

Part 1 - Summary of Published Literature Reviewed

| Title | Author | Reference | Summary |
|--|---|--|--|
| Microgeneration: A Discussion Paper for Stakeholder Review and Comment Version 1.0 (Discussion Purposes Only - DOES NOT Represent Government Policy) | Alberta Energy | Alberta Energy, August 2007 | Specifically discusses very small scale wind energy generation - at the individual level - in an attempt to make it possible for individuals to produce wind energy for self reliance, but also to regulate this market so individuals are not producing more energy than they need and creating a profit venture. |
| Wind Farm Revitalizes Brownfield Site | American Ceramic Society Bulletin | American Ceramic Society Bulletin, 86(8), 16, 2006 | Case study from California. Steel Winds Wind Farm is located on a former industrial site along the shores of Lake Erie. It is the first commercial deployment of state-of-the-art 2.5-MW Liberty series wind turbines manufactured by Clipper Wind power, Carpinteria, California. Located just south of Buffalo, NY, the 20-MW project is situated on a 30-acre portion of a former Bethlehem Steel facility, which is being returned to productive use under the NY Department of Environmental Conservation Brownfield Cleanup Program. Steel Winds will generate enough electricity to serve the needs of about 6000 homes. For the first five years the project will be operated by UPC Wind, with turbine operation and maintenance services provided by Clipper Wind power. |
| A Skyscraper for New Age | Ashrae Journal | Ashrae Journal, p.7-8, July 2007 | Case study from China. Can a skyscraper produce more energy than it consumes? The question will be answered in 2009 when the Pearl River Tower opens in Guangzhou, China. The 71-story, 2.2 million-ft ² (204,000m ²) skyscraper is designed by Skidmore, Ovinga and Merrill (SOM) to conserve and generate enough power to meet its energy demands. One of the more innovative element will be the sculpted facade that directs wind to wind turbines on the building's mechanical floors. |
| Best Practice Guidelines for Implementation of Wind Energy Projects in Australia | Australian Greenhouse Office | AusWEA (Australian Wind Energy Association), March 2002 | The guidelines aim to establish the process and approach for identifying, developing and implementing appropriate wind energy projects while acknowledging that each wind energy development will require assessment on its individual merits. Similarly the exact timing of the various activities outlined in these guidelines will vary depending on the individual developer's preferred approach. As a result no attempt has been made to define a checklist of project specifications or provide a schedule that can be universally applied to all developments equally. The developer will always need to investigate specific issues that may relate to a particular site and address these accordingly during the development process. |
| Environmental Noise Assessment Pubnico Point Wind Farm | Brian Howe and Nick McCabe | Howe, Brian and McCabe, Nick. Environmental Noise Assessment Pubnico Point Wind Farm, Nova Scotia, August 2006 | The sound level from the wind turbine generators can exceed the background sound level in the area by up to 13 dB under certain wind and atmospheric wind conditions, most notably light wind from the south. |
| When lightning strikes wind turbines | Carsten Wagener, Edward Doherty | Wagener, C., Doherty, E. in <i>Machine Design</i> , 82-84, October, 2007 | Discussion on technologies for avoiding damage when wind turbines are hit by lightning. In a typical lightning strike of a wind turbine, Franklin-type lightning rods in each blade conduct lightning energy to the rotor and then to the skin of the wind turbine nacelle. It then travels down the external skin of the tower to the base. Surge arresters connect between the 400/690-V power supply and a ground rod to keep lightning current out of the power circuitry. |
| Sail-Shaped Office Towers Support Wind Turbines | Catherine A. Cardno | Cardno, C.A. in <i>Civil Engineering</i> (08857024), 77(10), 14-15, 2007 | Case study from Bahrain. The article reports on the construction of two 50-story sail-shaped towers in Bahrain connected by three bridges that support a wind turbine that will generate electricity for the towers. The architectural form of the towers was created from using the nautical expression of a sail to harness the consistent onshore breeze and to create towers that would transcend time. The wind turbines are centered on one of the three bridges linking the towers. The shape of the towers creates negative air pressure as it funnels offshore breezes toward the wind turbines. |
| Environmental Impacts of Wind Energy Projects | Committee on Environmental Impacts of Wind Energy Projects, National Research Council | National Research Council. (2007) Environmental Impacts of Wind Energy Projects. | The US National Academy of Sciences suggests it takes at least 30 wind turbines to reach a kill rate of one bird per year. It was also noted that site selection and weather patterns have a substantial effect on this number. |
| The Influence of Large-Scale Wind Power on Global Climate | David W. Keith, Joseph F. DeCarolis, David C. Denkenberger, Donald H. Lenschow, Sergey L. Malyshev, Stephen Pacala, Philip J. Rasch | Keith, D.W., et al. Proceedings of the National Academy of Science of the United States of America, 10.1073/pnas.0406930101, 2004, electronic version available at http://www.pnas.org.proxy.hil.unb.ca/cgi/content/full/101/46/16115 | Assessment of climatic impacts of wind turbines. Large-scale use of wind power can alter local and global climate by extracting kinetic energy and altering turbulent transport in the atmospheric boundary layer. This paper reports on climate-model simulations that address the possible climatic impacts of wind power at regional to global scales by using two general circulation models and several parameterizations of the interaction of wind turbines with the boundary layer. It is found that very large amounts of wind power can produce non-negligible climatic change at continental scales. Although large-scale effects are observed, wind power has a negligible effect on global-mean surface temperature, and it would deliver enormous global benefits by reducing emissions of CO ₂ and air pollutants. |
| Energy Harvesting Gets Big - And Small | Don Tuite | Tuite, D. in <i>Electronic Design/Energy Independence</i> . 64-68. June, 2007 | Discusses the scaling of energy harvesting: Megascale Harvesting, Microscale Harvesting, and Practical Designs. |
| Wind Turbines' Magnetic Appeal | Drew Robb | Robb, D. in <i>Power Engineering</i> . 6-8. 2007 | The use of permanent magnets (PM) in wind power, paired with direct-drive, multiple generator and compared to synchronous/induction generators. |
| Comparative study of the behaviour of wind-turbines in a wind farm | Emilio Migoya, Antonio Crespo, Javier Garcia, Fermin Moreno, Fernando Manuel, Angel Jimenez, Alexandre Costa | Migoya, E., et al. in <i>Energy</i> , 32(10), 1871-1885, 2007 | The Sotavento wind farm is an experimental wind farm which has different types of wind turbines. It is located in an area whose topography is moderately complex, and where wake effects can be significant. One of the objectives of Sotavento wind farm is to compare the performances of the different machines; particularly regarding power production, maintenance and failures. |
| Wind farms Environmental noise guidelines (interim) | Environment Protection Authority (EPA), South Australia | EPA, December 2007. ISBN 1-876562-43-9 | 35dBA regulation, or 40dBA in an intensive rural or primary production/rural industry zone, or the background noise (LA90, 10) + 5dBA |
| Do wind turbines produce significant low frequency sound levels? | G.P. van den Berg | van de Berg, G.P. presentation at the 11th International Meeting on Low Frequency Noise and Vibration and its Control: Maastricht, The Netherlands 30 August - 1 September 2004 | Low frequency sounds occur when the blade encounters a sudden variation in air flow when it passes the tower; this has not been considered important because it resonates at 1 Hertz. However, this paper argues that this sound modulates a higher frequency sound that is well audible and impulsive in nature. This is stronger at night when the atmosphere is stable, and can become worse if frequencies from multiple turbines coincide. |
| Effects of the wind profile at night on wind turbine sound | G.P. van den Berg | van den Berg, G.P. in <i>Journal of Sound and Vibration</i> , 277(4-5), 955-970. 2007 | As a result of atmospheric changes at night, sounds from wind turbines can be up to 2.6 times higher than predicted at night. Turbines can also produce a thumping, impulsive sound when wind speed increases. Traditional predictions of noise levels are inaccurate because they do not account for this increase at night, or the thumping sound made at high wind speeds by the blades passing the tower. Coinciding pulse trains can cause the sound to increase directly in relation to how many turbines coincide. If two coincide, the pulse is 3db higher, if three coincide the pulse raises 5db. |

Part 1 - Summary of Published Literature Reviewed

| Title | Author | Reference | Summary |
|--|---|--|---|
| The Impact of R&D on Innovation for Wind Energy in Denmark, Germany, and the United Kingdom | Ger Klaassen, Asami Miketa, Katarina Larsen, Thomas Sundqvist | Klaasen, G., et al. in <i>Ecological Economics</i> , 54(2-3), 227-240, 2005 | This paper examines the impact of public research and development support on cost reducing innovation for wind turbine farms in Denmark, Germany, and the United Kingdom (UK). The authors first survey the literature in this field. The literature indicates that Denmark R&D policy has been more successful than in Germany or the UK in promoting innovation of wind turbines. Furthermore, such studies point out that (subsidy-induced) capacity expansions were more effective in the UK and Denmark in promoting cost-reducing innovation than in Germany. The second part of the paper describes the quantitative analysis of the impact of R&D and capacity expansion on innovation. Authors arrive at robust estimations of a learning-by-doing rate of 5.4% and a learning-by-searching rate of 12.6%. |
| Public Health & Safety | Global Energy Concepts | New York State Energy Resource and Development Authority; Public Health and Safety. 2005 | This report is part of a series in the New York State and Energy Resource and Development Authority's Wind Energy Tool Kit that examines a series of possible health and safety impacts of wind turbines and suggests that jurisdictions can address these potential impacts through establishing reasonable setbacks. |
| Wind Farms: Environmental Noise Guidelines | Government of South Australia | Government of South Australia. ISBN: 1 876562 43 9. February 2003 | Case study from Australia. The core objective of these guidelines is to balance the advantage of developing wind energy projects in this State with protecting the amenity of the surrounding community from adverse noise impacts. Wind farms need specific guidelines because wind turbines have unique noise generating characteristics and the environments surrounding wind farm sites usually have low ambient noise. |
| The spectrum of power from wind turbines | Jay Apt | Apt, J. in <i>Journal of Power Sources</i> . 169(2), 369-374. 2007 | The power spectrum density of the output of wind turbines provides information on the character of fluctuations in the turbine output. Here both 1-second and 1-hour samples are used to estimate the power spectrum of several wind farms. The measured output is found to follow a Kolmogorov spectrum over more than four orders of magnitude, from 30s to 2.6 days. Given the magnitude of these fluctuations, a wind system that incorporates batteries, fuel cells, super-capacitors, or other fast-ramp-rate energy storage systems would match fluctuations much better, and can provide an economic route for deployment of energy storage systems when renewable portfolio standards require large amounts of intermittent renewable generating sources. |
| Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk | Jesper K. Larsen, and Magella Guillemette | Larsen, J.K., Guillemette, M. in <i>Journal of Applied Ecology</i> , 44(3), 516-522, 2007 | Wind energy is a fast growing renewable energy source and many offshore wind parks will be erected in shallow waters (<40m deep) where various coastal bird species are found. The two main issues regarding offshore wind farms and birds are disturbance and collision risk. The movement and noise of rotors affected neither the number of common eiders flying within corridors nor the number of birds reacting to decoys. This suggests that the avoidance behaviour observed was caused by the presence of the structures themselves and that eiders use vision when avoiding human-made structures. The observed avoidance behaviour may result in a reduction of habitat availability within and around wind parks, and raises concerns about the possible impact of the extensive development of large-scale wind parks in shallow offshore waters, which are the main feeding areas for sea ducks and other marine birds. |
| Wind Turbines: Noise and Setback Regulations: a Brief Summary | Kaija Metuzals | Metuzals, K. 2006. Wind Turbines: Noise and Setback Regulations: a Brief Summary | Summary of decibel regulations and setback distances table |
| Flexible gears bolster wind-turbine reliability | Kenneth J. Korane | Korane, K.J. in <i>Machine Design</i> . P.24-28, August 2007 | Focuses on a gearbox product designed by Tinken out of Canton, Ohio which can handle 50% more torque than conventional gearboxes, thus increasing the lifespan by up to 6 times. |
| In Defense of the Wind | Lynn Tillotson & Pinker, L.L.P. | Printed document/booklet for advertisement/education purposes | Discusses development plans, appropriate sound thresholds, dealing with opposition, etc. Highlights December 2006 jury case in Abilene, Texas where a group of residents charged FPL Energy's Horse Hollow Wind Energy Center (the largest wind farm development in the world with more than 400 turbines) with the accusation that the turbines created a visual and auditory nuisance. Jurors deliberated for two days, and by a vote of 11-1 decided that the wind farm had not created a nuisance for the plaintiffs. This was the first case of its kind and monumental in the development of wind energy. |
| The Effects of a wind farm on birds in a migration point: the Strait of Gibraltar | Manuela de Lucas, Guyonne F.E. Janss, Miguel Ferrer | Lucas, M.d., et al. in <i>Biodiversity and Conservation</i> , 13(2), 395-407. 2004. electronic copy available at http://www.kluweronline.com.proxy.hil.unb.ca/isn/0960-3115/contents | The interaction between birds and wind turbines is an important factor to consider when a wind farm is constructed. A wind farm and two control areas were studied in Tarifa (Southern Spain). Variables were studied along linear transects in each area and observations of flight were also recorded from fixed points in the wind farm. The main purpose of the research was to determine the impact and degree of flight behavioural change in birds resulting from a wind farm. Study suggests that soaring birds can detect the presence of the turbines because they change their flight direction when they fly near the turbines and their abundance did not seem to be affected. This is also supported by the low amount of dead birds found in the whole study period in the wind farm area. More studies will be necessary after and before the construction of wind farms to assess changes in passerine populations. Wind farms do not appear to be more detrimental to birds than other man-made structures. |
| Small-Scale Wind Turbines, Policy Perspectives and Recommendations for the Municipality of the County of Kings | Marta Downarowicz, Rachel Harrison, Robert Kostiuik, Jeff Wilson | Dalhousie University School of Planning. 2006 | Report written by Dalhousie School of Planning for the Municipality of Kings County that explores the implementation of small scale wind turbines and makes recommendations for permanent policy amendments. The report gives an overview of policy in other jurisdictions, the County's MPS and LUB, and stakeholder input. |
| Landscape and Visual Assessment Guidance for Wind Energy Farm Development | Municipality of Grey Highlands | University of Guelph. 2006 | Report by School of Environmental Design and Rural Planning, University of Guelph, that developed a methodology for landscape assessment and development of criteria for required visual impact assessments. |
| Permitting of Wind Energy Facilities; A Handbook | National Wind Coordinating Committee | National Wind Coordinating Committee (US), Revised 2002. | A handbook for the process of permitting wind energy in the United States with a clear bias in favour of the wind energy industry. Reviews the typical steps in permitting, known impacts of noise, land use impact, bird mortality, etc. Very specifically and clearly recommends upwind placement/turbines as it helps to decrease the noise. |
| Life Cycle Assessment for Emerging Technologies: Case Studies for Photovoltaic and Wind Power | Niels Jungbluth, Christian Bauer, Roberto Dones, Olf Frischknecht | Jungbluth, N. et al. in <i>The International Journal of Life Cycle Assessment</i> , 10(1), 24-34. 2005. electronic copy available at http://www.springerlink.com.proxy.hil.unb.ca/content/r7347txq7567357m/ | This assessment includes four different wind turbines with power rates between 30kW and 800kW operating in Switzerland and two turbines assumed representative for European conditions - 800kW onshore and 2MW offshore. The complex installation of offshore turbines, with high requirements of concrete for the foundation and the assumption of a shorter lifetime compared to onshore foundations, compensate the advantage of increased offshore wind speeds. The differences for environmental burdens of wind power basically depend upon the capacity factor of the plants, the lifetime of the infrastructure, and the rated power. The higher these factors, the smaller the environmental burdens are. The wind power system is quite dependent on meteorological conditions and the materials used for the infrastructure. |
| Exergy and reliability analysis of wind turbine systems: A case study | Onder Ozgener, Leyla Ozgener | Ozgener, O., Ozgener, L. in <i>Renewable and Sustainable Energy Reviews</i> . 11(8), 1811-1826. 2006 | The study undertakes an exergy and reliability analysis of wind turbine systems. In order to extract the maximum possible power, it is important that the blades of small wind turbines start rotating at the lowest possible wind speed. The starting performance of a three-bladed, 3 m diameter horizontal axis wind turbine was measured in field tests. |
| Giant fans of wind energy | Patrick Mahoney | Mahoney, P. in <i>Machine Design</i> . P.47-51. August, 2007 | This article focuses on how the wind turbine works technically and the obstacles that come with an industry and product that are literally becoming super-sized. One portion discusses 'How high is too high?' and concludes that 100-m towers are better for inland while 80-m towers work better on the coast. According to the Global Wind Energy Council, global wind power capacity has been rising 20% annually (at least) since 2000. Modern wind turbines produce 200x more power than equivalent turbines of two decades ago. |
| Irish coast tidal turbine gets go-ahead after successful trials | Professional Engineering | Professional Engineering, p.9, 13 June 2007 | The 'SeaGen' unit will have a 12 MW capacity, making it the world's largest tidal current device by a significant margin. Turbine is like submerged windmill running off of tidal energy. To be installed and connected to the grid by early September 2007. |
| Wind Turbines Pose Lubrication Challenges | Saurabh Lawate, Michelle Graf (The Lubrizol Corp.) | Lawate, S., Graf, M. in <i>Power Engineering</i> . P.62-66. August 2007 | Focuses on maintenance of wind turbines; particularly on the use of lubricant and oil analysis. |

Part 1 - Summary of Published Literature Reviewed

| Title | Author | Reference | Summary |
|--|---|---|---|
| Is wind power ready for prime time? | Stephen Mraz | Mraz, S. in <i>Machine Design</i> . P.44-45. August 2007 | Upscale residents of Martha's Vineyard and Cape Cod oppose a wind farm there. The Cape Cod Wind Farm project would consist of 130 spinning wind turbines covering 25 square miles. The site would be 6 miles from shore, but residents fear it would spoil the scenery and kill the fish. Greenpeace (environmental activist group) insists that offshore windmills pose no threat to marine or avian life. |
| Public policy modelling of distributed energy technologies: strategies, attributes, and challenges | Thomas Bruckner, Robbie Morrison, and Tobias Wittmann | Bruckner, T., <i>Ecological Economics</i> , 54(2-3), 328-345. 2006 | The systems which provide active and passive energy-services are undergoing rapid institutional, commercial, and technical change. As part of this transformation, distributed energy technologies are expected to play a greater role. In addition, governments and local authorities are seeking to encourage selected distributed technologies, including wind power and cogeneration, for reasons of public interest. Even so, most energy sector policy support models have difficulty realizing distributed technologies, particularly where complex component/system interactions arise. High-resolution modelling addresses these shortcomings through increased topological resolution, greater temporal disaggregation, extended model scope, and support for context-dependent component performance. New modelling technique supports decentralized decision-making, automatically captures interacting commercial and technical dynamics, and may be used to investigate structural evolution. A summary of national energy policy modeling strategies and a roadmap are provided. |
| A changing perspective blows in | Tim Lloyd Wright | Wright, T. in <i>Hydrocarbon Processing</i> . P.13. August 2007 | Investment in new wind projects reached \$15 billion last year. The market for turbines grew by 30%. The world currently has around 75 GW of installed wind power capacity. About 20% of that was installed in 2006 alone. |
| Generating energy can be a breeze, Kruse says | USA Today | USA Today, 07347456. July, 2007 | Entrepreneurs Andy Kruse and David Calley present their product: Skystream - a residential wind turbine, 170 pounds, as short as 34 feet, 1.8 kilowatt |
| Response of Rocky Mountain Elk (Cervus elaphus) to Wind power Development | W. David Walter, David M. Leslie Jr., and Jonathan A. Jenks | Walter, W.D. et al. in <i>American Midland Naturalist</i> , 156(2), 363-375, 2006 | Wind-power development is occurring throughout North America, but its effects on mammals are largely unexplored. Our objective was to determine response of Rocky Mountain Elk to wind-power development in south-western Oklahoma. Ten elk were radio-collared in an area of wind-power development on 31 March 2003 and were relocated bi-weekly through March 2005. Wind-power construction was initiated on 1 June 2003 and was completed by December 2003 with 45 active turbines. The largest composite home range sizes (>80 km ²) occurred April-June and September, regardless of the status of wind-power facility development. The smallest home range sizes (<50km ²) typically occurred in October-February when elk aggregated to forage on winter wheat. No elk left the study site during the study and elk freely crossed the gravel roads used to access the wind-power facility. Carbon and nitrogen isotopes and percent nitrogen in feces suggested that wind-power development did not affect nutrition of elk during construction. Although disturbance and loss of some grassland habitat was apparent, elk were not adversely affected by wind-power development as determined by home range and dietary quality. |
| Wind Jammers | Wall Street Journal | Wall Street Journal - Eastern Edition, 250(49), A12. August 2007 | The article comments on the opposition by residents in Cape Cod, Martha's Vineyard and Nantucket in Massachusetts to a proposed wind farm in the area. Environmental group Greenpeace considers wind power a key source of renewable energy while some of the local residents consider it an offense against the scenery. The Cape Wind project will establish 130 wind turbines on Horseshoe Shoal. It asserts that advocates often promote renewable energy not for its economics but because it is virtuous. |
| Minnesota Model Encourages Community Wind | Dan Yarano | Yarano, D. in <i>North American Windpower</i> . 4(12), 18-22, 2008 | Some jurisdictions are recently introducing innovative community-based models for wind development that are moving from consultation to participation to encourage, develop and finance wind projects. For example, 'revenue participation' and 'flip' (ownership percentage flips to greater local ownership at a certain stage in a project) financial structures are being used in Minnesota so local landowners can participate in the development of utility-scale wind power. The goal of these projects is to return financial benefits to landowner beyond the typical land lease payments provided in projects developed by utilities or independent power producers. In exchange for these increased financial benefits, local landowners take a greater role in early development of the projects, occasionally including start-up cash contributions, securing land rights and applying for local permits. By participating in the risk and rewards of development, local communities increase local financial benefits by keeping energy dollars at 'home'. According to the Minnesota Department of Commerce., there are currently more than 850MW of community-based wind projects completed, under contract or being negotiated with Minnesota utilities. |

Part 2 - Summary of Online Research Findings

| Website Link | Organization | Publications | Date | General Information |
|--|--|---|-----------------------|--|
| http://www.eub.ca/docs/documents/directives/Directive038.pdf | Alberta Energy and Utilities Board | Directive 038, Noise Control | Revised February 2007 | Revised provincial requirements for noise control with specific wind turbine references in 1.3, 3.5.3, and 4.1.2. |
| www.nationalwind.org/events/siting/proceedings.pdf | Allen, Matthew | Tools for Evaluating Wind Turbine Visibility | 2005 | Summary of paper presented at conference on topic of wind turbine visibility including line of sight profiles, viewshed mapping, shadow flicker and photographic simulations. |
| http://www.awea.org/smallwind/documents/AWEASmallWindMarketStudy2007.pdf | American Wind Energy Association (AWEA) | AWEA Small Wind Turbine Global Market Study | 2007 | Reviews market for small wind and identifies state and federal policy as the pivotal factor for sustaining and growing small wind market. |
| www.awea.org/smallwind/documents/permitting.pdf | American Wind Energy Association (AWEA) | Permitting Small Wind Turbines: A Handbook | Sep-03 | Handbook that outlines considerations for permitting small wind turbines based on the California experience. |
| http://www.awea.org/smallwind/toolbox2/zoning.html | American Wind Energy Association (AWEA) | Small Wind Toolbox: Zoning | | Brief overview of zoning do's and don'ts from the US experience. |
| http://www.auswind.org/downloads/bestpractice/AUSWINDBestPracticeGuidelines.pdf http://www.auswind.org/downloads/bestpractice/AllAppendicesBPG181206.pdf | Australian Wind Energy Association (AusWEA) | Best Practice Guidelines for Implementation of Wind Energy Projects in Australia and Appendices | 2006 | Guidelines document best practice processes: site selection, preparation for development application, construction, operation and decommissioning at the end of the development's life. For all electromagnetic effects, means of mitigation, avoidance, and remedy can be found. Organizations involved in producing wind standards are highlighted. |
| http://www.auswind.org/downloads/landscape/Wind%20Farms%20&%20Landscape%20Iss%20Web.pdf | Australian Wind Energy Association (AusWEA) | Wind Farm and Landscape Values: Draft Issues Paper | May-04 | A large amount of information on characteristics, landscape values, design solutions, and landscape assessment information. |
| http://www.auswind.org/downloads/landscape/NAF07-06-27FINAL.pdf | Australian Wind Energy Association and Australian Council of National Trusts | Wind Farms and Landscape Values, National Assessment Framework, Final Version | Jun-07 | Framework is to provide a method for assessing, evaluating and managing the impact of wind turbine farms on landscape values. |
| http://www.state.vt.us/psb/document/7250Deerfield/Petition+Support+Docs/Zimmerman/DFLD-JZ-18+Shadow+Flicker+Analysis.pdf | AWS Truewind, LLC | Shadow Flicker Analysis | Jun-06 | Shadow flicker analysis report of the proposed Deerfield Wind Project in Vermont, done on behalf of Vermont Environmental Research Associates |
| www.nationalwind.org/events/siting/proceedings.pdf | Baring-Gould, Ian | Turbine Operation in Icing Climates | 2005 | Summary of paper presented at conference on topic of icing. |
| www.nationalwind.org/events/siting/proceedings.pdf | Bo Sondergaard, Danish Electronics, Light and Acoustics (DELTA) | Propagation of Noise from Wind Turbines on-shore and offshore | 2005 | Precis of paper presented at National Wind Coordinating Conference on wind turbine impacts. |
| http://www.bwea.com/media/news/070328.html | British Wind Energy Association (BWEA) | New research blows away myths on wind farms | 28-Mar-07 | The research found no clear relationship between proximity of wind farms and property prices. Paper cites another study in the US found that property prices within a five mile radius of a wind farm appeared to rise above the regional average, suggesting that wind turbines actually had a positive effect on value. |
| http://www.bwea.com/ref/noise.html | British Wind Energy Association (BWEA) | Noise from Wind Turbines - the facts | Jun-00 | Therefore, if a single turbine emits a 90-100dBA noise level, a 50-60dBA may be reached at 40m and a 35dBA level may be reached at a distance of 500m. |
| http://www.bwea.com/you/siting.html | British Wind Energy Association (BWEA) | Siting a small wind turbine | Jun-05 | The turbulence at top and bottom of cliffs or sharp edges makes them unsuitable for wind turbines. It is essential that turbines be sited away from obstructions, with clear exposure or fetch for the prevailing wind. The ideal position for a wind turbine generator is a smooth hill top, with a flat clear fetch, at least in the prevailing wind direction. Study recommends turbines be placed away from local obstructions such as large trees and houses, or use a taller tower to ensure that the turbine is well above the obstructions. |
| http://www.bwea.com/small/cases.html | British Wind Energy Association (BWEA) | Small Wind Case Studies | 2007 | Several case studies on performance of small wind turbines. Corrou Station - 2.5 kW battery charging wind turbine used for lighting the unmanned remote train station for one hour over each time the train stops when it is dark. Berwickshire Housing Association - three 1.5 kW rooftop turbines aiming to lower tenants fuel costs and reduce reliance on fossil fuel based energy. Ladygrove Primary School - 2.5 kW turbine, generates electricity directly for use in the school with extra being supplied to the local grid, received ~\$25 000 funding, annual savings of ~\$800 and a reduction of 3.5 tonnes/year of CO2 emissions. |
| http://www.caithnesswindfarms.co.uk/ | Caithness Wind Farm Information Forum | Summary of Wind Turbine Accident data to August 31st 2007 | 2007 | Accident statistics relating to wind turbines up until August 31st, 2007. |
| http://www.canwea.ca/images/uploads/File/FINAL-CanWEAPositionOnSetbacks-2007-09-28.pdf | Canadian Wind Energy Association (CanWEA) | CanWEA Position on Setbacks for Large-Scale Wind Turbines in Rural Areas (MOE Class 3) in Ontario | 2007 | Guidance for Municipalities in Ontario on Setbacks for Large-Scale Wind Turbines in Rural Areas. |
| http://www.canwea.ca/images/uploads/File/Wind_Energy_Policy/Municipal_Policy/Rural_Municipalities_Review_and_Approval_Processes_-_Final.pdf | Canadian Wind Energy Association (CanWEA) | Overview for Municipalities of the Review and Approvals Required for Wind Farms in Ontario | 2005 | Comprehensive list of non-municipal bodies that may require review and approval of wind farms and the aspects of development that require municipal approval in rural Ontario. |

Part 2 - Summary of Online Research Findings

| Website Link | Organization | Publications | Date | General Information |
|---|---|--|--------------|--|
| http://www.canwea.ca/images/uploads/File/Wind_Energy_Policy/Municipal_Policy/Rural_Municipalities_Zoning_Template_-_CanWEA_-_Final.pdf | Canadian Wind Energy Association (CanWEA) | Proposed Official Plan Amendment for Rural Municipalities in Ontario Related to Wind Energy Resources | 2005 | Proposed amendment for Official Plan, Zoning by-law, setback matrix and definitions. |
| http://www.canwea.ca/images/uploads/File/EN/Small_Wind_Siting_Guidelines.pdf | Canadian Wind Energy Association (CanWEA) | Small Wind Siting and Zoning Study: Development of Siting Guidelines and a Model Zoning By-law for Small Wind Turbines (under 300 kW). | 2006 | eFormative Options and Entegrity Wind Systems report that addresses small wind definition, overview of municipal approaches to small wind, best practice guidelines for consumers and installers, and model zoning bylaw. |
| http://www.canwea.ca/images/uploads/File/CanWEA_Infrasound_Study_Final.pdf | Canadian Wind Energy Association (CanWEA) | Wind Turbines and Infrasound | 2006 | HGC Engineering report addresses the issues of infrasound and wind turbines and potential impact on residences. |
| http://www.canwea.ca/images/uploads/File/CanWEA_Wind_Turbine_Sound_Study_-_Final.pdf | Canadian Wind Energy Association (CanWEA) | Wind Turbines and Sound: Review of Best Practices and Guidelines | 2007 | HGC Engineering report reviews best practices related to wind turbines and noise. |
| http://www.canwea.ca/images/uploads/File/Wind_Energy_Policy/RABC-CanWEA-TechnicalInformationGuidelinesrePotentialImpactofWindTurbines_2.pdf | Canadian Wind Energy Association (CanWEA) and Radio Advisory Board of Canada (RABC) | Technical Information and Guidelines on the Assessment of the Potential Impact of Wind Turbines on Radio communication, Radar and Seismoacoustic Systems | 2007 | Guidelines provide a series of analytical methodologies to help identify potential impact and interference and act as a voluntary trigger for proponent to notify applicable authority. |
| http://www.canwea.ca/images/uploads/File/GH-RiskAssessment-38079or01a(1).pdf | Canadian Wind Energy Association (CanWEA), by Garrad Hassan Canada Inc. | Recommendations for Risk Assessments of Ice Throw and Blade Failure in Ontario | 31-May-07 | Recommendations for assessing the risk of ice fragments shed from wind turbines striking members of the public in the vicinity of wind farm projects in Ontario and a literature review of wind turbine rotor blade failures based on publicly available information. |
| http://www.cbc.ca/technology/story/2006/09/08/bats-turbines.html | CBC News | Why are wind turbines killing Alberta's bats? | 8-Sep-06 | University of Calgary research project under Dr. Robert Barclay to determine impacts on bats from win turbine development (specifically at the Summerview Wind Farm in Pincher Creek, Alberta) |
| www.cwee.unbc.ca/publications/Mackenzie%20et%20al%202007%20EA%20Scoping%20Documents%20for%20BC.pdf | Centre for Wind Energy and the Environment | Wind Energy Development and Environmental Impact Assessment Scoping Process for British Columbia | 2006 | Report on workshop discussions held at the University of Northern British Columbia on the effect of wind energy development on aerial wildlife. |
| http://coastalhabitatalliance.org/reports/Collision-Report-Executive-Summary-12-18-07.pdf | Coastal Habitat Alliance | Collision Report | Dec-07 | Case study of two proposed developments in South Texas which have already begun construction despite the opposition due to the location: one of the most significant migratory bird corridors connecting Canada and the US to Mexico and South America. A failed project results in bad publicity for wind development, and in this case, it could result in major negative environmental effects (bird fatalities). |
| http://www.countyofessex.on.ca/general/documents/FinalBackgroundStudy5.9.07_000.pdf | County of Essex, by Jones Consulting Group Ltd. | Background Research Paper Windpower & Renewable Energy Planning Study | 4-Sep-07 | Outlines several standards that are used globally to mitigate against the impacts of shadow flicker. These include limiting the amount of time a receptor is affected by shadow flicker to a maximum of 30 hours per calendar year and a maximum of 30 minutes per day (based on a world case calculation – maximum shadow during a day between sunrise and sunset on a cloudless day); maximum of 30 hours per year based on actual/real predicted values as opposed to worst case calculation (based on a German court decision to tolerate 30 hours of actual shadow flicker per year and then applying the probability of sunshine for the area); and separation of the turbine and receptor of a minimum distance of 10 rotor diameters. Variations of the maximum 30 hours per year of shadow flicker have become the prominent standard in use globally. The distance that should be calculated: within 1300m of a turbine with a total height of 140m. |
| http://www.stopillwind.org/downloads/WindTurbineAccidentComp.pdf | Craig, David | Wind Turbine Accident Compilation | 2006 | Accident statistics relating to wind turbines, last updated January 1, 2006. |
| http://www.currykerlinger.com/birds.htm | Curry & Kerlinger, LLC | What Kills Birds? | date unknown | Various causes of bird mortalities and statistics to match |
| http://www.berr.gov.uk/energy/sources/renewables/planning/onshore-wind/shadow-flicker/page18736.html | Department for Business Enterprise and Regulatory Reform, UK | On Shore Wind: Shadow Flicker | | Brief information sheet on shadow flicker for on shore wind turbines. |
| www.airforce.forces.gc.ca/8wing/squadron/ates_turbines_e.asp | Department of National Defence | Wind Turbines and Potentital Impact on Air Traffic Control and Air Defense Radar Systems | 2007 | Process that outlines when to consult with DND concerning the potential development of a wind turbine farm. |
| http://www.countyofessex.on.ca/general/documents/DA2007WindTurbinesandWildlifeLiteratureReviewFinal.pdf | Dougan & Associates Ecological Consulting & Design | County of Essex Windpower & Renewable Energy Planning Study: Wind Turbines & Wildlife: A Literature Review | Dec-07 | Summerview Wind Farm (Pincher Creek, Alberta) study found 620 bats killed in one season (and 30 birds). A case study is done on the Erie Shore Wind Farm, as it is one of the few Canadian examples of a location which has done a significant post-construction study in Canada. Results are very positive; showing that proper siting can reduce bird and bat mortality at wind farms. |
| www.cws-scf.ec.gc.ca/publications/eval/prot/protocols_e.pdf | Environment Canada, Canadian Wildlife Service | Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds | Apr-07 | Companion to Wind Turbines and Birds, A Guidance Document for Environmental Assessment that provides information on types of protocols that may be useful for baseline studies and follow-up monitoring at proposed wind energy sites. |

Part 2 - Summary of Online Research Findings

| Website Link | Organization | Publications | Date | General Information |
|--|--|---|-----------------------|---|
| www.cws-scf.ec.gc.ca/publications/eval/turb/turbines_e.pdf | Environment Canada, Canadian Wildlife Service | Wind Turbines and Birds, A Guidance Document for Environmental Assessment | Apr-07 | Guide refers to environmental assessment of wind energy installations with respect to birds. Pre-assessment tool to identify site and design features that should be considered to minimize impacts on birds. The guide uses a matrix approach based on site sensitivity and facility size to rank the proposed project into one of four project categories that indicates the relative level of effort anticipated in determining and mitigating potential adverse effects to birds. Baseline information, follow-up requirements, and information on assessing cumulative effects are included. |
| http://www.epilepsyfoundation.org/about/types/triggers/photosensitivity.cfm | Epilepsy Foundation | Triggers: Photosensitivity and Seizures | 2002, revised 2005 | Information page by the Epilepsy Foundation, US concerning exposure to flashing lights that can trigger seizures. |
| www.wind-works.org/articles/noisewt.html | Gipe, Paul | Noise from Small Wind Turbines: An Unaddressed Issue | | Article by researcher and author of wind turbine publications about lack of research into understanding and analysing impacts of noise from small wind turbines. |
| www.powernaturally.org/Programs/Wind/toolkit/18_publichealthand safety.pdf | Global Energy Concepts | Public Health and Safety | 2005 | Part of a series of reports in the New York State Energy Research and Development Authority's Wind Energy Tool Kit focussing on public health and safety |
| http://www.energy.gov.ab.ca/Electricity/pdfs/FactSheet_Wind_Power.pdf | Government of Alberta | Talk About Wind Power: Facts on Wind Power | Sep-07 | Fact Sheet: wind has the potential to power 20% of Canada's electricity demand (17 million homes), Alberta currently produces 497 MW of wind energy connected to the grid and has 5500 MW proposed, describes the 'cap' in wind energy in place Alberta before September 2007. |
| www.em.gov.bc.ca/AlternativeEnergy/windpower/windpolicy_07.pdf | Government of British Columbia | Wind Power Projects on Crown Land | 2005 | The Wind Power Operational Policy outlines the type, term and pricing of tenures for wind energy projects on Crown lands. |
| www.communities.gov.uk/documents/planningandbuilding/pdf/147447 | Government of Great Britain | Planning for Renewable Energy, A Companion Guide to PPS22 | 2004 | Document outlines how different levels of government will be involved in renewable energy planning and describes how criteria based policy will be developed. |
| www.gov.mb.ca/conservation/wind-farms | Government of Manitoba | Questions and Answers Regarding Manitoba's Crown Land Policies for Wind Farms | 2006 | Through the Energy Development Initiative the province is developing a wind power strategy and has outlined in a general format its approach to wind farm development on Crown lands. |
| http://www.windturbinehealthhumanrights.com/wtnoise_health_2007_a_barry.pdf | Harry, Dr. Amanda | Wind Turbines, Noise, and Health | Feb-07 | Negative health effects occur in people living as far as 1 mile from wind turbines; therefore, until further medical research can be conducted, she recommends a setback of 1.5 miles. |
| http://www.environ.ie/en/Publications/DevelopmentandHousing/Planning/FileDownload,1633,en.pdf | Irish Department of the Environment, Heritage & Local Government | Wind Energy Development Guidelines | 2004 | This report considered the following factors as important aspects in controlling the visual impact of wind turbines: siting and location, spatial extent and scale, cumulative effects, spacing of turbines, height of turbines, colour and lighting. More than one tower requires a qualitative assessment to minimize the visual impact in certain areas. The development of incremental wind turbine proposals is monitored to gauge the cumulative visual impact on the environment. |
| www.irac.pe.ca/document.aspx?content=legislation/PlanningAct-SubdivisionAndDevelopmentRegulations.asp | Island Regulatory and Appeals Commission, PEI | Planning Act, Subdivision and Development Regulations | Updated June 27, 2007 | Section E 54.1 outlines PEI Provincial regulations for Wind Energy Conversion System Developments |
| www.energy.ca.gov/2005publications/CEC-500-2005-184/CEC-500-2005-184.pdf | Larwood, Scott and vanDam, C.P, California Wind Energy Collective | Permitting Setback Requirements for Wind Turbines in California | 2006 | Study that looks at barriers to new wind energy development with newer turbine designs and reviews existing setbacks and resommendaitons for development of setbacks. |
| www.physics.rutgers.edu/~matilsky/windmills/throw.html | Matilsky, Terry | More on Rotor Throw and Ice Projectiles | | Professor of Physics and Astronomy at Rutgers University in New Jersey who advocates for a more conservative setback distance to protect from ice and blade throw of 518m. |
| http://www.nrel.gov/docs/fy04osti/34662.pdf | Migliore, P. et al | Acoustic Tests of Small Wind Turbines | 2003 | Preprint of a conference paper of the National Renewable Energy Laboratory of the National Wind Technology Centre in the US where 8 small wind turbines ranging from 400W to 100kW were tested for acoustic emissions. Improvement has been made in newer small wind turbines to reduce noise. |
| www.ene.gov.on.ca/envision/gp/4709e.pdf | Ministry of the Environment, Ontario | Interpretation for Applying MOE NPD Technical Publications to Wind Turbine Generators | Revised July 6, 2004 | Guidance document to assist wind turbine development proponents in determining what information should be submitted when applying for a Certificate of Approval (Air). |
| http://www.mdpinchercreek.ab.ca/WECS%20Review.pdf | Municipal District of Pincher Creek No. 9 Report prepared by Oldman River Regional Services Commission | Wind Energy Conversion Systems Review - Draft | 2007 | Mandated review commissioned by municipality after a specified number of turbines were developed in the municipality. Review contains current bylaws, information from public consultations and proposed future direction for bylaws and further study. |
| http://www.nationalwind.org/publications/wildlife/Mitigation_Toolbox.pdf | National Wind Coordinating Committee (NWCC) | Mitigation Toolbox 2007 | 2007 | Mitigation toolbox is a compilation of mitigation policies, guidelines and research that are either directly or indirectly applicable to the wind industry. Although there is considerable research on mitigation, and there are many tools that might be applied in the context of wind power, few scientifically proven mitigation strategies are currently available to the wind industry. |
| www.nationalwind.org/publications/siting/Siting_Factsheets.pdf | National Wind Coordinating Committee (NWCC) | State Siting and Permitting of Wind Energy Facilities | Apr-06 | Offers examples of range of approaches for siting wind energy projects in several US states. |
| www.nationalwind.org/events/siting/proceedings.pdf | National Wind Coordinating Committee (NWCC) | Technical Considerations in Siting Wind Developments: NWCC Research Meeting, Dec. 1-2, 2005 | 2006 | Summaries of papers presented at conference on topics of visual, lighting, sound, electromagnetic and safety impacts. |
| www.nationalwind.org/publications/siting/Wind_power_Facility_Siting_Case_Studies.pdf | National Wind Coordinating Committee (NWCC) | Wind Power Facility Siting Case Studies: Community Response | Jun-05 | Study examined communities' reactions to local wind development projects with the intent of identifying circumstances that distinguish welcomed projects from projects that were not accepted. |

Part 2 - Summary of Online Research Findings

| Website Link | Organization | Publications | Date | General Information |
|--|---|--|------------------------------|--|
| http://www.nationalwind.org/publications/wildlife/wildlife_factsheet.pdf | National Wind Coordinating Committee (NWCC) | Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions | Nov-04 | Fact Sheet: Second Edition, average American Home uses approximately 10,000 kWh per year (~6,000-12,000), 1 MW turbine may generate enough power for 200-600 households; impacts on birds/bats vary from wind farm to wind farm, generally two local impacts are observed: 1) direct mortality from collision, 2) indirect impacts due to avoidance, habitat disruption, and displacement; both migrating and resident birds can collide; raptors are at a higher risk, higher frequency of collisions, reasons unknown; belief that most nocturnal migrating birds migrate at elevations above today's typical turbine heights and that most topographical relief has little influence on migratory behaviour. Pertains to wind turbines of 40 kW or larger. |
| http://www.nationalwind.org/publications/siting/permitting2002.pdf | National Wind Coordinating Committee, National Conference of State Legislatures, USA | State Siting and Permitting of Wind Energy Facilities | 2002 | Compilation of examples that represent the range of siting approaches for wind turbines across the United States. |
| http://www.wind-watch.org/press-070402.php | National Wind Watch | Noise Complaints on Rise with New Industrial Wind Power Projects | 2-Apr-07 | The French National Academy of Medicine has called for a halt of all large-scale wind development within 1.5 kilometers of any residence, because the sounds emitted by the blades constitute a permanent risk for people exposed to them. The U.K. Noise Association studied the issue and agreed with the recommendation of a 1-mile setback. National Wind Watch calls on the commercial wind industry to respect the people who reside in targeted development regions, to honor their right to healthy lives and peaceful enjoyment of their homes, by adopting meaningful setbacks -- measured in miles, not in feet. |
| www.navcanada.ca/ContentDefinitionFiles/Services/ANSPrograms/forms/NC10-0441_en.dot | Nav Canada | Land Use Proposal Submission Form | current | General land use procedure outline and form to submit to Nav Canada for potential wind turbine development |
| www.noblepower.com/issues-and-answers/documents/06-08-23NEP-ShadowFlicker-FS4-G.pdf | Noble Environmental Power | Wind Fact Sheet #4: Shadow Flicker | | Brief information sheet explaining shadow flicker and possible health impacts related to photosensitivity of certain individuals. |
| http://www.gov.ns.ca/enla/ea/docs/EAGuideWindPower.pdf | Nova Scotia Department of Environment and Labour | Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document | 2007 | Guide ensures that proponents will consider issues associated with wind turbines as part of the Nova Scotia Environmental Assessment process. |
| http://www.gov.ns.ca/natr/land/policywindenergy.htm | Nova Scotia Department of Natural Resources | Wind Energy Generation on Crown Land | 2007 | Policies and procedures for developing wind energy generation systems on Crown Land in NS. |
| http://www.ontario-sea.org/pdf/LandownersGuideToWindEnergy.pdf | Ontario Sustainable Energy Association | Ontario Landowner's Guide to Wind Energy | 2005 | A tool for landowners considering wind power development on their land covering models, impacts, land options, lease agreements and financial analysis. |
| http://www.powerauthority.on.ca/Storage/52/4743_C-8-2_Att_17.pdf | Palmer, William K.G. P.Eng. | Setbacks to Wind Turbines in Ontario: An Engineering Justification Based on Public Safety Risk and Ontario Noise Regulations | Aug-06 | Claims the statements and conclusions reached in the Enbridge Ontario Wind Project Environmental Screening Report were inadequate and without justification. He recommends a setback from property lines of 2 times (turbine tower height + blade radius) and a noise setback from homes of 1000m. "...Applying the method shown in the noise assessment of the Enbridge Screening Report will result in over 87% of homes at distances of up to 900 metres above the Ontario standard for noise at times when masking is not available..." |
| http://www.ninapierpont.com/pdf/Health_hazard_and_quality_of_life_3-2-05.pdf | Pierpont, Nina MD PhD - published as an editorial article in the Malone (NY) Telegram | Health, hazard, and quality of life near wind power installations: How close is too close? | Mar-05 | Strong belief that wind turbines should not be sited any less than 1.5 miles (2.2km) from any receptor. Also noted negative effects of noise generated from wind development on the older generation (loss of inner ear functionality, dizziness, etc). |
| www.gov.ns.ca/just/regulations/REGS/envassmt.htm | Province of Nova Scotia | Environmental Assessment Regulations, Section 49 Environment Act - Schedule A Class 1 | current | Pertains to Environmental Assessment required for an electric generating facility which has a production rating of 2 megawatts or more derived from wind energy. |
| http://www.awea.org/smallwind/documents/permitting.pdf | Renewable Energy Program, California Energy Commission and American Wind Energy Association | Permitting Small Wind Turbines: A Handbook, Learning from the California Experience | 2003 | Information on installing and permitting small wind turbines. Includes model zoning ordinance and best practices for municipalities in California |
| www.ceere.org/rerl/publications/whitepapers/Wind_Turbine_Acoustic_Noise_Rev2006.pdf | Renewable Energy Research Laboratory, University of Massachusetts | Wind Turbine Acoustic Noise | June 2002, amended Jan. 2006 | Includes information on sources of wind turbine sounds, infrasound, sound reduction methods, sound from small turbines, factors that affect sound, noise standards and regulations. Recommendation include the following: For large scale turbines- Consider turbines only when accompanied by manufacturer's noise data based on IEC standards or where turbine will be sited in area where there will clearly be no problem; must comply with community noise standards but not held to additional levels of regulation; siting of wind turbines must take into consideration sound levels; if turbine is proposed within a distance equivalent to 3 times the blade-tip height of residences or other noise-sensitive receptors, a noise study should be performed and publicized. For small turbines (under 30Kw)- Sound levels should be measured at higher and lower wind speeds in addition to those measured under the IEC standard. Operation-mode, time-dependent and frequency-dependent component need to be described - need to provide sound measures that proved accurate representation of issues. Wide variety of sound levels from small turbines make blanket setback limits difficult; should be examined carefully based on technology. |

Part 2 - Summary of Online Research Findings

| Website Link | Organization | Publications | Date | General Information |
|---|--|--|-------------------------------|---|
| http://www.bwea.com/ref/novar.html | Robertson Bell Associates, commissioned by National Wind Power Limited | Novar Residents Survey | Jul-98 | Between 13th June-1st July 1998, 203 interviews were carried out among people living near Novar Estate (34 turbines): 69% of those questioned were in favour of the development of wind power in the UK and 68% supported their 'local' wind farm. More people thought the turbines graceful than ugly. |
| http://www.bwea.com/ref/taffely.html | Robertson Bell Associates, commissioned by National Wind Power Limited | Taff Ely Residents Survey | Dec-97 | Between 6-11 December 1997, 336 face-to-face interviews were carried out among people living within a two mile radius of the Taff Ely Wind Farm (20 turbines): more than three in five (63%) say they support the Taff Ely wind farm, including 28% who say they strongly support it. Seven in ten residents (71%) identify no drawbacks with the wind farm. |
| http://www.wind.appstate.edu/reports/Fall2004AdamSacora'sNoiseEmittedbySmallWindTurbinesResearchPaper.pdf | Sacora, Adam | Assessing the Noise Emitted by Small Wind Turbines | Fall, 2004 | Graph taken from the Danish Wind Industry Association showing the 6dBA decrease given doubling of distance. |
| www.renewwisconsin.org/wind/Toolbox-Fact%20Sheets/Shadow%20flicker%20and%20strobing.pdf | Sagrillo, Mick | Home-sized Wind Turbines and "Strobing" | 2003 | Article published in Windletter, monthly newsletter of the American Wind Energy Association, by a small wind energy advocate that states that small wind turbines do not create shadow flicker problems because of size. |
| www.awea.org/faq/sagrillo/ms_ice_0306.html | Sagrillo, Mick | Home-Sized Wind Turbines and Flying Ice | Jun-03 | Sagrillo reviews the literature available and identifies several papers and reports that address ice throws at large wind farms, but none about home-sized turbines. He examines these reports to understand their relevance to home-sized wind systems, and attempts to draw any applicable conclusions. He states that risks are very limited and through anecdotal references refers to ice throw as not occurring beyond the radius of the total turbine height during heavy winds. |
| http://www.sanantonio.gov/aviation/info_noise_regulations2.asp | San Antonio International Airport | Figure: Indoor and Outdoor Noise Level Measurements | date unknown | Common indoor and outdoor sound level measurements. |
| www.scotland.gov.uk/library/pan/pan45-00.asp | Scottish Executive Development Department | Renewable Energy Technologies, PAN 45, Revised 2002 | 2002 | Information on impacts and suggested mitigation strategies of wind turbines |
| http://www.snh.org.uk/pdfs/polsum/StrategicLocationalGuidanceforOnshoreWindfarmsSummary.pdf | Scottish Natural Heritage | Policy Summary: Strategic Locational Guidance for Onshore Wind Farms in Respect of the Natural Heritage | July 2002, Updated April 2005 | This document describe an effort to "zone" Scotland to protect national historic sites, etc from impact of wind turbines. |
| www.web1.msve.msv.edu/cdnr/icethrowseifertb.pdf | Seifert, Henry | Risk Analysis of Ice Throw from Wind | 2003 | Research paper presented at BOREAS, Finland analysing risks of ice throw. |
| http://www.shetland.gov.uk/developmentplans/documents/ADOPTEDVERSATION.pdf | Shetland Islands Council | Interim Planning Policy Guidance: Domestic & Community Aerogenerators and Solar Energy | Nov-04 | Planning and guidance policy from Shetlands Island Council, including brief sections on noise, shadow flicker, electromagnetic inference, visual impact, and safety. |
| http://www.energy.ca.gov/2007publications/CEC-700-2007-008/CEC-700-2007-008-CMF.PDF | State (California) | California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (California Energy Commission) | Oct-07 | Voluntary guidelines which provide information to help reduce impacts to birds and bats from new development or repowering of wind energy projects in California. They include recommendations on preliminary screening of proposed wind energy project sites; pre-permitting study design and methods; assessing direct, indirect, and cumulative impacts to birds and bats in accordance with state and federal laws; developing avoidance and minimization measures; establishing appropriate compensatory mitigation; and post-construction operations monitoring, analysis, and reporting methods. |
| http://www.moorsydeactiongroup.org.uk/dnload/noiseassoc_report.pdf | Stewart, John (The UK Noise Association) | Location, Location, Location: an investigation into wind farms and noise by The Noise Association | Jul-06 | As a general rule, turbines should not be sited within a mile of where people live. Academy of Medicine in Paris agrees. The official government guidelines for the siting of wind farms should be revised to take account of the more intrusive nature of the noise in areas where the overall background noise is low. |
| http://www.sd-commission.org.uk/publications/downloads/Wind%20Power%20-%20your%20questions%20answered%20FINAL.pdf | Sustainable Development Commission | Wind Power: Your Questions Answered | date unknown | Explains UK application process for wind development approval, as well as answers questions relating to the idea of 'Why Wind Power?' |
| http://www.thebluemountains.ca/intranet/files/documents/Constraint%20Summary%20Report%2024%204%2007.pdf | Town of Blue Mountains, by Jones Consulting Group Ltd. | constraints analysis: Renewable Energy Review | 24-Apr-07 | The analysis outlined visual sensitivity of an area – the natural, uninterrupted landscape that exists – as well as the visual absorption capacity – the ability for that natural, uninterrupted landscape to absorb change. In the same region, the Niagara Escarpment Commission has taken a position prohibiting any large scale wind development facilities anywhere within the Niagara Escarpment Plan partially due to their assessment of negative visual impacts. |
| http://www.tc.gc.ca/CivilAviation/Regserv/Affairs/cars/Part6/includes/printable.asp?lang=en | Transport Canada | Canadian Aviation Regulations (CARs), Part VI - General Operating and Flight Rules, Standard 621.19 - Standards Obstruction Markings | 2000 | Standards to ensure aviation safety based of height and location of a structure. |
| www.tc.gc.ca/pdf/26-0427.pdf | Transport Canada | Standards Obstruction Markings - Aeronautical Obstruction Clearance Form | current | Form to submit to Transport Canada for structures within 6 km of aerodrome, 2 km of a TC radar, radio navigation or radio communication antenna, over 20 m in height, or a new structure within 15 m of a dominant structure and exceeds it in height. |

Part 2 - Summary of Online Research Findings

| Website Link | Organization | Publications | Date | General Information |
|---|---|--|--------|--|
| http://windfarms.files.wordpress.com/2007/12/wind_ordinance_11-28-071-final-draft-1.pdf | Trempealeau County | Wind Generator and Wind Generating Facility Ordinance for Trempealeau County; Chapter 21 | Nov-07 | Setback requirement of 1 mile (1.6km) from any inhabited structure unless mitigation methods agree to (and recorded) by any habitant within this boundary. |
| http://www.defenselink.mil/pubs/pdfs/WindFarmReport.pdf | U.S. Department of Defense | The Effect of Windmill Farms on Military Readiness | 2006 | Report to the Congressional Defense Committees that discusses mitigation approaches to reduce impact of wind turbines on air defense radar. |
| http://joomla.wildlife.org/documents/positionstatements/Draft_Wind_Energy.pdf | Wildlife Society (US): The Impacts Wind Energy Facilities on Wildlife and Wildlife Habitat (Technical Review) | (Draft position statement) | | The document makes the point that the use of standardized protocols to address specific questions would greatly improve comparability of studies and credibility of efforts. Consistency across data collection efforts, post-construction evaluations, and access to resulting data will be critical for conducting meta-analyses so that consistent effects could be detected. Policy of The Wildlife Society in regard to wind energy development is outlined. |
| www.bwea.com/pdf/small/wineur.pdf | WINEUR | Wind Energy Integration in the Urban Environment | Jul-05 | Study to identify conditions necessary for integration of small wind turbines in the urban environment |
| www.awea.org/pubs/documents/01_AWEA_Audubon_Proceedings_24.pdf | Workshop Proceedings, American Wind Energy Association, Audubon California, Centre for Energy Efficiency and Renewable Technologies | AWEA / Audubon Workshop: Understanding and Resolving Bird and Bat Impacts | Feb-06 | Meeting summary from the "Understanding and Resolving Bird and Bat Impacts" forum held in January of 2006. Wind developers, government officials, researchers, conservation organizations and other experts gathered to share the best current data on wind power's impacts on birds and bats in California and to consider state-wide guidelines for the study, siting and operation of wind power facilities to prevent and minimize such impacts. Abstracts of panel presentations and individual speeches are included, along with summaries of the discussions following each presentation. |
| http://www.who.int/docstore/peh/noise/guidelines2.html | World Health Organization (WHO) | Guidelines for Community Noise | 1999 | World Health Organization's Noise Guidelines: continuous sound greater than 30dBA disrupts sleep, and sound at 45dBA creates sleep disturbance. |

Part 3 - Summary Discussions with Technical Experts

| Correspondence with | Location | Organization | Date | Discussion |
|---|---------------|---------------------------------|------------------------|---|
| Gordon Whitehead, Retired Audiologist | Nova Scotia | N/A | 2-Apr-07 | Personal letter of communication to Ms. Aftab Erfan (Jacques Whitford) as a response to the public input meeting held at St. Margaret's Bay Centre to discuss wind development within the HRM. "The purpose of this letter is to provide a brief comparison between my report of 23 May 2006, which contained the sound level measurements and analysis that I generated, and the report of HCG Engineering entitled Environmental Noise Assessment – Pubnico Point Wind Farm, Nova Scotia, of 23 August 2006 (Natural Resources Canada Contract NRCAN-06-00046), in addition to a couple of other points." |
| Dr. John Walker, Noise & Air Quality Specialist | Nova Scotia | Jacques Whitford | 5,6-Nov-07 & 11-Jan-08 | Infrasound occurs naturally. When people are exposed to frequencies of less than 20 hertz, you begin to get complaints of infrasound. Modulation from the wind turbine blades is about 1 hertz, but 'masking' noise (i.e. highway or other wind) often makes it acceptable during day time. Stratification of the atmosphere at night causes background noise to decrease and the turbines to seem louder. The wind turbine sound/velocity is often oddly close to a resting human heart. Recommended a conversation with Tom Mills @ Vestas. In agreement that more accurate regulations are needed in the industry. Acknowledges that best distance from the turbine depends on the turbine height and power but sees 1.5km as a viable option. Explains that upwind turbines are the only viable option now and reduce noise considerably from where wind power originated - although do not eliminate modulation issues. |
| Tom Mills, Wind & Site Engineer | Oregon | Vestas | 6-Nov-07 | More accurate regulations are needed as the current ones are based on the old German models. Developers will tend push the current (inadequate) regulations and subsequently 'dirty' the name/concept of wind energy. Regulations are not advanced enough to protect against impacts of wind turbines currently as inferior regulations are being stretched. It's important to note the sound level of individual turbines in comparison to background noise at any location. Suggest setting a 35/40 db sound level/limit at the nearest residence, then if developer has the resources and wants to push that, they have to do a site background noise check and must prove that they are less than 5 db higher than the current background noise. Also suggests referring to South Australian Sound Guidelines, which were based on the New Zealand guidelines relating to ISO 9613-2. |
| Bill Ellis, Manager Technical Services | Nova Scotia | Nova Scotia Power Inc. | 9-Nov-07 | Nova Scotia Power's Net Metering Program aligns with the Small-scale category and is applicable to generators (any renewable type) rated less than 100 kW. These are typically owner-operated units that are normally directly connected to the consumer's service. These wind turbines are typically in the 1 kW to 50 kW range with the vast majority in the 1kW to 10kW range and are usually mounted on steel truss tower which are guyed. There is a standard NSPI power rate for this type of connection and information can be found in NSPI's Rates & Regulations (Regulation 3.6). The Large-scale wind generation aligns with the various wind turbines (currently 60 MW) connected to NSPI's Distribution (12 kV and 25 kV) and Transmission systems (69 kV, 138 kV, 230 kV, 345 kV). These large-scale utility grade wind generators are typically designed with capacities in the range of 0.6MW to 2.0MW and as high as 5MW under development, with the majority of models at the 1 to 2 MW range. These turbines may be connected individually or in multiples in a wind farm. They are typically mounted on self-standing (unguyed) hollow steel towers with nacelles at heights of 60/80/100 meters. Typically these types of installations would have a formal Interconnection Agreement with the host utility and would have a Power Purchase Agreement with the end user/purchaser of the energy generated. |
| Tony Mason | New Brunswick | Transport Canada | 3-Dec-07 | Transport Canada is concerned about acceptable siting, lights and paint (colour) of wind turbines. There is a great deal of interpretation of the recommendations in the Canadian Aviation Regulations Standard 621.19 across the country. Currently there is a review of the standards that is being considered by the Justice Department. Mr. Mason recommends that the Aeronautical Obstruction Clearance Form 26-0427 (0005-01) be filled out and sent into the regional office of TC for review. With regard to lighting, TC strongly recommends lighting for structures over 150 m and would suggest lighting for towers between the heights of 90-150 m. In the CAR Standard 621.19 there is a recommendation that blades be painted orange and white but this is no longer suggested since the painting scheme causes the blade to be less visible. Instead a solid white colour is recommended. |
| Paul Pinard and Darrell Perala, Aeronautical Information Services | Ontario | Nav Canada | Dec. 13 and 14, 2007 | Discussion with Aeronautical Information Services at Nav Canada focussing on when a wind turbine developer needs to contact the department about a proposed turbine development. Nav Canada needs to know specifically about any turbines proposed within a 10 km radius of an airport and outside of a 10 km radius of any proposed built structure taller than 30.5 m (100ft). Potential developers need to fill out the Land Use Proposal Submission Form and send to the department. Nav Canada notes that the impacts of wind turbines on radar and other communication systems are continuing to emerge as wind turbines, especially wind farms, are becoming more prevalent. With regard to small wind turbines, the department needs to know about proposed installations over 30.5m so that they can be plotted on their land use maps and be entered into their database for reference for future developments. Although the form could be overly technical for some small wind farm developers the department essentially is looking for total turbine height and the coordinates of the proposed development. Developers can contact Nav Canada at 1-866-577-0247 or landuse@navcanada.ca for further information or assistance. Essentially, Nav Canada is interested in plotting structures on their land use maps (national database of towers) and preventing any potential interference with radar systems. |
| Mark Elderkin | Nova Scotia | Department of Natural Resources | 17-Dec-07 | One of the authors of the current NS guidelines; believes location choice makes a wind farm acceptable or not in terms of impact on wildlife (inclusive of birds and bats). Bats are less of an issue on coastal areas because they are more centrally located here in NS, while areas which should be avoided to protect birds are staging areas for migrating song birds, extreme fog areas, lower Digby Neck, and Cape Sable Island. Also presents the idea that high places in the province are serving as connectivity corridors for mammals as a result of all of the low land being taken up by roads and developments. Notes that the an evaluation of the cumulative sum of any proposed project is asked for to mitigate natural avoidance of any areas by mammals. |

Part 4 - Summary of Governmental Bodies and Documents Consulted

**The following government (municipal and *provincial*) bodies were consulted as part of this research project either by phone interview, web search and/or email correspondence.

| | |
|---|--|
| <u>Nova Scotia</u> | |
| Department of Environment and Labour | |
| Department of Natural Resources | |
| County of Pictou | |
| District of Clare | |
| District of Digby | |
| Annapolis District Planning Commission | |
| District of Guysborough | |
| District of Yarmouth | |
| County of Colchester | |
| District of Argyle | www.munargyle.com/~munargyl/index.php?option=com_docman&task=cat_view&gid=23& |
| District of Barrington | www.barringtonmunicipality.com/land%20use%20by-law.pdf |
| Region of Queens Municipality | www.regionofqueens.com/documents/1st%20Draft.pdf |
| Halifax Regional Municipality | www.halifaxregionalplanning/documents/HRMWindEnergyStudyReport.DOC |
| | www.halifax.ca/council/agendasc/documents/061121ca10-1-3.pdf |
| Town of Truro | http://truro.ca/documents/MPSOfficeConsolidation-May10_001.pdf |
| | http://truro.ca/documents/LUBOfficeConsolidation-May10_001.pdf |
| Cape Breton Regional Municipality | http://www.cbrm.ns.ca/portal/services/departments/planning/documents/CBRMMPWitha |
| | http://www.cbrm.ns.ca/portal/services/departments/planning/documents/CBRMLUBwitham |
| County of Cumberland | http://www.cumberlandcounty.ns.ca/bylaws/2005-01.pdf |
| | http://www.cumberlandcounty.ns.ca/bylaws/2007-03.pdf |
| County of Kings | www.countykings.ns.ca/comdev/mps/sections/mps-5-4.pdf |
| | www.countykings.ns.ca/comdev/lub/sections/section1.pdf |
| District of Lunenburg | http://www.modl.ca/component/option,com_docman/Itemid,380/task,cat_view/gid,101/ |
| Municipality of East Hants | |
| <u>Prince Edward Island</u> | |
| Provincial Planning Act | |
| City of Charlottetown | www.city.charlottetown.pe.ca/files/Zoning_%20Development_Bylaw_July_2007.pdf |
| <u>Ontario</u> | |
| Ministry of the Environment | |
| City of Windsor | |
| Township of Frontenac Islands | |
| Township of Prince | |
| Municipality of Grey Highlands | www.greycounty.ca/files/pagecontent/County%20Modified%20LOPA%2010-Oct11-2007.pdf |
| Township of Huron-Kinloss | www.huronkinloss.com/documents/downloads/officialplan.pdf |
| Prine Edward County | www.pecounty.on.ca/government/planning_services/pdf/1816-2006ZoningBylaw.pdf |
| County of Bruce | www.brucecounty.on.ca/planning.php |
| | www.brucecounty.on.ca/downloads/planning/Staff- |
| <u>Manitoba</u> | |
| Portage Community Planning Services Regional Office | |
| Regional Municipality of Cartier | |
| <u>Alberta</u> | |
| Department of Infrastructure and Transportation | |
| Alberta Energy and Utilities Board | http://www.mdpinchercreek.ab.ca/WECS%20Review.pdf |
| Municipal District of Taber | |
| Municipal District of Pincher Creek | |
| <u>British Columbia</u> | |
| Ministry of Energy, Mines and Petroleum Resources | |
| Peace River Regional District | |