Report 2008).

The alternative mitigation measures would allow blade throw or ice shedding occurrences associated with WESs, installed within Whatcom County, to be viewed non-significant.

No Action

Under the no action alternative wind turbines may be sited in any zoning district as an accessory use, and are subject to limited setback requirements under Whatcom County's Code, Chapter 20 (WCC 20.80.210). These requirements set minimum setback requirements for sitings next to principal and minor arterials, major and minor collectors, side yards, and back yards. In more densely populated areas (rural and urban), the minimum setback for all structures, including accessory structures are subject only to a setback requirement of 5 feet from neighboring properties. Setback distances required from side and back yards are increased in zoning districts with fewer residencies per square mile (20' in AG and RF zones; 30' in HII; 100' in CF). These setback requirements may not create a "safe distance" from wind turbines to neighboring properties to protect them of potential hazards, such as blade throw or ice shedding occurrences. The no action alternative does not set standards on what type of model could be installed. Modern wind turbines are equipped with over speed controls and emergency safety stop mechanisms; however, older models may not have similar designs. Impacts are seen as minor significant.

Additional Mitigation Measures

Proposed Mitigation

The ordinance has setback requirements and height limitations that shall apply to all WESs and meteorological towers within zoning district areas. In areas that allow for systems greater than 100 feet tall it must obtain additional permits and be located at least 30 feet above any obstruction within 500 feet. These requirements help mitigate potential injury or death caused by blade throw by creating a hazard-safe zone around the tower with a radius of 1.2 times the tower height and allowing greater system sizes to be installed in less densely populated areas.

Alternative Action

Landowners would install cold weather packages in their WESs and avoid placing their towers in extreme harsh weather conditions (such as on a mountain-top) to further mitigate any potential harm or injury caused by ice shedding (Wind Powering America 2008). Safety signs and public education efforts warning the public of dangers associated with wind turbines during winter weather could further ensure that proper safety measures are followed. Maintenance staff would also be trained to recognize icing conditions and confirm that shut down occurs when conditions dictate (WTSG Report 2008).

3.8.3 Tower Collapse

Existing Conditions

Wind turbine tower collapse, while extremely rare, is still a major public health and safety concern regarding system installment and design. "Tower collapse" may occur if the tower of its base or anchorage to the foundation were to fail that would cause pieces of the wind system to fall over or buckle due to gravity (KPFF 2006).

Study Methodology

Modern wind turbine towers and their foundation have incorporated designs to withstand extreme earth shaking/seismic events (magnitude 8.0), 100-year flood erosion (including drainage scour), and high winds up to 130 mph. Whatcom County rarely records wind speeds at this velocity, especially because the strongest storm to hit the United States in the century, called "Storm of the Century," had gusts between 75 and 100mph and a record high wind gust of 127mph in Willamette Valley. Since the March 1993 wind storm, the west coast and inland areas have not experienced such high record winds (Storm King 2008).

WES designs include a safety system to ensure the wind turbine is shut down immediately on the onset of mechanical syndromes (such as nacelle vibration, over speed, grid electrical disorders or loss of grid power) (See "blade throw/ice shedding" section for more information on system safety design) (Mountain View EIS 2007). Turbines must be constructed in compliance with international standards and local building codes, which make the possibility of tower collapse an extremely unlikely event. More than 12,000 wind turbines were documented and analyzed by the Washington State Energy Facility Site Evaluation Council (2003) and not one of them was involved in any case of tubular wind tower collapse.

Expected Impacts

Proposed Action

As stated above under "Study Methodology," the chances of wind turbine collapse are extremely unlikely given modern wind system design, and guidelines and regulations set forth at the federal, state and local levels that workers and landowners must comply. However, if the tower of its base or anchorage to the foundation were to fail, the hemispherical hazard zone on the ground would have a distance radius equal to the tower height (to the rotor centerline) plus one half the rotor diameter. Persons, animals and facilities within this radius would be subject to risk of tower collapse or blade throw that would most likely result in damage, injury or death. Theoretically, it is also possible for tubular steel towers to buckle at some point along their length. Under this scenario the potential area of impact would be smaller than that of a tower failing at its base. The potential hazards associated with tower collapse are seen as non-significant (KPFF 2006).

Alternative Action

The alternative must still comply with all federal, state and local guidelines and regulations regarding the project's affect on the environment, building and construction, and occupational and public health and safety. Landowners must equip modern turbine design that can withstand structural interferences (high winds, floods, earthquakes) to avoid causing collateral damage by tower failure. The alternative minimizes the potential for causing adverse environmental effects and human health risk if an accident occurred on-site due to the increase in setback requirements from the property line and related land use zoning laws. By creating more strict guidelines as to where WESs can be located in relation to adjacent properties and designated critical habitat areas lessens the risk of potential harm or injury caused by tower collapse. Potential hazards associated with tower collapse are non-significant.

No Action
The no action alternative allows wind turbines to be sited in any zoning district as an accessory use, and must comply with county setback requirements (*WCC 20.80.210*). These setback requirements may not create a "safe distance" from wind turbines to neighboring properties and residencies in case of tower collapse. Under current code, there is no stipulation regarding the system design, and older models may not have incorporated design to withstand some environmental conditions. However, the likelihood of an extreme seismic event, a 100-year flood, and winds above 130mph occurring within Whatcom County are not high. The expected impacts under the no action alternative would be non-significant.

Additional Mitigation Measures

Proposed Mitigation
The setback requirements and tower height limitations stipulated by the Whatcom County Planning & Development Services helps to mitigate potential injury or death caused by tower collapse. The setback requirement of 1.2 times the tower height from neighboring property lines and allowing greater system sizes to be installed in less densely populated areas lessens the chances a person may be injured or killed if an event were to occur.

3.8.4 FIRE HAZARD

Existing Conditions
Wind turbines have the potential to present fire hazards because they contain relatively few flammable components; that, in the presence of electrical generating equipment and electrical cables can ignite a fire or cause a medical emergency within the tower or the nacelle. These flammable components include various oils (lubricating, cooling, and hydraulic) and potentially hazardous materials.

Expected Impacts

Proposed Action
Wind turbines present response difficulties to local emergency service providers and fire departments due to their height, physical dimension and complexity of the system. The combination of the elevated location of the nacelle and the enclosed space of the tower interior makes response to fire potentially difficult for local fire departments or emergency service providers to reach. The presence of potentially hazardous materials and high voltage electrical equipment creates another safety risk to local responders (Searchlight Wind Energy 2008). However, in any case a turbine fire generally poses a risk only to the structure itself (WTSG Report 2008). Therefore, potential fire hazard is determined non-significant.

Alternative Action
Maximum wind turbine system size and location requirements stipulated in the alternative minimize risk of potential fire hazard to public health and safety. The amount of potential hazardous material used for the operation and maintenance of wind turbines is lessened highly populated areas, where the system size is limited to maximum height. Shorter tower heights would

be easier for fire personnel to respond and extinguish. And, emergency response time for local service providers is quicker in higher populated districts. In rural and under populated areas, fire generated in the nacelle of a 200 foot tall turbine is not as significant compared to fire in a "high impact industrial" zoning district.

No Action

Under the no action alternative, local emergency service providers and fire departments would respond in case of emergency. But, due to the potential height of wind turbines, fires may not be reachable by emergency services (Searchlight Wind Energy 2008). High voltage electrical equipment and the presence of potentially hazardous materials can also present a safety risk to local responders, as well as the potential start for ground fires to occur (WTSG Report 2008). However, these incidences are rare, and wind turbine fires usually only pose risk to the structure itself. Therefore, fire hazard associated with WESs is determined non-significant.

Additional Mitigation Measures

Proposed Mitigation

The ordinance makes clear that "all wind energy systems shall comply with requirements per the Washington State Department of Labor & Industries and the current adopted edition of the National Electrical Code (NEC)" and "all electrical equipment be safely and appropriately enclosed from unintentional access by means such as barrier fencing, equipment cabinetry or similar. All access doors to Wind Turbine towers and electrical equipment shall remain locked until access is necessary" (Whatcom County Council Agenda Bill 2008). This strictly limits access into the turbine interior to authorized personnel, which makes the system more safe and secure. Also, in the case of any emergency event, local fire departments or emergency service providers would respond and protect the area for ground level fires that may result.

Alternative Action

The amount of hazardous materials shall be minimized by using non-toxic, biodegradable materials. Each turbine should have a first responder designated to assist emergency personnel in locating the turbine in the event of an emergency, and the landowner should be trained in tower rescues as part of the emergency preparedness plan. Response units would be able to handle a turbine fire should it occur by alerting neighbors and protecting the area for ground level fires that may result (WTSG Report 2008). Potential fire hazard under the alternative action is determined as non-significant.

3.8.5 LIGHTNING STRIKE

Existing Conditions

Lightning is the sudden, uncontrolled release of stored electrons that comprise electrical energy. A large number of electrons are usually stored as a result of thunderstorm activity, which creates high voltage electrical energy potential. The energy is then dissipated by discharging to a lower energy potential area. Because lightning strikes are most likely to hit the highest points on a landscape, the nature of a wind turbine structure is such that lightning strike is a potential hazard (Woodlawn Wind Farm EIS 2004).

Study Methodology

Studies show that the probability of a wind turbine being struck is low. The probability of a wind turbine with a 50 meter (164 foot) rotor being struck by lightning is 1 in 1,000,000 per year, and even less for the Northwest region of the United States (Global Energy Concepts 2005). National Oceanic and Atmospheric Administration (NOAA) National Weather Service presents lightning flash density data for Washington State that shows the average number of annual lightning flashes is between 0+ to .5 flashes per square kilometer. Whatcom County has an annual lightning flash density of 0+ to .25 per square kilometer (NOA 2000).

Expected Impacts

Proposed Ordinance

If a high intensity lightning strike were to hit a WES, its electrical equipment will not survive its direct hit and the system's components would have to be replaced for normal operations to recommence (Integral Controls). However, the probability of such event is low; therefore, its expected impacts are non-significant.

Alternative Action

The alternative makes it easier for landowners to install larger (and taller) wind turbines in less populated areas, and smaller wind turbines in residential and urban areas where lightning strike probability is significantly less. Under the alternative, risk to public health and safety resulting from wind turbine lightning strike is minimized compared to the proposed action. Potential lightning effect on health and safety is non-significant.

No Action

The no action alternative allows wind turbines to be sited in zones as an accessory use, but must comply with district height restrictions and setback requirements. Landowners, however, could install larger (and taller) wind systems in residential areas if they obtain a variance and conditional use permit. These actions do not significantly increase the probability of a lightning strike of occurring; therefore, the effects of installing WESs under the no action alternative on the public's health and safety are non-significant.

3.8.6 SHADOW FLICKER

Existing Conditions

Shadow flicker describes the phenomenon of alternating changes in light intensity caused by discontinuous shadow casting from rotating wind turbine blades (Woodlawn Wind Farm EIS, 2004). This occurs as the rotating blades pass between the sun and an observer and is the function of several factors that includes the following: the location of people relative to the turbine, the wind speed and direction, the diurnal variation of sunlight, the geographic latitude of the location, the local topography, the presence of any obstructions, and as a function of tower height and rotor diameter (WTSG Report 2008).

Study Methodology

Shadow flicker, sometimes described as "strobe effect," can be difficult to block out and can cause human health effects if exposed for extended periods. Some people have reported a loss of balance,

nausea and feelings that are largely associated with car or sea sickness (Knoll 2006). People with a personal or family history of migraine, or migraine-associated phenomena such as car sickness or vertigo, are more susceptible to these effects. The strobe effect can also provoke seizures in people with epilepsy. Research exists to suggest that the maximum flicker frequency should not exceed 2.5 Hz in order to these effects (Pierpont 2005).

Shadow flicker intensity decreases as the distance between the viewer and the turbine increases. One study claims that beyond 1 kilometer from a wind turbine, the blades do not appear to be chopping the light, but the turbine is regarded as an object with the sun behind it (Woodlawn Wind Farm EIS 2004).

In Lincoln Township, Wisconsin 230 people living near wind turbines for 2 years were surveyed and the study reported that 33% of residents 800 feet to ¼ mile from the turbines found shadows from the blades to be a problem; 40% living ¼ to ½ mile away; 18% living ½ mile to 1 mile away; and 3% reported a problem living 1 to 2 miles away. The wind turbine sizes in this case were commercial-scale and towered more than 260 feet (Pierpont 2005).

The American Wind Energy Association, on the other hand, states that shadow flicker is not a problem during most of the year at U.S. latitudes because the sun's angle is not low enough in the sky to cause health effects. However, shadow flickering may still be considered an annoyance by some (Health and Safety 2004).

Expected Impacts

Proposed Ordinance

The rate at which modern three-blade wind turbines rotates is less than 1.75 Hz, which is below the threshold frequency of 2.5 Hz identified to cause potential human health effects (Health and Safety 2004). Therefore, the potential impact of shadow flicker on human health is considered negligible and no impact.

Alternative Action

The alternative action meets the standards of the proposed action; therefore, the potential impact of shadow flicker on human health is negligible and no impact. The blade-passing frequency is less than the threshold of 2.5Hz that is identified to cause potential health effects.

No Action

The no action alternative would allow wind turbines to be sited in any zoning district as an accessory use, and must comply with County setback requirements, in Chapter 20.80.210. Currently, Whatcom County's Code does not address WESs, and landowners may choose to install older model designs without over speed control. In more windy conditions, the blade-passing frequency may exceed the threshold of 2.5Hz and cause potential health effects to neighboring residencies, such as feelings of car sickness, headaches, or seizures for those who suffer from epilepsy. Effects on public health under the no action alternative may be minor significant.

Additional Mitigation Measures

Proposed Ordinance

The ordinance makes clear that all WESs "be equipped with over speed controls to limit rotation of blades to a speed below the designed limits of the system. No changes or alterations from the certified design shall be permitted unless accompanied by a licensed professional engineer's statement of certification" (Whatcom County Council Agenda Bill 2008). The over speed controls will not allow the wind turbines to exceed the 2.5 Hz blade sweeping frequency threshold.

3.8.7 Electromagnetic Interference

Existing Conditions

Electromagnetic Radiation [EMR] is a wavelike pattern of electric and magnetic energy moving together. Types of EMR include X-rays, ultraviolet, visible light, infrared and radio waves. EMR is emitted by natural sources like the sun, the earth and the ionosphere. High frequency EMR waves such as X-rays can be damaging to humans but it takes long term exposure to very high levels to damage biological tissue. The concern of EMR is to human health but to electromagnetic interference (EMI). EMI is any type of interference that can potentially disrupt, degrade or interfere with the effective performance of an electronic device. Today's society is dependent on the use of devices that utilize electromagnetic energy such as power and communication networks, electrified railways, and computer networks. During the generation, transmission and utilization of electromagnetic energy, the devices generate electromagnetic disturbance that can interfere with the normal operation of other systems. Therefore, wind turbines have the potential to interfere with devises that utilize EMR

Expected Impacts

Proposed Ordinance

Radars and Radio signals

Wind turbines may have an impact on aviation activity, both civil and military, due to interference with radars that manage aircraft operations. Radar is a system for detecting the presence or position or movement of objects by transmitting radio waves, which are reflected back to a receiver. The radio wave transmitted by radar can be interrupted by an object (also called target), then part of the energy is reflected back (called echo or return) to a radio receiver located near the transmitter. Unwanted radio and background noise can impair effective telecommunications which rely on a strong signal to noise ratio (EWEA).

Masking

Radar systems work at high radio frequencies and therefore depend on a clear 'line of sight' to the target object for successful detection. When any structure or geographical feature is located between the radar and the target, it will cause a shadowing or masking effect. The interference varies according to turbine dimensions, type of radar and the aspect of the turbine relative to the radar. The masking of an aircraft can occur by reflecting or deflecting the returns when the aircraft is flying in the 'shadow' of wind turbines and thus is not detected. Also the masking can occur when returns from the towers and blades of the wind turbines are so large that returns from real aircraft

are lost in the 'clutter' (radar returns from targets considered irrelevant to the purpose of the radar (EWEA).

Returns/Clutter

Radar returns may be received from any radar-reflective surface. In certain geographical areas, or under particular meteorological conditions, radar performance may be adversely affected by unwanted returns, which may mask those of interest. Such unwanted returns are known as radar clutter. Clutter is displayed to a controller as 'interference' and is of concern primarily to air surveillance and control systems - ASACS and aerodrome radar operators, because it occurs more often at lower altitudes. The combination of blades from different turbines at a wind farm can give an appearance of a moving object, which could be considered as an unidentified aircraft requiring controllers to take action to avoid a crash with another aircraft (EWEA).

Scattering, Refraction and/or False Returns

Scattering occurs when the rotating wind turbine blades reflect or refract radar waves in the atmosphere. The source radar system or another system can absorb the waves and provide false information to that system. This effect is not well known, but it has been reported in Copenhagen airport as a result of the Middelgrunden offshore wind farm (EWEA).

The possible effects are multiple, false radar returns are displayed to the radar operator such as blade reflections are displayed to the radar operator as false radar contacts; radar returns from genuine aircraft are recorded but in an incorrect location; and garbling or loss of information.

Marine radars and communication and navigation systems may suffer interference from nearby wind farms. Howard & Braun (2004) stated that most of the effects of Hoyle offshore wind farm do not significantly compromise marine navigation or safety. Mitigation measures in open water include the definition of vessel routes distant from wind farms, while in restricted areas the boundaries of wind farms must be kept at appropriate distances from navigation routes or port approaches (EWEA).

Electromagnetic Interferences

Interference can be produced by three elements of a wind turbine: the tower, rotating blades and generator. The tower and blades may obstruct, reflect, or refract the electromagnetic waves. Interference to mobile radio services is usually negligible. Interference to However, when turbines are installed very close to dwellings, interference has been proven difficult to rule out. The interference area may be calculated using the Fresnel zone. This area is around and between the transmitter and receiver and depends on transmission frequency, distance between them and local atmospheric conditions (EWEA).

The impact of wind turbine generators on electromagnetic waves is relatively minor and a means of mitigation, avoidance and usually be found for all potential impacts. Wind turbines proximity to telecommunication facilities or structures can directly interfere with telecommunications by reflecting of refracting EMR signals. According to the proposed ordinance, each WES shall be set back from the nearest above ground public or private non-participating utility a distance no less 1.2 times the tower height. Up to a maximum of tower height plus 20 feet determined from the exiting power line or telephone line. This distance might be sufficient but it is possible that the one of the proposed mitigation methods might need to be employed to fully mitigate all interference. This may very variable from site to site depending what type of telecommunication infrastructure is located closest to the construction site.

Interference to television signals can be caused by either the reflection or obstruction of the signal by the turbine blades. With glass reinforced plastic blades, modern wind turbines will cause minimal television interference. Portable TV and radio broadcasting could be affected if in direct proximity of a wind turbine.

Alternative Action

The increase in the size of turbines that will be allowed in rural and agricultural areas will have greater interference with RMA because the wind turbine blades will be larger, creating more surface area to impede telecommunications. This will be of little consequence because there are few telecommunications facilities located in these areas. The alternative helps mitigate the interference of RMA by limiting the height of wind turbines to 35 feet instead of 100 feet in areas of high density telecommunications.

No Action

Without the proposed ordinance and alternative the fallowing impacts would be less likely to affect Whatcom county residents: EMR interference, return/clutter, scattering, refraction, masking, and interference with radio and TV signals.

3.9 ENERGY

Existing Conditions

Energy and Whatcom County

The locality of Whatcom County near the Canadian Border makes it an important thoroughfare for energy transmission to the major users of services to the south. Many utilities services including natural gas, petroleum products, and electricity pass through Whatcom County (Comp plan). The principal sources of energy in Whatcom County are electricity and fossil fuels such as gasoline, natural gas, and oil. Energy production within Whatcom County comes mainly from co-generation facilities, large and small hydropower generation facilities.

Utility services in Whatcom County are provided by a number of private and public utility operators. Electrical power is mainly provided by Puget Sound Energy (PSE) with smaller providers including Whatcom PUD, and the cities of Blaine and Sumas contributing. Cascade Natural Gas provides natural gas to most areas of the county. Telecommunications services are provided by a number of telephone carriers, AT&T Broadband for cable, and a number of wireless communication companies (Whatcom Comp Plan).

Puget Sound Energy delivers an average load of 300 MW and up to 500MW of peak power to approximately 93,000 customers in Whatcom County. This is accomplished through over 1,113 miles of overhead neighborhood power distribution, 688 miles of underground neighborhood power distribution, 238 miles of high-voltage transmission lines, 28 distribution substations, and 11 transmission and switching stations. PSE currently has three generating facilities in Whatcom County; Sumas, Encogen, and Whitehorn Generating Station. (PSE Factsheet)

Washington State law under RCW 80.60 provides guidelines for Net Metering and connection of small wind power systems to the power grid. PSE coordinates with customers who generate at

least a portion of the electricity they use through means of solar PV, wind, biomass from animal waste, fuel cell, or other qualifying renewable energy generating systems to connect to the grid. This law provides for credits to individuals for the amount of energy they provide back to the system through local production that they do not use. RCW 80.60 limits the number of consumer net metering connections for an individual utility to 0.25% of that utilities 1996 peak load. All connections utilizing net metering must be sources generating less than 100kw.

A number of agencies have influence over the availability and regulation of renewable energy. The Whatcom County Code contains a number of statements recognizing support for renewable energy approaches. The Federal Energy Regulatory Commission (FERC) regulates the sale of wholesale electricity in the United States. The Washington Utilities and Transportation Commission (WUTC) is a three member board that has supplementary regulatory authority in Washington State. Beginning January 1, 2002, RCW 19.29A directed sixteen of Washington's electric utilities to offer a voluntary "qualified alternative energy product", power generated by renewable sources. Between January and September 2007, 33.7 megawatts of green power were purchased by utility customers in Washington State; a 48 percent increase over 2006. (Green Power Report 2007)

Expected Impacts

Proposed Ordinance

The expected impacts of additional wind energy can be broken down by the types of wind energy. Large scale WES's pose impacts on availability of power grid infrastructure to move the often isolated power source to market and in general the relatively sporadic availability of wind power in the region requires additional preparation by the utilities to have traditional sources ready to make up the difference. Another impact is that existing power grid infrastructure may become constrained and unable to handle all of the energy inputs leading to wasting.
SWES's being a far minor and dispersed input would have little impact to the power grid. Due to the restriction placed on the number of customers-generators there is very little impact to existing infrastructure.

Alternative Action

The alternative ordinance encourages siting of wind turbines in more rural areas and in clusters. This will facilitate easier connections with the energy grid. The alternative has similar though lessened impacts overall to the proposed ordinance

No Action

The expected impacts will be very limited under the no action alternative as it does not encourage wide use of alternative wind power avoiding the consequent challenges.

Additional Mitigation Measures

Proposed Mitigation

Adjust location of larger projects to areas of the grid that are able to handle the increased power generation or upgrade existing infrastructure.

SUMMARY OF FINDINGS

The focus of this environmental impact assessment is on Whatcom County's Wind Energy Ordinance and how it impacts the built and natural environment. The intent of the proposed wind energy ordinance is to make it easier for county residents and business interests to install WESs compared to current regulations. The proposed action may have a more significant adverse effect on the environment as it may not limit wind turbine installations in areas that are not suitable compared to the no action alternative. Regardless, the attempt to promote renewable energy development is commendable.

It is our intent to develop an alternative that not only encourages renewable wind energy development, but in doing so, creates a more logical framework and result-oriented approach. The alternative caters to existing land use and focuses on areas most viable to place wind turbines, and works to mitigate some of the adverse effects under the proposed action. Our analysis attempts to further demonstrate the importance of creating regulation that shows the least amount of environmental impacts and the viability of wind power in Whatcom County.

However, while the alternative action works to mitigate some foreseen environmental impacts that may result under the proposed action in the installation of WESs both pose impacts that are minor to non-significant. Although the proposed action provides a significant worst case scenario it is highly unlikely to come to fruition due to Whatcom County's limited wind resource and the associated poor economic feasibility. Therefore, both the proposed and alternative actions provide suitable regulatory guidance on the development of WESs in Whatcom County.

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APPENDICES

Appendix 1: Whatcom County Base Map

Appendix 2: Whatcom County Wind Resource Map

Appendix 3: Whatcom County Critical Areas Map

Appendix 4: Wind Turbine Viewshed Analysis for Proposed Action

Appendix 5: Wind Turbine Viewshed Analysis for Alternative Action

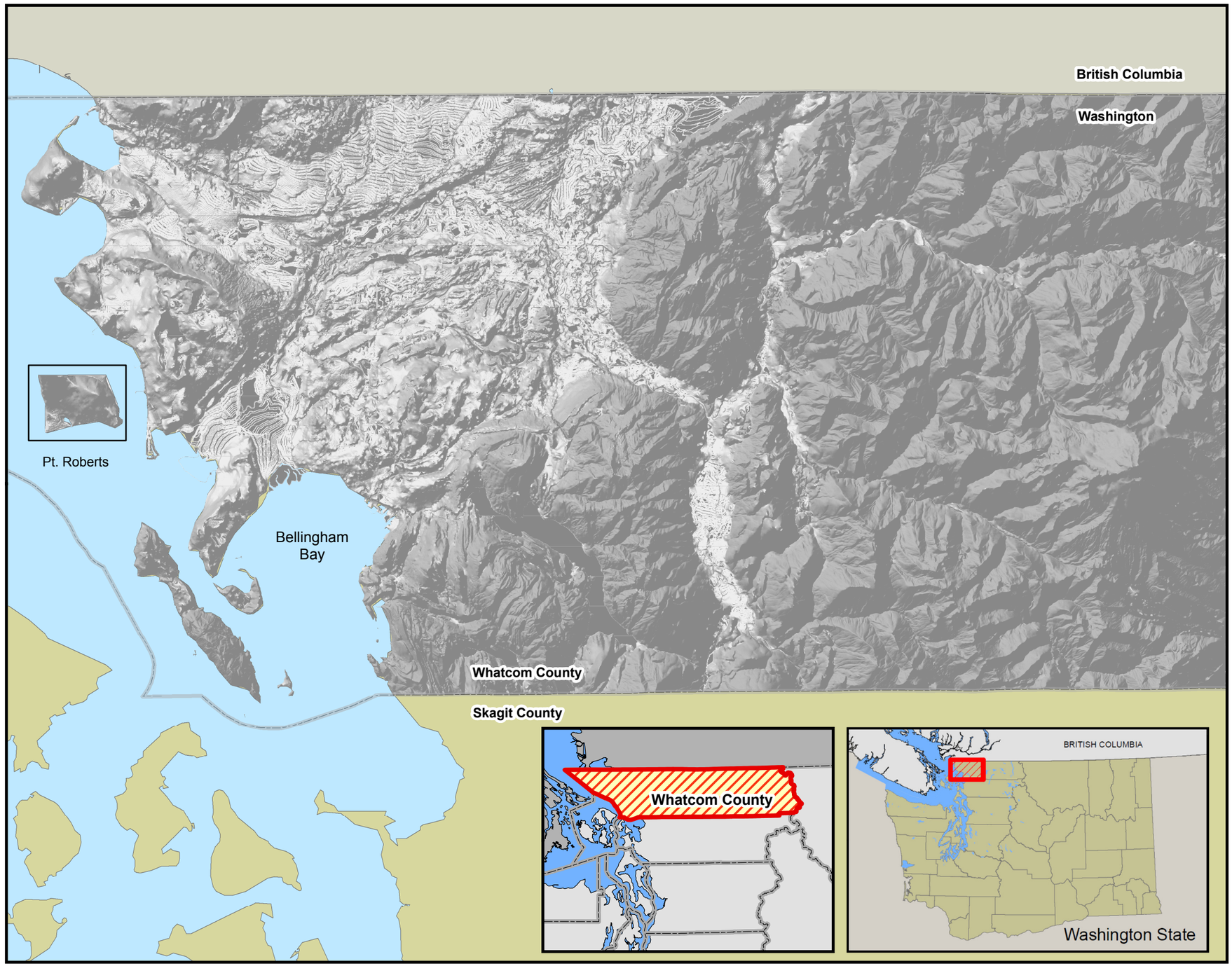
Appendix 6: Wind Turbine Land Suitability Analysis for Proposed Action

Appendix 7: Wind Turbine Land Suitability Analysis for Alternative Action

Whatcom County

Figure A-1

EIA Project Area



Legend

- Whatcom County
- Washington State
- British Columbia

Hillshade

High: 10.780 ft

Low: 0

Source:
USGS, 2001

Projection:
NAD_1927_UTM_Zone_10N
Projection: Transverse_Mercator

Prepared by:
Erica Bartlett & Derek Schruhl

N

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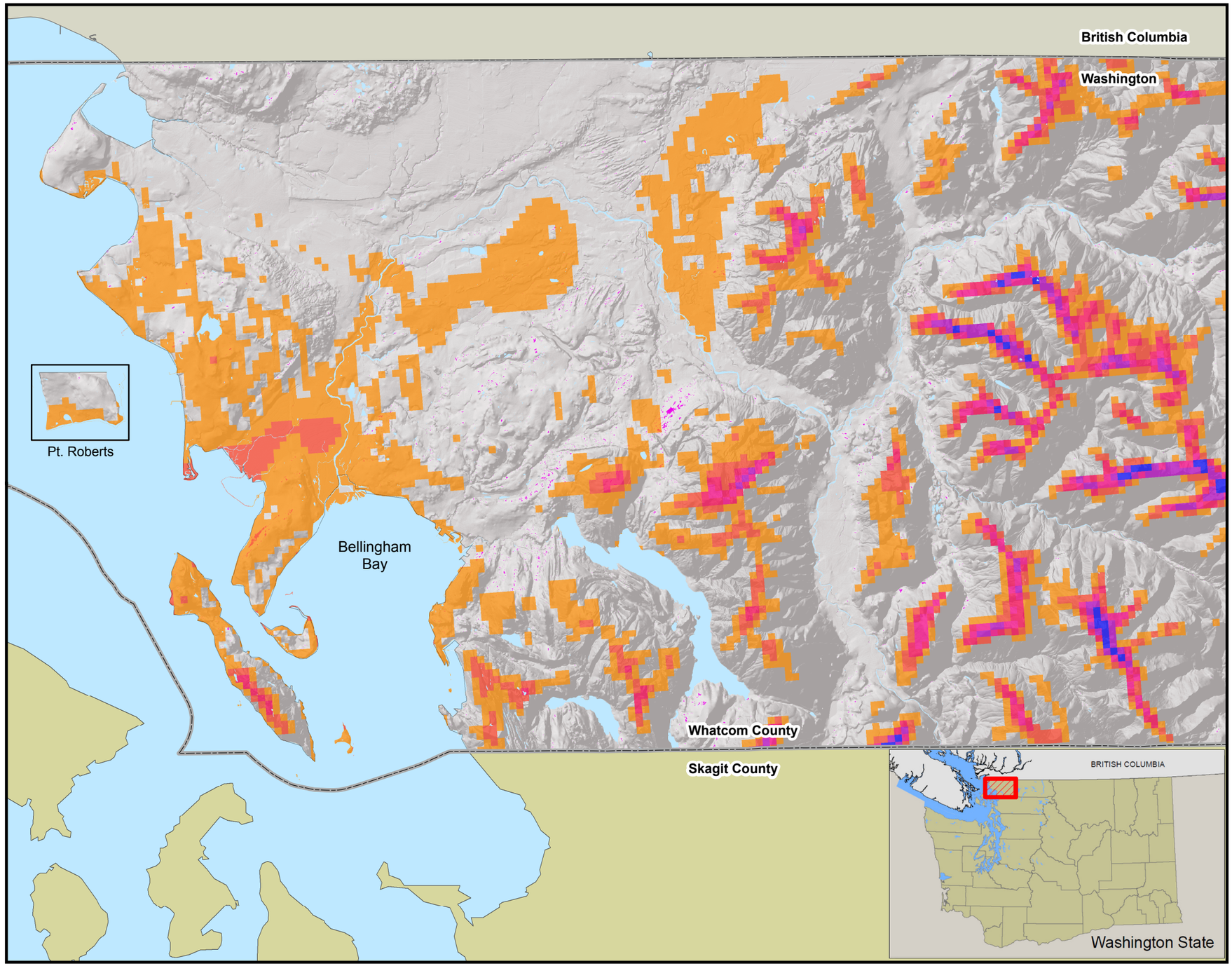

Whatcom County

Figure A-2

Wind Power Resource Estimates

Legend

Whatcom County

Wind Power Classification	Wind Speed at 50m (mph)
2 - Marginal	12.5 - 14.3
3 - Fair	14.3 - 15.7
4 - Good	15.7 - 16.8
5 - Excellent	16.8 - 17.9
6 - Outstanding	17.9 - 19.7
7 - Superb	>19.7

Source:
U.S. Department of Energy
National Renewable Energy
Laboratory, June 2002

Projection:
NAD_1927_UTM_Zone_10N
Projection: Transverse_Mercator

Prepared by:
Erica Bartlett & Derek Schruhl

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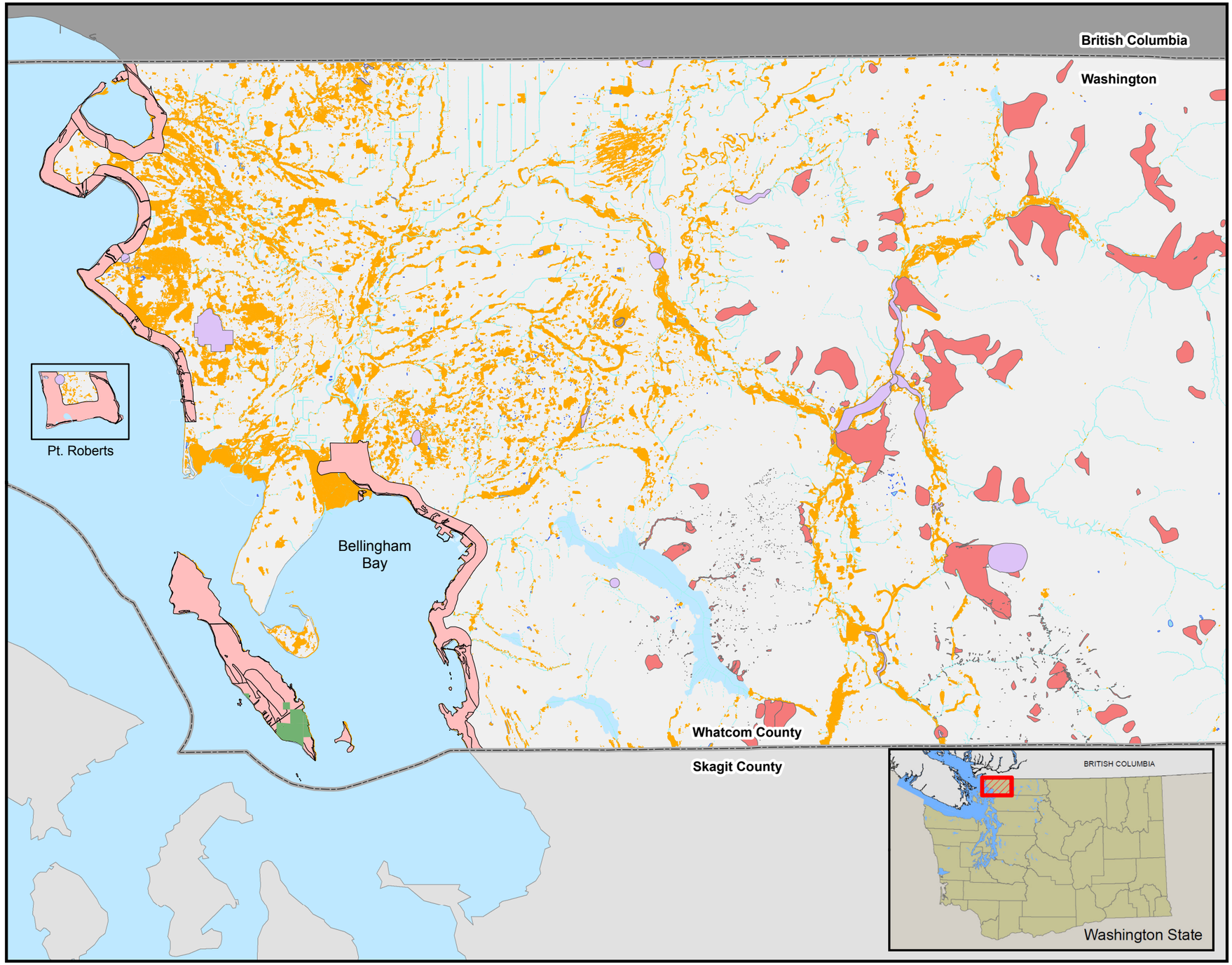

Whatcom County

Figure A-3

Whatcom County Critical Areas

Legend

- Whatcom County
- National Resource Conservation Area
- Fish & Wildlife Habitat Conservation Area
- Shoreline Landslide Hazardous Area
- Landslide Hazardous Area
- Wetland (CAO)
- Ponds
- Fish Stream Habitat

Sources:
National Wetlands Inventory, Whatcom County GIS Data, 1992 Whatcom County Study to identify Category 1 wetlands, 2003 Bellingham Urban Growth Area wetland survey, 2003 Priority Habitats and Species dataset, and NOAA Coastal Change Analysis Program

Projection:
NAD_1927_UTM_Zone_10N
Projection: Transverse_Mercator

Prepared by:
Erica Bartlett & Derek Schruhl

N

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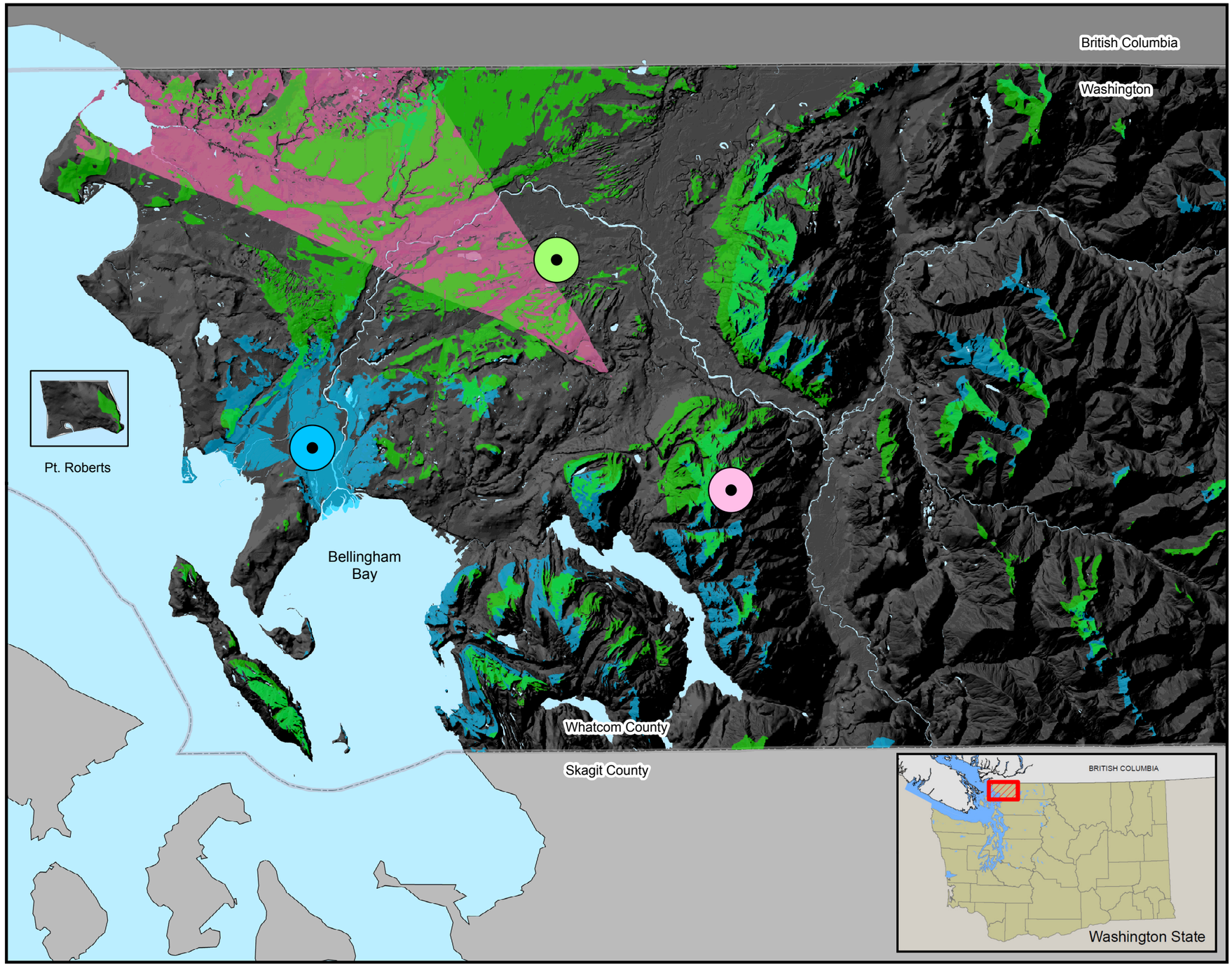


Whatcom County

Figure A-4

Wind Turbine Viewshed Analysis Proposed Action

Legend

- Whatcom County
- 100ft Turbine Sites
  - Rural Zoning District
  - Agricultural Zoning District
  - Forestry Zoning District
- Viewshed Impact Areas
  - Rural
  - Agricultural
  - Forestry
- Hillshade
  - High: 10.780 ft
  - Low: 0

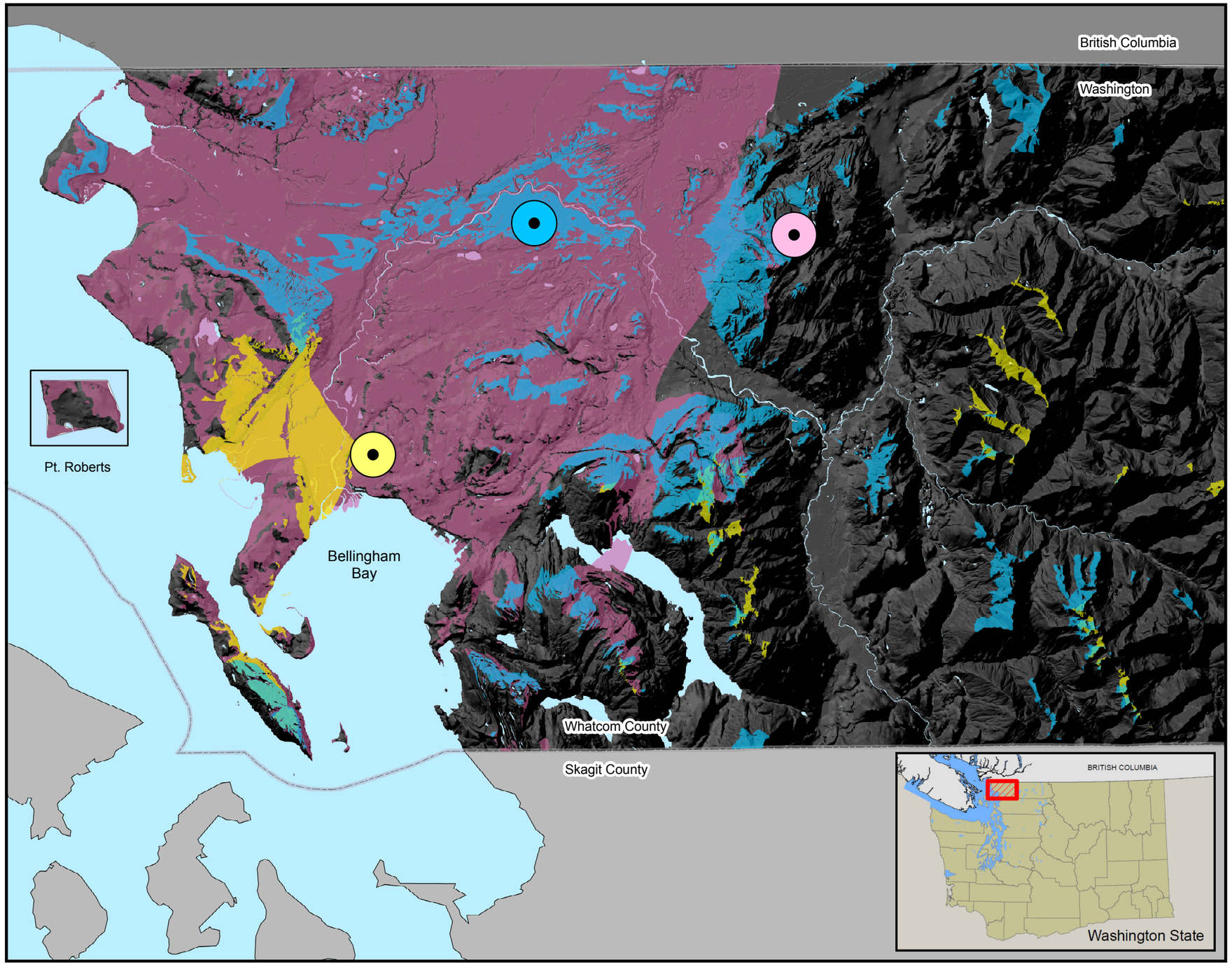
Source:
USGS, 2001

Projection:
NAD_1927_UTM_Zone_10N
Projection: Transverse_Mercator

Prepared by:
Erica Bartlett & Derek Schruhl

N

0 2 4 8 Miles



Whatcom County

Figure A-5

Wind Turbine Viewshed Analysis Alternative Action

Legend

- Whatcom County

200ft Turbine Sites
- Agricultural Zoning District
- Forestry Zoning District

35ft Turbine Sites
- Commercial Residential Zoning District

Viewshed Impact Areas
- Agricultural
- Commercial Residential
- Forestry

Hillshade
- High: 10.780 ft
- Low: 0

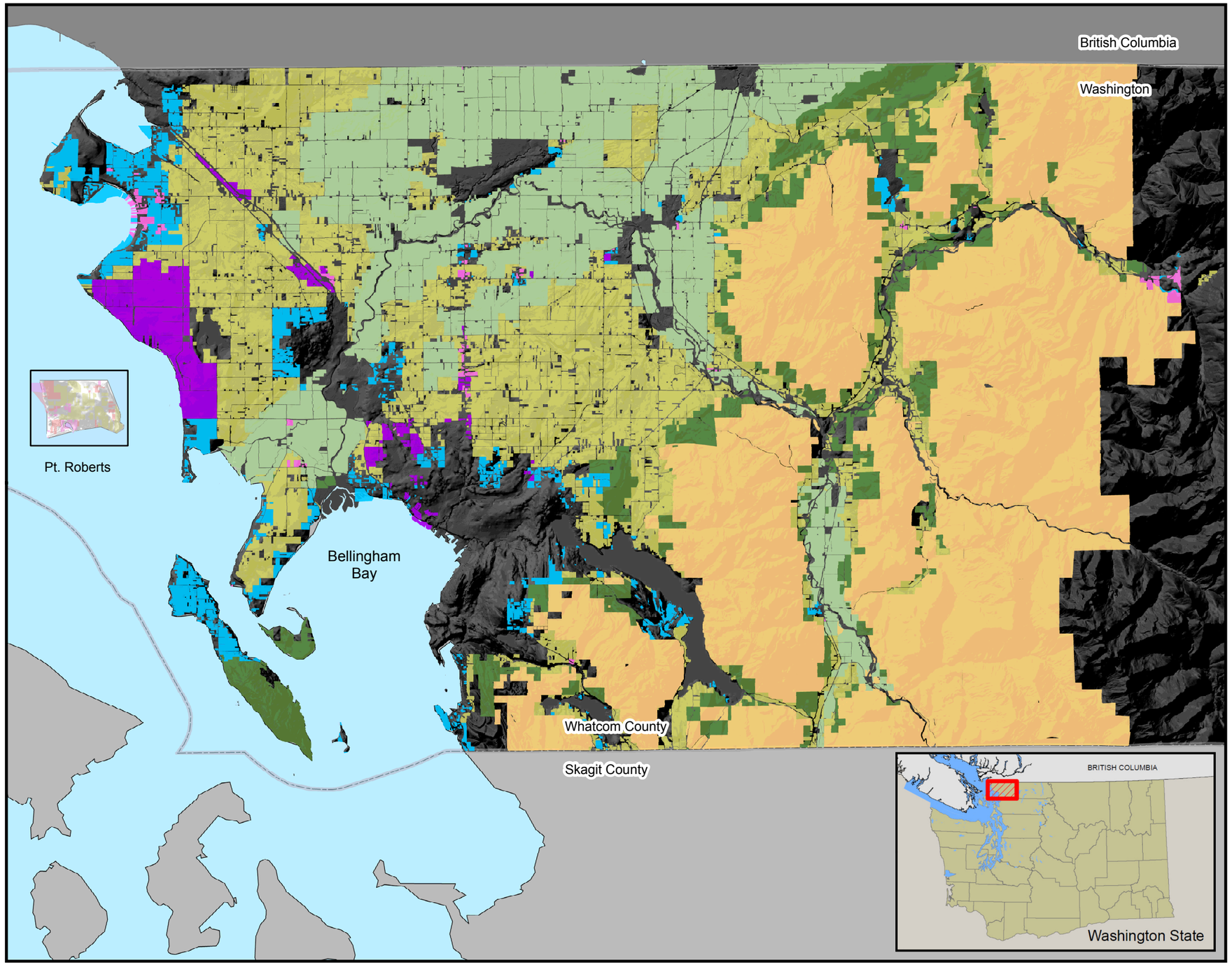
Source:
USGS, 2001

Projection:
NAD_1927_UTM_Zone_10N
Projection: Transverse_Mercator

Prepared by:
Erica Bartlett & Derek Schruhl

N

0 2 4 8 Miles



Whatcom County

Figure A-6

Wind Turbine Siting Analysis: 120 ft Setback Proposed Ordinance

Legend

- Whatcom County
- Agriculture
- Commercial Forestry
- Residential
- Rural Forestry
- Industrial Manufacturing
- Commercial
- Rural

Hillshade

High: 10.780 ft

Low: 0

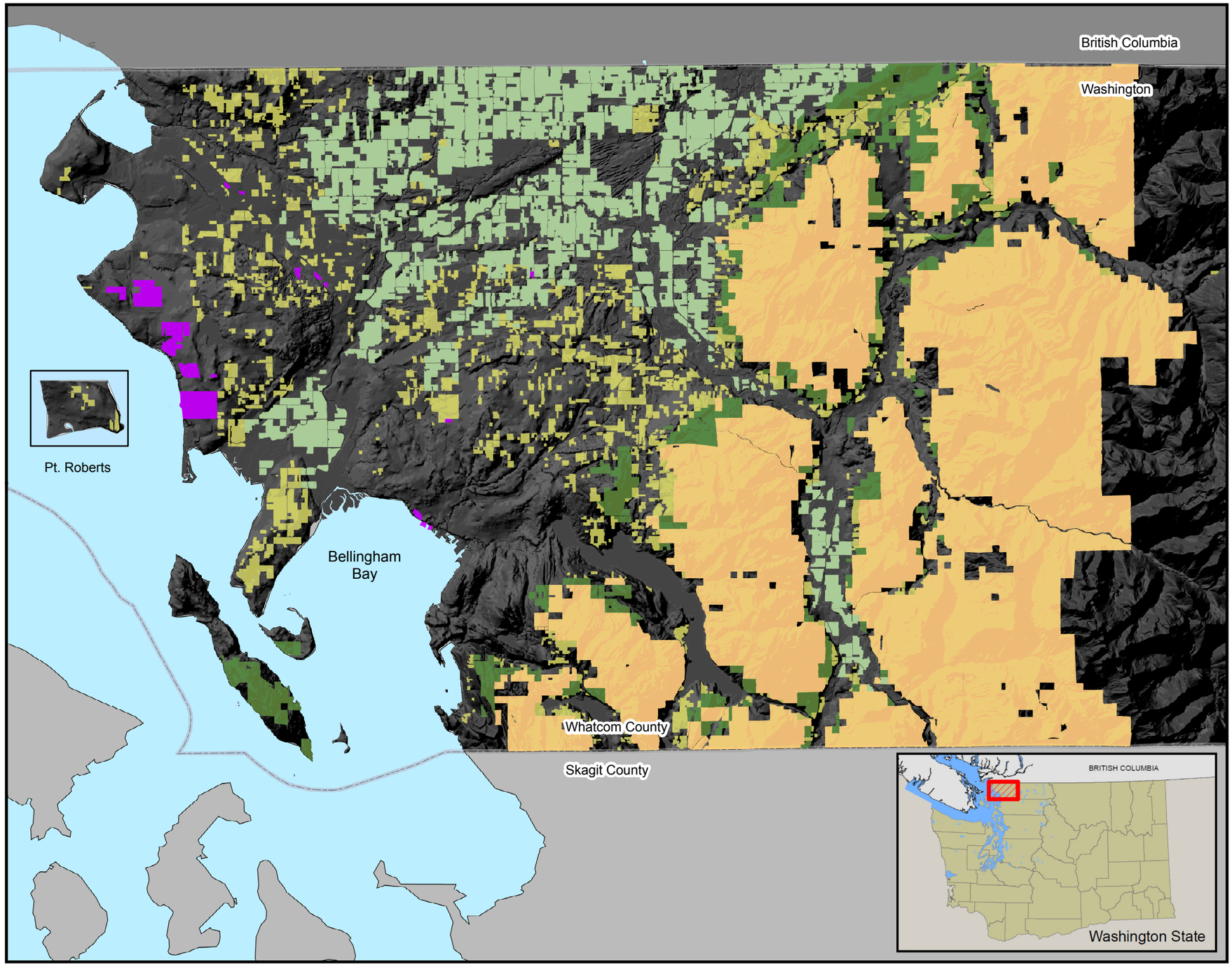
Source:
Whatcom County Planning and Development Services Dept, USGS, 2007

Projection:
NAD_1927_UTM_Zone_10N
Projection: Transverse_Mercator

Prepared by:
Erica Bartlett & Derek Schruhl

N

0 2 4 8 Miles



Whatcom County

Figure A-7

Wind Turbine Siting Analysis: Property/ Critical Areas Setbacks Alternative Ordinance

Legend

- Whatcom County
- Agriculture
- Commercial Forestry
- Residential
- Rural Forestry
- Industrial Manufacturing
- Commercial
- Rural

Hillshade

High: 10.780 ft

Low: 0

Source:
Whatcom County Planning and Development Services Dept, USGS, 2007

Projection:
NAD_1927_UTM_Zone_10N
Projection: Transverse_Mercator

Prepared by:
Erica Bartlett & Derek Schruhl

N

0 2 4 8 Miles