BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION BY PREVAILING WIND PARK, LLC FOR A PERMIT FOR A WIND ENERGY FACILITY IN BON HOMME, CHARLES MIX, AND HUTCHINSON COUNTIES, SOUTH DAKOTA, FOR PREVAILING WIND PARK ENERGY FACILITY

SD PUC DOCKET EL18-026

PRE-FILED SUPPLEMENTAL DIRECT TESTIMONY OF MICHAEL MAROUS
ON BEHALF OF PREVAILING WIND PARK, LLC

August 10, 2018

I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, employer, and business address.

A. My name is Michael MaRous. I am the owner and president of MaRous & Company. My business address is 300 South Northwest Highway, Suite 204, Park Ridge, Illinois 60068.

Q. Briefly describe your educational and professional background.

A. I graduated from the University of Illinois at Urbana-Champaign with a B.S. in Urban Land Economics and began my career working with a Chicago real estate appraisal and consulting firm. I founded MaRous & Company in 1980. I have a South Dakota State Certified General Appraisal License, No. 1467CG.

During my career, I have appraised real estate located in more than 25 states and reflecting a total value in excess of $15 billion. Properties include general industrial, commercial, and residential parcels, as well as vacant land and also specialized properties and interests, including air/development rights, billboards, cemeteries, easements, golf courses, gambling facilities, schools, streets, tank farms, waste transfer stations, utility and railroad rights-of-way, and energy-related projects.

Energy-related projects include the Dakota Range Wind Project in Codington County and Grant County, Deuel Harvest Wind Farm in Deuel County, and the Crocker Wind Farm in Clark County, all in South Dakota; the Grand Ridge V and Otter Creek wind farms in LaSalle County, the Pleasant Ridge Wind Farm in Livingston County, the Walnut Ridge Wind Farm in Bureau County, the McLean County Wind Farm in McLean County, and the Twin Forks Wind Farm in Macon County, all in Illinois; the Freeborn Wind Farm in Freeborn County, Minnesota; the Ida II Wind Farm in Ida County, the Palo Alto County Wind Farm in Palo Alto County, both in Iowa; the Orangeville Wind Farm in Wyoming County, New York; the Dorchester County Solar Farms in Dorchester County, Maryland; and the

Badger Hollow Solar Farm in Iowa County, Wisconsin; and proposed natural gas-fired electric plants in various locations.

My statement of qualifications is included at the end of the August 10, 2018 Market Impact Analysis ("Market Analysis") for the Prevailing Wind Park Project attached as Exhibit 1.

II. OVERVIEW

Q. What is your role in the Prevailing Wind Park Energy Facility ("Project")?

A. I was retained by Prevailing Wind Park, LLC ("Prevailing Wind Park") to prepare an independent market analysis of the potential impact, if any, the Project would have on the value of the properties in the general area of the Project in Bon Homme, Hutchinson and Charles Mix counties ("Project area"). Specifically, the analysis addressed the question of whether market data indicates that the Project will have an effect on the value of residential uses and/or agricultural land in proximity to the proposed wind turbines. When I use the phrase "proximity to wind turbines," I generally mean turbines within five times the tip height of a wind turbine.

Q. What is the purpose of your Supplemental Direct Testimony?

A. The purpose of my testimony is to provide information specific to South Dakota and the Project area in Charles Mix, Bon Homme, and Hutchinson counties with respect to the potential impact of wind turbines on rural residential and agricultural property.

Q. Have such studies been conducted previously in South Dakota?

A. I conducted similar studies in connection with the Dakota Range Wind Project and Crocker Wind Farm Project. Those studies were filed with the South Dakota Public Utilities Commission ("Commission") in Docket Nos. EL18-003 ("Dakota Range") and EL17-055 ("Crocker"), respectively.

The potential impact, if any, which wind farms have on property values was also addressed in research performed by Mr. David Lawrence on behalf of the Commission Staff in the Dakota Range proceeding. Mr. Lawrence's research focused on the potential impacts, if any, that wind towers have on rural residential and agricultural properties, respectively, in Brookings County.

Q. Have peer-reviewed studies been conducted previously in South Dakota?

A. There are no peer-reviewed studies that have studied South Dakota properties. I was also unable to locate any other peer-reviewed market analysis specific to South Dakota wind farms. Large-scale peer-reviewed studies have evaluated the potential impact of wind turbines on property values outside of South Dakota. While these studies are not specific to South Dakota, they are authoritative studies that have produced consistent results. In my report, and in my testimony, I address how these studies support my analysis.

Q. Please identify the sections of the Application that your testimony supports.

A. My testimony supports Section 20.1.2.3, Property Value Impacts and the associated appendices, Appendix P (2009 Berkeley Property Values Study) and Appendix Q (2013 Berkeley Property Values Study).

Q. What exhibits are attached to your Supplemental Direct Testimony?

A. In addition to my Market Analysis, Exhibit 1, I am sponsoring the following exhibits:

- Exhibit 2: Brian Guerin, Jason Moore, Jamie Stata, and Scott Bradfield (2012). Impact of Industrial Wind Turbines on Residential Property Assessment in Ontario: 2012 Assessment Base Year Study. Municipal Property Assessment Corporation.

- Exhibit 3: Jason Moore, Jamie Stata, and Scott Bradfield (2016). Impact of Industrial Wind Turbines on Residential Property Assessment in Ontario: 2016 Assessment Base Year Study. Municipal Property Assessment Corporation.

- Exhibit 4: Corey Lang and James Opaluch (2013). Effects of Wind Turbines on Property Values in Rhode Island. Environmental and Natural Resource Economics, University of Rhode Island.
- Exhibit 5: Richard J. Vyn and Ryan M. McCullough (2013). The Effects of Wind Turbines on Property Values in Ontario: Does Public Perception Match Empirical Evidence? University of Guelph, Canada.
- Exhibit 6: Carol Atkinson-Palombo and Ben Hoen (2014). Relationship between Wind Turbines and Residential Property Values in Massachusetts. University of Connecticut and Lawrence Berkeley National Laboratory.
- Exhibit 7: Surrebuttal Testimony of David Lawrence on Behalf of the Staff of the South Dakota Public Utilities Commission, *In re the Matter of the Application by Dakota Range I, LLC and Dakota Range II, LLC for a Permit of a Wind Energy Facility in Grant County and Codington County, South Dakota, for the Dakota Range Wind Project*, Docket No. EL18-003, (June 8, 2018).

III. MARKET ANALYSIS FOR PREVAILING WIND PARK PROJECT

Q. How did you familiarize yourself with the Project?

A. To familiarize myself with the Project, I reviewed documents relating to the proposed Project, including the Application filed in this matter, engineering information, and several pre-filed testimonies. I reviewed the proposed layout and representative turbine models in the Application and the applicable regulations and zoning ordinances.

As a function of my work, I am generally familiar with the current market for real estate toward eastern South Dakota. To further develop my knowledge of the market, and specifically the market in and around the Project area, I researched property values and market conditions through a variety of methods (e.g., interviews with market participants, survey of assessors, public records, and online research). I also visited the Project area on June 14, 2018.

Q. What data did you evaluate in conducting your market value analysis?

A. The Market Analysis brings together several different data sources and ways of evaluating the potential impacts of wind turbines on properties. As detailed further in the Market Analysis, I evaluated the footprint of the Project, as well as the surrounding area, and reviewed rural residential and agricultural property sales data. I also researched agricultural land values in Bon Homme, Charles Mix, and Hutchinson counties and in other counties in South Dakota in which wind farms are located, and looked at market trends for both agricultural and residential land for the past five years. I also considered the economic impact on the larger community by the approval of the use as proposed. In addition, I considered the opinions of assessors in eight South Dakota counties with active wind projects. In addition to analyzing South Dakota-specific information, I considered my prior analyses for wind projects in similar counties in Minnesota, Iowa, and Illinois, including paired sales and discussions with assessors in counties with active wind farms. I also considered the analysis of Mr. Lawrence in the Dakota Range proceeding, attached as <u>Exhibit 7</u>. Finally, I reviewed relevant literature on wind farm property value impact analyses previously conducted and interviewed local real estate professionals, including brokers and six auctioneers throughout South Dakota.

Q. Could you discuss in more detail the matched pair analysis you conducted?

A. Yes. Broadly speaking, the purpose of a matched pair (or paired sales) analysis is to determine whether and how a particular characteristic or factor affects, if at all, the value of real estate. In this case, the factor being reviewed is a proximate wind turbine. To conduct the matched pair analysis in this instance, I needed to identify sales that were proximate to wind turbine(s) and sales that were not proximate to wind turbine(s). After those sales are identified, then an appraiser like me can go through the process of comparing the two properties, making adjustments as appropriate to account for the properties' differences, and determining, based on the data, whether proximity to wind farms affected the prices.

To gather the necessary information to conduct a matched pair analysis in this case, I reviewed data on the market for single-family houses in the area of the proposed wind farm and from other areas in the county from public sources, and from the Bon Homme County, Charles Mix County, and Hutchinson County public records, and public records from nine other counties in South Dakota.[1] The research throughout Bon Homme County, Charles Mix County, and Hutchinson County indicated that there was a relative lack of sales proximate to wind turbines in these counties.

To bolster the quantity and quality of the data to be analyzed, I looked beyond Bon Homme, Charles Mix, and Hutchinson counties. The most substantial sales data found in South Dakota from locations in the general market area of a wind farm, based on data research from the entire state, were residences proximate to the Buffalo Ridge Wind Farms in Brookings County. Mr. Lawrence first identified six proximate residential sales in Brookings County during the Crocker proceeding. I conducted further research to determine if there were any additional proximate sales using the Beacon subscription service, another source of property sales information for Brookings County. I concluded that the six sales Mr. Lawrence had identified were appropriate sales for purposes of my analysis. I then researched Brookings County sales data to determine whether there was a comparable non-proximate sale for each that could be used to conduct a paired sales analysis. I found six non-proximate sales and conducted a paired sales analysis using six pairs of property sales in Brookings County.

I also reviewed matched pair sales data in rural areas of Minnesota, Iowa, and Illinois.

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[1] Deuel County, Clark County, Codington County, Grant County, Aurora County, Brookings County, Day County, Hyde County, and Jerauld County.

Q. What were your conclusions from the matched pair analysis?

A. As detailed in the Market Analysis, there is no record evidence to support a conclusion that proximity to wind turbines affects residential property values. In all cases, when I evaluated the two properties in detail and made appropriate adjustments for factors that can affect a property's value, such as building size, building type and quality, lot size, location, utilities and sale date, the prices of the two properties were essentially the same on a per square foot value. The value of agricultural properties with turbine leases is positively affected.

These conclusions are consistent with what I have studied on other wind farm projects in South Dakota, Minnesota, Iowa, and Illinois. The data and conclusions in the Market Analysis are also consistent with the similar data and conclusions provided in the Surrebuttal Testimony of Mr. Lawrence that is attached at Exhibit 7.

Q. Do your conclusions align with the other data you considered in your Market Analysis?

A. Yes. The data and conclusions in the paired sales analysis are consistent with the information that we learned from interviewing market participants such as local real estate professionals, interviewing assessors, and reviewing peer-reviewed literature, as well as with the work done on behalf of Commission Staff by Mr. Lawrence, and with my own prior work.

Q. Your company interviewed local real estate professionals, auctioneers, and brokers in South Dakota to gather information about how wind turbines affected values of proximate properties, if at all. Please provide an overview of your contacts with local real estate professionals.

A. We contacted local real estate professionals to discuss market conditions, specific market transactions, and to investigate whether they had experience with, or knowledge of any impact of wind farms on residential property values. Interviews were conducted with six auctioneers throughout South Dakota. A summary of those interviews is included in the Market Analysis. Their experience echoes my report findings and conclusions, mainly that turbine leases have a positive effect on the values of agricultural land under wind leases and that there is no market evidence that wind farms negatively impact the values of properties in proximity to turbines.

Q. Your company also interviewed assessors in South Dakota, Iowa, Illinois and Minnesota regarding the potential property value impacts of wind farms. What was the purpose of those interviews?

A. My interviews of assessors in South Dakota was intended to be another data point for my overall analysis of the potential impact of wind turbines on property values. Appraisers routinely and reasonably rely upon information provided by assessors to prepare market analyses and appraisals and I believe it was appropriate to do so here. The assessors have experience in assessing properties in counties where wind farms are located. The assessors' interactions with landowners and knowledge of landowner complaints about valuation and formal value appeals is valuable data and indicates that wind farms have not resulted in reduced assessments on proximate properties.

Q. Please provide an overview of the assessors survey effort you completed.

A. In South Dakota specifically, we surveyed assessors in eight South Dakota counties that each had more than 25 operational wind turbines: Aurora County, Brookings County, Campbell County, Charles Mix County, Day County, Hyde County, Jerauld County, and McPherson County. We spoke with assessors in each county to gather information on their experience regarding the impact of wind farms upon market values and/or assessed values of surrounding properties. We conducted similar interviews of assessors in 26 counties in Iowa, 8 counties in Minnesota, and 18 counties in Illinois.

Q. You interviewed assessors in eight counties in South Dakota where there are more than 25 wind turbines.[2] Why did you select these counties when there

are 12 counties that have operating wind turbines in the state of South Dakota?

A. I chose to focus on wind farms that had more than 25 wind turbines to better match the scale of the up to 61-turbine Prevailing Wind Park Project both in number of turbines and project footprint.

The sizes of the wind farms in the 12 counties in South Dakota with wind turbines vary greatly. Two of the 12 counties have just two wind turbines (Brule County) or three wind turbines (Miner County). Two other counties have wind farms that are half the size of my study threshold: Hand County has 10 turbines and Clark County has 11 turbines belonging to the Oak Tree Farm which was developed by an upper end Hunt Club and Inn. The Oak Tree Wind Farm is adjacent to their lodge, with meeting and wedding facilities. This is one of the more desirable if not the most valuable recreational facility in Clark County. I concluded that these wind farms were not good comparables to the Prevailing Wind Park Project because of their smaller sizes.

That leaves eight counties with more than 25 wind turbines. As I noted, I included all eight of those counties in the South Dakota Assessors Survey contained in my Market Analysis.

Q. Knowing that assessors do not have to be licensed as appraisers for their work, why do you think the assessors are nevertheless a meaningful source of information?

A. While assessors may have less formal training than appraisers, they are required to complete specified property valuation training, and also have personal knowledge of the market in their area. A county assessor must obtain the Certified Appraiser Assessor designation from the South Dakota Department of Revenue.[3] To be eligible for this certification, they must have "at least one year of full-time

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[2] Aurora County, Brookings County, Campbell County, Charles Mix County, Day County, Hyde County, McPherson County, and Jerauld County.

[3] SD Laws 10-3-1.1; SD Laws 10-3-1.2; SD Admin. Rules 64:02:01:14.

experience in the assessing and appraising field, have completed and passed the required training prescribed in § 64:02:01:16, and ha[ve] passed the certification examination."[4] Assessors also have first-hand knowledge of property values in their communities. They receive input on factors influencing value and know of complaints from parties protesting the assessor's opinion of market value. As a result, assessors are a helpful source of information for my Market Analysis.

Q. What were the results of your assessor surveys?

A. The South Dakota assessors and all other assessors interviewed reported that there was no market evidence to support a negative impact on residential property values as a result of the development of and proximity to a wind farm:

- In the past 18 months, two assessor's offices have experienced a real estate tax appeal based upon wind farm-related concerns, but the appeals were denied by both counties, Aurora County and Campbell County.
- There had been no reductions in assessed valuations due to proximity to wind turbines.
- Residential assessed values had fluctuated consistently as influenced by market conditions, with no regard for proximity to a wind turbine.
- Virtually all assessors volunteered that the wind farms provided positive economic benefits to their counties and, in fact, had a positive impact on real estate values overall.
- County assessors consistently reported that whatever initial concern there may have been regarding property values during the planning and approval stages of the various wind farms, it dissipated after the wind farm was constructed. Further, county assessors repeatedly stated that county revenues and revenues to individual farms outweighed any initial concerns that residents had about the wind farms adjoining their communities.

[4] SD Admin. Rules 64:02:01:05.

Q. Please explain why you believe that sales and assessor data from Minnesota, Iowa and Illinois are relevant to the issue of whether the Project may impact property values in South Dakota.

A. The wind farm areas I studied in Minnesota, Iowa, and Illinois are relevant to evaluating the potential impact of wind farms on property values in the Project area for several reasons. First, the areas are all in high wind areas and have similar agricultural economies (corn, soybeans, and livestock, including cattle, hogs, and poultry), similar demographics, and similarly low density (small acreage) rural residential properties. In these areas, rural land values are largely driven by productivity and many farmers are economically struggling. Second, the market participants (buyers) for agricultural land are similar in these areas, primarily local farmers and national investors. Third, the local economies are driven by the positive or negative of climate and economy for agricultural products. Fourth, the infrastructure is generally aged and school districts in particular are struggling to fund existing infrastructure, add quality teachers, and add new technology, which makes the areas less desirable to new residents. Fifth, there is low economic job potential in these areas and the best and brightest are not returning after high school, because of lack of infrastructure, area amenities, and limited job possibilities.

Q. Based on your analysis, what conclusions did you reach?

A. As detailed in my Market Analysis, I concluded that there was no market data indicating the Project would have a negative impact on either rural residential or agricultural property values in the area surrounding the Project. Further, market data from South Dakota, as well as from other states, supports the conclusion that the project will not have a negative impact on rural residential or agricultural property values in the surrounding area. In addition, for agricultural properties that host turbines, the additional income from the wind lease may increase the value and marketability of those properties. These conclusions are further supported by relevant peer-reviewed literature, as well as by my own decades of experience, my recent work on similar issues in South Dakota, and the work done on behalf of the Commission's Staff by Mr. Lawrence in a recent proceeding.

I will address my review of the relevant peer-reviewed literature next, and then the recent work Mr. Lawrence did in connection with wind farm projects before the Commission.

IV. PEER-REVIEWED LARGE-SCALE STUDIES

Q. The Application and the Market Analysis include a discussion of peer-reviewed studies, including the Lawrence Berkeley National Laboratory ("LBNL") studies. Can you please provide additional details regarding the LBNL studies?

A. The 2009 and 2013 LBNL studies are included in Appendices P and Q of the Application.[5] LBNL is a member of the national laboratory system supported by the U.S. Department of Energy through its Office of Science. It is managed by the University of California and is charged with conducting unclassified research across a wide range of scientific disciplines. LBNL conducted regression studies on a nationwide basis in 2009 and 2013 to study the potential effects of the proximity of wind turbines on property values.

Q. What methodologies did the LBNL Studies employ?

A. The 2009 study included an analysis of 7,489 sales within 10 miles of 11 wind farms and 125 post-construction sales within one mile of a wind turbine. The 2009 study used rural settings and wind farms with more than 50 turbines. The 2013 study included 51,276 sales located in nine states and proximate to 67 wind farms, and 376 post-construction sales within one mile of a wind turbine. Like the 2009 study, all were located in rural settings and near wind farms of more than 50 turbines. The 2013 study "used a number of sophisticated techniques to control for

[5] Ernest Orlando Lawrence Berkeley National Laboratory, The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis (December 2009) and Ernest Orlando Lawrence Berkeley National Laboratory, A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States (August 2013).

other potential impacts on home prices, including collecting data that spanned well before the wind facilities' development was announced to after they were constructed and operating. This allowed the researchers to control for any pre-existing differences in home sales prices across their sample and any changes that occurred due to the housing bubble."[6]

Q. Please discuss the conclusions of the LBNL Studies.

A. Neither study found statistical evidence that home values near wind turbines were affected. Specifically, with respect to the 2013 study, LBNL states that "[t]his study, the most comprehensive to-date, builds on both the previous Berkeley Lab study as well as a number of other academic and published United States studies, which also generally find no measureable impacts near operating turbines."[7]

Q. Do you agree with the conclusions of the LBNL Studies?

A. Yes. The studies found no statistically significant relationship between wind turbines and property value, which is consistent with my conclusions noted above.

Q. Are there any other peer-reviewed studies that conclude that there is no significant evidence of negative impact on property values from wind turbines?

A. Yes. There are several studies that, combined, reviewed more than 2,500 transactions within one mile of operating turbines. They all found no evidence of value impact.

Q. Please describe these other studies.

A. The studies I was referencing are summarized below:

- The Municipal Property Assessment Corporation's ("MPAC") studies on the Impact of Industrial Wind Turbines on Residential Property Assessment in

[6] "No Evidence of Residential Property Value Impacts Near U.S. Wind Turbines, a New Berkeley Lab Study Finds" (August 27, 2013), http://newscenter.lbl.gov/2013/08/27/no-evidence-of-residential-property-value-impacts-near-us-wind-turbines-a-new-berkeley-lab-study-finds/.

[7] *Id.*

Ontario. This study was originally conducted in 2008 and updated in 2012 ("MPAC 2012") (attached as Exhibit 2) and 2016 ("MPAC 2016") (attached as Exhibit 3). The conclusions in both studies are similar: "there is no statistically significant impact on sale prices of residential properties in these market areas resulting from proximity to an IWT [Industrial Wind Turbine], when analyzing sale prices." Exhibit 2 at 6. Using 2,051 properties and generally accepted time adjustment techniques, MPAC "cannot conclude any loss in price due to the proximity of an IWT." Exhibit 2 at 30. Further, Appendix G of the MPAC 2012 study "Re-sale Analysis" states in the "Summary of Findings" that "MPAC's own re-sale analysis using a generally accepted methodology for time adjustment factors indicates no loss in price based on proximity to the nearest IWT." Exhibit 2 at 163 (Appendix G).

- Corey Lang and James Opaluch (2013). Effects of Wind Turbines on Property Values in Rhode Island. Environmental and Natural Resource Economics, University of Rhode Island. (Attached as Exhibit 4). Structured similarly to the LBNL Studies, this study included 48,554 total sales proximate to 10 wind farms, and 412 post-construction sales within one mile of a turbine. These wind farms were mostly small facilities in urban settings. The study included nuisance and scenic vista stigmas. The report stated, "Both the whole sample analysis and the repeat sales analysis indicate that houses within a half mile had essentially no price change . . ." after the turbines were erected. Exhibit 4 at 18. The study found no statistical evidence of a large, adverse effect of wind turbines on property values.

- Richard J. Vyn and Ryan M. McCullough (2013). The Effects of Wind Turbines on Property Values in Ontario: Does Public Perception Match Empirical Evidence? University of Guelph, Canada. (Attached as Exhibit 5). This study analyzed two wind farms in Melancthon Township, Ontario, Canada, using 5,414 total sales and 18 post-construction sales within one kilometer of a wind turbine. The study included nuisance and scenic vista stigmas. The study concluded that: "these results do not corroborate the concerns regarding potential negative impacts of turbines on property values." Exhibit 5 at 2.

Carol Atkinson-Palombo and Ben Hoen (2014). Relationship between Wind Turbines and Residential Property Values in Massachusetts. University of Connecticut and Lawrence Berkeley National Laboratory. (Attached as Exhibit 6). This study included 312,677 total sales proximate to 26 wind farms, and 1,503 post-construction sales within one mile of a wind turbine. These wind farms were located in urban settings and were primarily proximate to small wind farms. The study included wind turbines and other environmental amenities/disamenities (including beaches and open spaces/landfills, prisons, highways, and major roads) together, for nuisance stigma. "Although the study found the effects from a variety of negative features . . . and positive features . . . the study found no net effects due to the arrival of turbines." Exhibit 6 at 3.

V. RELEVANT INFORMATION FROM RECENT WIND PROJECTS IN SOUTH DAKOTA BEFORE THE COMMISSION

Q. Have you testified before the Commission regarding other wind projects in South Dakota?

A. Yes. As noted above, I have performed analyses on the impact of wind farms on property values for multiple wind projects in South Dakota. For example, the Crocker (EL17-055) and the Dakota Range (EL18-003) proceedings. I offered testimony in both of those matters. My testimony, which was based on the in-depth analyses I performed, included my conclusion that there was no market evidence that proximity to a wind turbine adversely affected property values in those cases. My testimony in this case reaches the same conclusion and is supported by additional data.

Q. Does the testimony offered by Mr. Lawrence in the Dakota Range proceeding align with your conclusions?

A. Yes. Mr. Lawrence filed testimony in June of 2018 that aligns with my conclusions.

Specifically, Mr. Lawrence's research led him to conclude that, based on the evidence and research he had conducted,

(1) "the evidence supports the presumption there have been no adverse effects on the selling price of rural residential properties in proximity to a wind tower, turbine or wind project," Exhibit 7 at 5; and

(2) "the research supports the presumption there have been no adverse effects on the selling price of agricultural properties in proximity to and within the boundaries of the property with a wind tower." Exhibit 7 at 6.

While Mr. Lawrence points out that additional research could be performed that would incorporate additional sales, his work, along with mine, demonstrate that anecdotes and/or similar assertions that wind projects decrease the value of nearby properties do not withstand scrutiny and are unsupported by data.

Mr. Lawrence's work also helped to demonstrate that allegations that the values of rural residential properties within the viewshed of a wind project are negatively affected are not supported by the data. The Rural Residential Transaction Summary Table at Exhibit 1 to Mr. Lawrence's testimony (which is attached as Exhibit 7 to my testimony) showed that seeing and/or hearing wind turbines does not reduce nearby properties' values:

Rural Residential Transaction Summary Table						
Transaction Reference	**Property Type**	**Physical Evidence of Effects**	**Interview Evidence of Effects**	**Sales Evidence of Effects**	**Consistency of Sale Evidence with Interview Evidence**	**Overall Conclusion**
BK1	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK2	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK3	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK4	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK5	Rural Residential	*None*	None	None	Consistent	No measurable effects
BK7	Rural Residential	Yes	None	None	Consistent	No measurable effects

****Turbines were not in operation during the site visit of BK5. Winds light and variable. ****

Likewise, Mr. Lawrence's work on agricultural properties suggests that the value of properties proximate to wind farms is not decreased and that the value of properties that host turbines is likely increased. *See* Exhibit 7 at 5-6. There is no data that supports the opposite conclusion.

VI. CONCLUSION

Q. Do you have any concluding remarks?

A. Yes. Having studied the potential impacts of wind farm projects on properties in South Dakota and across the Midwest, the data consistently shows that property values are not negatively impacted by proximate wind farm projects. As set forth above and in my Market Analysis, sales data, interviews with market participants, real estate professionals and assessors, peer-reviewed literature, and testimony on behalf of Commission Staff all consistently support the conclusion that there is no record evidence to support a conclusion that proximity to wind turbines negatively affect proximate rural residential or agricultural property values.

Q. Does this conclude your Supplemental Direct Testimony?

A. Yes.

Dated this 10th day of August, 2018.

Michael MaRous

MaROUS & COMPANY

August 10, 2018

Fredrikson & Byron, P.A.
200 South 6th Street - Suite 4000
Minneapolis, Minnesota 55402

Attention: Ms. Lisa Agrimonti, Attorney at Law

Subject: Market Impact Analysis
Proposed Prevailing Wind Park
Bon Homme County, Charles Mix County, and Hutchinson County, South Dakota

Dear Ms. Agrimonti,

In accordance with your request, the proposal to develop a wind farm in Bon Homme County, Charles Mix County, and Hutchinson County, South Dakota, has been analyzed and this market impact analysis has been prepared.

MaRous & Company has conducted similar market impact analyses and studies for a variety of clients and for a number of different proposed developments over the last 30 years. Clients have ranged from municipalities, counties, and school districts, to corporations, developers, and citizen's groups. Energy-related projects that MaRous & Company has worked on include the Deuel Winds Wind Farm in Deuel County, the Dakota Range Wind Project in Codington County and Grant County, and the Crocker Wind Farm in Clark County, all in South Dakota; the Grand Ridge V and Otter Creek Wind Farms in LaSalle County, the Pleasant Ridge Wind Farm in Livingston County, the Walnut Ridge Wind Farm in Bureau County, the McLean County Wind Farm in McLean County, and the Twin Forks Wind Farm, in Macon County, all in Illinois; the Freeborn County Wind Farm in Freeborn County, Minnesota; the Ida II Wind Farm in Ida County, the Palo Alto County Wind Farm in Palo Alto County, both in Iowa; the Orangeville Wind Farm in Wyoming County, New York; the Dorchester County Solar Farms in Dorchester County, Maryland; and the Badger Hollow Solar Farm in Iowa County, Wisconsin; and proposed natural gas-fired electric plants in various locations. Some of the other types of proposals that MaRous & Company has analyzed include: commercial developments such as shopping centers and big-box retail facilities; religious facilities such as mosques and mega-churches; residential developments such as high-density multifamily and congregate-care buildings and large single-family subdivisions; recreational uses such as skate parks and lighted high school athletic fields; and industrial uses such as waste transfer stations, land-fills, and quarries.

In addition to this experience, MaRous & Company has appraised a variety of properties in the large market area of the proposed project in South Dakota, in North Dakota, in Iowa, and in Minnesota in the last 3 years, including: industrial facilities, food processing plants, and warehouse and distribution facilities ranging in size from 50,000 to 1,000,000 square feet, and more than 20 major retail facilities.

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Ms. Lisa Agrimonti
Proposed Prevailing Wind Park, LLC
August 10, 2018

Purpose and Intended Use of the Study

The purpose of this appraisal assignment is to analyze the potential impact, if any, on the value of the surrounding rural residential and agricultural properties due to the development of the proposed wind farm. Specifically, this study is designed to address the question of whether the development of the proposed wind farm will have an effect on the value of residential uses and/or agricultural land in proximity to the turbines. Any other use or user of this report is considered to be unintended.

Executive Summary

As a result of the market impact analysis undertaken, I concluded that there is no market data indicating the project will have a negative impact on either rural residential or agricultural property values in the surrounding area. Further, market data from South Dakota, as well as from other states, supports the conclusion that the project will not have a negative impact on rural residential or agricultural property values in the surrounding area. Finally, for agricultural properties that host turbines, the additional income from the wind lease may increase the value and marketability of those properties. These conclusions are based on the following:

- The proposed use will meet or exceed all the required development and operating standards;
- Controls are in place to insure on-going compliance;
- There are significant financial benefits to the local economy and to the local taxing bodies from the development of the proposed wind farm;
- The proposed wind farm will create well-paid jobs in the area which will benefit overall market demand;
- An analysis of recent residential sales proximate to existing wind farms, which includes residential sales within five times turbine tip height, did not support any finding that proximity to a wind turbine had any impact on property values;
- An analysis of agricultural land values in the area and in other areas of the state with wind farms did not support any finding that the agricultural land values are negatively impacted by the proximity to wind turbines;
- Studies indicate that wind turbine leases add value to agricultural land;
- A survey of County Assessors in eight South Dakota counties in which wind farms are located determined that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm, and that there were no reductions in assessed valuations;
- A survey of County Assessors in eight Minnesota counties in which wind farms are located determined that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm, and that there were no reductions in assessed valuations;

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- A survey of County Assessors in 26 Iowa counties in which wind farms are located determined that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm, and that there were no reductions in assessed valuations; and
- A survey of County Assessors in 18 Illinois counties in which wind farms are located determined that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm, and that there were no reductions in assessed valuations.

Definition of Market Value

When discussing market value, the following definition is used:

The most probable price a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:

- Buyer and seller are typically motivated;
- Both parties are well informed or well advised, and acting in what they consider their own best interests;
- A reasonable time is allowed for exposure in the open market;
- Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and
- The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.[1]

Scope of Work and Reporting Process

Information was gathered concerning the real estate market generally and the market of the area surrounding the proposed conditional use specifically. The uses in the surrounding area were considered. The following summarizes the actions taken:

- Review of the applicable codes and/or regulations and/or other public documents for Bon Homme County, Charles Mix County, and Hutchinson County on wind energy;
- Review of the *Application to the South Dakota Public Utilities Commission for Facility Permit* for the proposed Prevailing Wind Park, LLC, including associated appendices;
- Direct Testimony and Resumes of Expert Witnesses:
  - James Damon
  - Bridget Canty
  - Keith Thorstad
  - Aaron Anderson
  - Chris Howell

[1] (12 C.F.R. Part 34.42(g); 55 Federal Register 34696, August 24, 1990, as amended at 57 Federal Register 12202, April 9, 1992; 59 Federal Register 29499, June 7, 1994)

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- Review of the demographics in the area of the proposed wind farm;
- Data on the general market area of the proposed wind farm, and on the other areas in South Dakota and/or Bon Homme County, Charles Mix County, and Hutchinson County in which existing wind farms are located;
- Data on the market for single-family houses in the immediate area of the proposed wind farm and from other areas in the county from public sources, and from the Bon Homme County, Charles Mix County, and Hutchinson County public records, and public records from nine other counties in South Dakota[2];
- Local real estate professionals were interviewed concerning recent sales in the area, local market conditions, and the impact of wind turbines on property values in the area;
- Properties used for development of the matched pairs were physically inspected on the exterior, and photographs of the interiors were reviewed where available;
- Inspections were performed of the subject area and the areas in nearby counties with existing wind farms by Michael S. MaRous on June 14, 2018. As well as inspections of Clark County by Michael S. MaRous on April 5-6, 2018, inspections of Codington County and Grant County by Michael S. MaRous and Joseph M. MaRous on February 18-19, 2018, and inspections of Deuel County by Michael S. MaRous on October 4-5, 2017.

This document is considered to conform to the requirements of the *Uniform Standards of Professional Appraisal Practice and Advisory Opinions* (USPAP). This letter is a brief recapitulation of the appraisal data, analyses, and conclusions; additional supporting documentation is retained in the MaRous and Company office file. There are no extraordinary assumptions or hypothetical conditions included in the market study.

In order to form a judgment concerning the potential impact, if any, on the value of the surrounding residential properties of the approval of the conditional use for the proposed wind farm, I have considered the following:

- The character and the value of the residential and agricultural properties in the general area of the proposed wind farm;
- Agricultural land values in Bon Homme County, Charles Mix County, and Hutchinson County, and in other South Dakota counties in which wind farms are located;
- Market trends for both residential and agricultural land up to the past 5 years;
- The economic impact on the larger community by the approval of the conditional use as proposed; and
- The impact on the value of the surrounding residential and agricultural properties by the approval of the proposed wind farm.

[2] Deuel County, Clark County, Codington County, Grant County, Aurora County, Brookings County, Day County, Hyde County, and Jerauld County

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Description of Area and Proposed Development Area Analysis[3]

Bon Homme County is located in the southeast region of the state of South Dakota. The 2017 population for Bon Homme County was estimated to be 6,949 persons, down from 7,070 in 2010. The county population is situated in approximately 2,434 households as of 2017. The median household income was estimated to be $44,290. Of the total approximately 2,970 housing units in the county, 535 or approximately 18 percent are vacant. The median single-family house value was $89,813.

The unemployment rate in Bon Homme County as of 2017 was 0.8 percent, and the median weekly household wage in 2017 was $791.

Charles Mix County is located in the southeast region of the state of South Dakota. The 2017 population for Charles Mix County was estimated to be 9,508 persons, up from 9,129 in 2010. The county population is situated in approximately 3,417 households as of 2017. The median household income was estimated to be $38,242. Of the total approximately 3,995 housing units in the county, 579 or approximately 14.5 percent are vacant. The median single-family house value was $87,929.

The unemployment rate in Charles Mix County as of 2017 was 5.7 percent, and the median weekly household wage in 2017 was $683.

Hutchinson County is located in the southeast region of the state of South Dakota. The 2017 population for Hutchinson County was estimated to be 7,412 persons, up from 7,343 in 2010. The county population is situated in approximately 3,007 households as of 2017. The median household income was estimated to be $45,305. Of the total approximately 3,462 housing units in the county, 454 or approximately 13.1 percent are vacant. The median single-family house value was $90,101.

The unemployment rate in Hutchinson County as of 2017 was 1.8 percent, and the median weekly household wage in 2017 was $809.

The largest city in the southeast region of the state is Yankton, with 14,557 persons, and it is located approximately 30 miles southeast of the subject's eastern border. The largest city in Bon Homme County is Springfield, with 1,938 persons, and it is located approximately 12 miles south of the subject's southern border. The largest city in Charles Mix County is Wagner, with 1,482 persons, and it is located approximately 5.5 miles west of the subject's western border. The largest city in Hutchinson County is Parkston, with 1,826 persons, and it is approximately 12 miles north of the subject's northern border. Other nearby cities consist of Avon, which is located directly adjacent to the south of the project foot print, with 949 persons, and Tripp, which is located directly adjacent to the northeast of the project foot print, with 638 persons.

[3] The demographic data included in this section of the report are taken from Site-to-do-Business, https://www.stdb.com. Unless otherwise indicated, the data is from 2017.

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The proposed wind farm is located on the borders of Bon Homme County, Charles Mix County, and Hutchinson County, and will be in the townships of Choteau Creek, Lone Tree, Oak Hollow, Fair, and Northwest Bon Homme. A copy of a map of the proposed footprint of the wind farm is located in the addenda to this report.

Like the majority of South Dakota, this area is primarily rural in nature. In addition to farms, there are single-family houses situated on either smaller lots or larger farmsteads. The following tables summarize recent sales of these types of residences in the general area of the proposed Prevailing Wind Park, and the census population of Avon, Scotland, and Wagner from 2000 to 2017. A map illustrating the location of each of these sales is included in the addenda to this market impact study.

RECENT SINGLE-FAMILY RESIDENTIAL SALES SUMMARY
IN THE AREA NEAREST TO THE PROPOSED PREVAILING WIND PARK

No.	Location	Sale Price	Sale Date	Distance to Proposed Wind Farm Footprint (Ft.)	Site Size (Acres)	Year Built	Building Size (Sq. Ft.)	Sale Price Per Sq. Ft. of Bldg. Area Incl. Land
1	312 Main St. N. Avon, South Dakota	$104,000	11/17	6,600	0.19	1973	2,160	$48.15
2	411 2nd S. S.W. Wagner, South Dakota	$105,000	11/17	35,640	0.26	1979	1,340	$78.36
3	311 Main St. N. Avon, South Dakota	$110,000	5/17	6,600	0.27	1900	1,823	$60.34
4	416 3rd St. S.W. Wagner, South Dakota	$112,000	5/17	37,540	0.25	1976	1,248	$89.74
5	128 Park St. N.E. Wagner, South Dakota	$123,500	10/15	35,165	0.26	1930	2,390	$51.67
6	29672 394th Avenue. Wagner, South Dakota	$150,000	7/17	40,020	1.00	1972	1,600	$93.75
7	29261 415th Ave. Scotland, South Dakota	$160,000	9/16	25,870	5.00	1925	1,652	$96.85

POPULATION BY CENSUS YEAR

	AVON, SOUTH DAKOTA			SCOTLAND, SOUTH DAKOTA			WAGNER, SOUTH DAKOTA		
Year	2000	2010	2017	2000	2010	2017	2000	2010	2017
Population	1,063	991	949	1,462	1,238	1,189	3,394	3,309	3,385

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Proposed Project

The proposed project currently is expected to generate up to 219.6 megawatts from up to 61 wind turbines. The turbines will be the GE 3.8-137 model with an output of 3.83 megawatts each and will be approximately 586 feet (178.5 meters) to the top of the blade tip. The proposed project area is described in a map in the addenda to this market study. All turbines will be new, and none will be experimental or prototype equipment. The turbine specifications are described in the following table.

Characteristic	Turbine Model[a] GE 3.8-137
Nameplate capacity	3.83 MW
Hub height	110 meters (361 feet)
Rotor diameter	137 meters (449 feet)
Total height	178.5 +/- 1 meters (586 +/- 3 feet)
Cut-in speed[b]	3 m/s
Rated speed[c]	12 m/s
Cut-out speed[d]	25 m/s over 600s 30 m/s over 30s 34 m/s over 3s
Rotor area	14,741 m^2
Rotor speed	Variable – max is around 13.6 rpm

(a) MW = megawatt; m/s = meters per second; m^2 = square meters; rpm = revolutions per minute
(b) Cut-in wind speed = wind speed at which turbine begins operation
(c) Rated speed = wind speed at which turbine reaches its rated capacity
(d) Cut-out wind speed = wind speed above which turbine shuts down operation
(e) High Wind Operation package

The total cost is estimated to be $297,000,000 with a possible fluctuation of +/- 20 percent. Ancillary construction includes 16-foot to 36-foot-wide gravel-covered access roads, an underground electrical power collector system and communications lines, a collector substation that will increase voltage from 34.5 kV to 115 kV, an interconnection switching station to send power across the Western Area Power Administration's existing Utica Junction Substation, up to four meteorological towers, an operations and maintenance building, and temporary construction areas. Agreements with each county and with townships impacted will identify roads to be used and any terms for use of those roads by the project will require repairing of any damage caused by the project. All setback, noise, and shadow flicker standards for participants and nonparticipants will be met for each turbine. The specific setback, noise, and shadow flicker requirements are illustrated in the below table.

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Approximately 140 residential properties within the proposed project area are proximate to a proposed wind turbine. Below is a table summarizing the distances of the wind turbines to the nearby residential properties.

Turbine Distances to Nearest Residential Properties Within the Project Area of Prevailing Wind Park	
Shortest Distance in Feet	1,556
Furthest Distance in Feet	21,687
Average Distance in Feet	5,522

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Category	Requirements/Commitments
State Requirements	
Setbacks	Turbines shall be set back at least 500 feet or 1.1 times the height of the tower, whichever is greater, from any surrounding property line (SDCL 43-13-24).
Bon Homme County Requirements[a]	
Setbacks	(a) Distance from currently occupied off-site residences, business and public buildings shall be not less than one thousand (1,000) feet. Distance from the residence of the landowner on whose property the tower(s) are erected shall be not less than five hundred (500) feet or one point one (1.1) times the system height, whichever is greater. For the purposes of this section only, the term "business" does not include agricultural uses. (b) Distance from right-of-way of public roads shall be not less than five hundred (500) feet or one point one (1.1) times the system height, whichever is greater. (c) Distance from any property line shall be not less than five hundred (500) feet or one point one (1.1) times the system height, whichever is greater, unless appropriate easement has been obtained from adjoining property owner.
Noise	Noise level produced by the LWES shall not exceed forty-five (45) dBA, average A-weighted sound pressure at inhabited dwelling existing at the time the permit application is filed, unless a signed waiver or easement is obtained from the owner of the dwelling. The permittees shall submit a report of predicted noise levels at habitable residential dwellings within one mile of proposed tower locations to the Board no less than forty-five (45) days prior to commencing construction.
Voluntary Commitments in Charles Mix and Hutchinson Counties	
Setbacks	(a) Distance from currently occupied off-site residences, business and public buildings will be not less than 1,000 feet. Distance from the residence of the landowner on whose property the tower(s) are erected will be not less than 500 feet or 1.1 times the system height, whichever is greater. The term "business" does not include agricultural uses. (b) Distance from right-of-way of public roads will be not less than 500 feet or 1.1 times the system height, whichever is greater. (c) Distance from any property line will be not less than 500 feet or 1.1 times the system height, whichever is greater, unless appropriate easement has been obtained from adjoining property owner.
Noise	Noise level produced by the wind turbines will not exceed 45 dBA, average A-weighted sound pressure at currently inhabited dwellings, unless a signed waiver or easement is obtained from the owner of the dwelling.
Shadow Flicker Commitment	
Shadow Flicker	Shadow flicker produced by the wind turbines will not exceed 30 hours per year at currently inhabited dwellings of non-participants.

(a) Bon Homme County, South Dakota, Zoning Ordinance (amended November 3, 2015)

Project Benefits

Total direct economic benefits of the Prevailing Wind Park project are estimated to be approximately $60,000,000. These benefits will be generated by real estate taxes, annual payments to participating land owners, and good-neighbor agreements. In accordance with the State of South Dakota's property assessment requirements for wind turbines, real estate tax benefits for the entire Prevailing Wind Park are estimated to be greater than $790,430 per year, or approximately $23,713,000 over 30 years, if the full capacity is constructed.

Annual payments to participating landowners and good-neighbor agreements will add significantly to the local economy. Participating landowners will be receiving a share of more than $1,230,000 in annual payments, or approximately $37,000,000 over the entire life of the project. Additionally, the project will generate approximately 245 temporary construction jobs and is expected to create approximately 8 to 10 permanent jobs when fully operational. Prevailing Wind Park, LLC anticipates that approximately 80 percent of all the jobs created will be locally hired.

When adding the annual tax revenue to the annual land rent payments, plus the permanent job revenue, the economic annual benefit due to the project could exceed $2,000,000. It is estimated that 41 acres of cropland and 4 acres of pasture land could be used for the wind farm, support facilities, and transmission lines. The lost cropland rent at an average of $190 per acre, could be less than $7,800 per year. The lost pasture land rent at an average of $64 per acre, could be less than $250 per year. Simply compared, the annual economic benefits of greater than $2,000,000 compared to lost crop/pasture land rents of approximately $8,050, is a substantial annual and long-term economic benefit to the area.

Further direct impacts of the project will come from contributions to the community, such as donations to various local festivals and fairs in Avon and Bon Homme County, sponsoring a program booklet advertisement of local businesses for Czech Days in Tabor, and donating the Avon Little League scoreboard in Avon. Further indirect impacts from the construction of the project, including permits and construction jobs, as well as induced impacts from the increase in household spending also are anticipated.

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Market Impact Analysis

A market impact analysis is undertaken to develop an opinion as to whether the proposed wind farm will have an effect on the value of residential properties and/or agricultural land in proximity to the turbines. This analysis includes:

- A matched pair analyzing the impact on value of residential properties proximate to a wind farm in Brookings County, South Dakota, as well as matched pairs developed in counties with similar demographics, land use, and economic characteristics, just east of this area in Minnesota, and in similarly rural counties in Iowa and Illinois;
- The value of agricultural land in the southeast region of South Dakota in the areas with existing wind farms;
- Interviews of local real estate professionals;
- The results of a survey of assessors in South Dakota, Iowa, Minnesota, and Illinois with existing wind farms in their respective jurisdictions; and
- The results of several academic and peer-reviewed studies of the impact of wind turbines on residential property values.

Matched Pair Analysis

A matched pair analysis is a methodology which analyzes the importance of a selected characteristic, in this instance proximity to a wind turbine, to the value of a property.[4] This technique compares the sale of a property in proximity to the selected characteristic to the sale of a similar property in the same market area and under similar market conditions but without the proximity to the selected characteristic.

It is difficult to find properties that are identical except for proximity to a wind turbine, and which also occurred under substantially similar market conditions, especially in rural areas. Many sales in the area also are conducted privately from family member to family member, or passed down from generation to generation, causing there to be a lack of sale information or, in most cases, the properties do not sell at full value. The research throughout Bon Homme County, Charles Mix County, and Hutchinson County indicated that there was a lack of sales proximate to wind turbines in any county. The most substantial sale data found in South Dakota from locations in the general market area of a wind farm, based on data research from the entire state, were residences proximate to the Buffalo Ridge Wind Farms in Brookings County.

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[4] See the discussion "Paired Sales Analysis" and "Sale/Resale Analysis" in Bell, Randall, MAI, Real Estate Damages, *Applied Economics and Detrimental Conditions, Second Edition,* Appraisal Institute, 2008, pages 25-27. The ideal is to review a sale and resale of a property in proximity to a selected characteristic, to compare it to a sale and resale of a similar property without such proximity, and to then analyze whether the proximity to the selected characteristic influenced the change in value. However, in rural areas it usually is not possible to find data for this type of "pure pair" analysis.

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Due to the lack of sales data proximate to wind turbines in South Dakota, data from nearby states that have a stronger presence of wind turbines, similar demographics, similar economics, and similar agricultural characteristics, have been analyzed.

Details of the sales included in this analysis are retained in the MaRous & Company office files; maps in the addenda to this report illustrate the location of the properties. Unless otherwise indicated, none of the purchasers in these transactions appear to own any other property in proximity, and none of the transactions appear to have a wind turbine lease associated with the property.

South Dakota Analysis - Brookings County Matched Pair No. 1

The Buffalo Ridge Wind Farms are located in Brookings County in the East-Central region of South Dakota and consist of 129 turbines that began commercial operations in 2009. Both phases I and II are located primarily in Brookings County. Phase I came online in 2009 with 24 turbines generating approximately 50.4 MW of power. Phase II was much larger, following the first phase the next year in 2010 with 105 turbines generating approximately 210 MW of power. A property located at 21088 487th Avenue, Elkton, South Dakota, sold in October 2016 for $183,000. The nearest turbine is approximately 1,028 feet to the south of this property.

This property is compared with a similar property located at 5705 Rathum Loop, Brookings, South Dakota, that sold in June 2015, which is not located proximate to any wind turbines. The salient details of these two properties are summarized in the table below.

The following aerial map illustrates the relationship of the 487th Avenue property to the closest wind turbines.

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BROOKINGS COUNTY MATCHED PAIR NO. 1

	1A - Proximate to a Wind Turbine	1B - Not Proximate to a Wind Turbine
Address	21088 487th Ave. Elkton, SD 57026	5705 Rathum Loop Brookings, SD 57006
Distance from Turbine	1,028 Feet	N/A
Sale Date	October 14, 2016	June 5, 2015
Sale Price	$183,000	$142,000
Sale Price/Sq. Ft. (A.G.)	$66.64	$68.33
Year Built	2003	1973
Building Size (Sq. Ft.)	2,746	2,078
Lot Size (Acres)	8.00	0.49
Style	One-story, frame (vinyl) 5 bedrooms, 3 bath	One-story; frame (vinyl) 3 bedrooms, 1 bath
Basement	Partial	Crawlspace/Partially finished
Utilities	Central air; Forced-air heat; Well & septic	Central air; Forced-air heat; Well & septic
Other	1-car attached garage patio, deck, utility buildings	1-car attached garage; 3-car detached garage; patio, deck, utility buildings

21088 487th Avenue

5705 Rathum Loop

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Both the 487th Avenue property and the Rathum Loop property are ranch-style houses, however Rathum Loop appears to contain only three bedrooms, whereas 487th Avenue has five bedrooms. An upward adjustment of Rathum Loop for the superior building style of 487th Avenue is required. In the case of the Rathum Loop property, there are utility buildings, a detached three-car garage, and a one-car attached garage; however, the 487th Avenue property has a just one larger utility building and an attached one-car garage. A downward adjustment for the superior outbuildings of Rathum Loop is required. The 487th Avenue building is of newer construction and Rathum Loop is approximately 50 years old. Both properties are considered to be in normal condition by the Brookings County Assessor. An upward adjustment of Rathum Loop is required due to 487th Avenue's newer vintage. An upward adjustment is made for the larger building size of the 487th Avenue property. The 487th Avenue property is also situated on a much larger lot than that of the Rathum Loop property requiring an upward adjustment; however, both lots are surrounded by agricultural and pasture land, which mitigates the size differential to some degree. The Rathum Loop property has a superior location to the 487th Street property due to its close proximity to the town of Brookings, requiring a downward adjustment.

Considering the adjustments noted in the following table for the older vintage and smaller size of the Rathum Loop property and for the superior market conditions of the 487th Avenue property, the difference in the sale price does not support the conclusion that proximity to the wind turbines had a negative impact on the value of the 487th Avenue property.

ADJUSTMENT GRID MATCHED PAIR NO. 1

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
1B	5705 Rathum Loop Brookings, South Dakota	+	+	+	+	-	+	◦	◦	-

\+ Positive adjustment based on comparable being inferior in comparison to property #1A

\- Negative adjustment based on comparable being superior in comparison to property #1A

◦ No adjustment necessary

South Dakota Analysis - Brookings County Matched Pair No. 2

A property located at 19824 478th Avenue, Toronto, South Dakota, sold in March 2011 for $235,000. The nearest turbine is approximately 1,548 feet to the northwest of this property.

This property is compared with a similar property located at 20485 475th Avenue, Brookings, South Dakota, that sold in August 2016, which is not located proximate to any wind turbines. The salient details of these two properties are summarized in the table below.

The following aerial map illustrates the relationship of the 478th Avenue property to the closest wind turbines.

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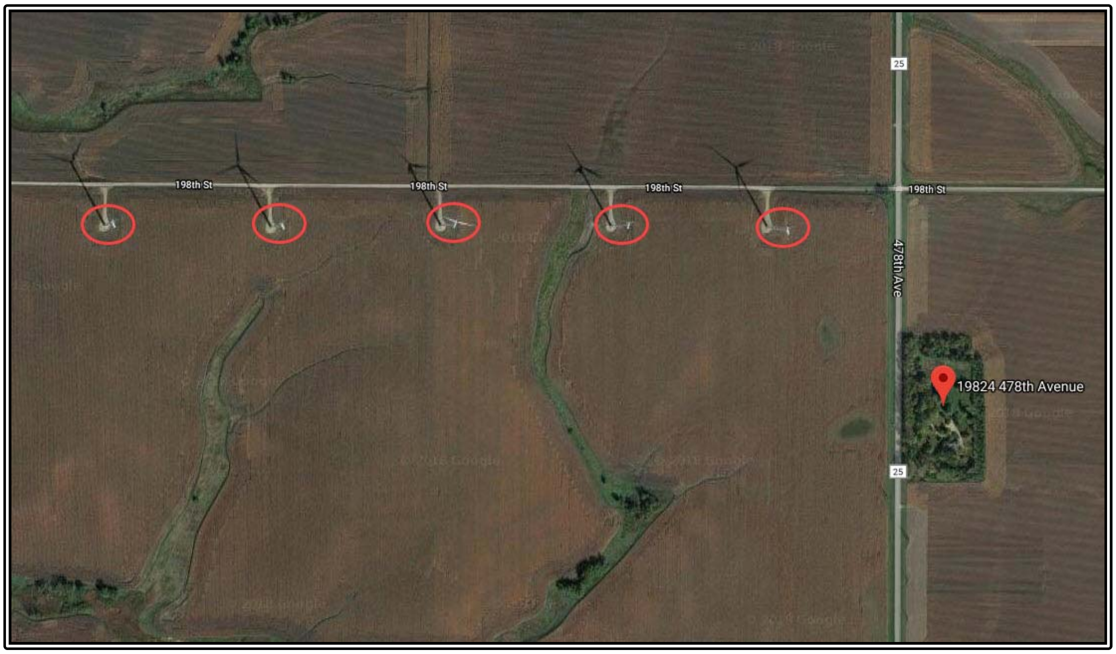

BROOKINGS COUNTY MATCHED PAIR NO. 2

	2A - Proximate to a Wind Turbine	2B - Not Proximate to a Wind Turbine
Address	19824 478th Ave. Toronto, SD 57268	20485 475th Ave. Brookings, SD 57002
Distance from Turbine	1,548 Feet	N/A
Sale Date	March 14, 2011	August 10, 2016
Sale Price	$235,000	$300,000
Sale Price/Sq. Ft. (A.G.)	$100.38	$129.53
Year Built	1998	2016
Building Size (Sq. Ft.)	2,341	2,316
Lot Size (Acres)	9.50	19.10
Style	1.5-story, frame (stone/vinyl) 3 bedrooms, 1.2 bath	One-story; frame (vinyl) 4 bedrooms, 3 bath
Basement	Partial	Full
Utilities	Radiant floor heat; Well & septic	Central air; Geothermal heat; Well & septic
Other	1-car attached garage	3-car attached garage

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19824 478th Avenue

20485 475th Avenue

Although the 478th Avenue property is a 1.5-story house and the 475th Avenue property is a ranch-style house, the two houses are of equivalent size. In the case of the 475th Avenue property, there is an attached three-car garage, while the 478th Avenue property has an attached one-car garage. A downward adjustment for the superior outbuildings of 475th Avenue is required. The 475th Avenue building is of newer construction than 478th Avenue property. Both properties are considered to be in normal condition by the Brookings County Assessor. A downward adjustment of 475th Avenue is required for its newer vintage, as well as a downward adjustment of 475th Avenue for its superior market conditions. The 475th Avenue property is situated on a much larger lot than that of the 478th Avenue property requiring a downward adjustment; however, both lots are surrounded by agricultural and pasture land, which mitigates the size differential to some degree. The 475th Avenue property has a superior location to the 478th Avenue property due to its close proximity to the town of Brookings, requiring a downward adjustment.

Considering the adjustments noted in the following table for the newer vintage and superior market conditions of the 475th Avenue property, the difference in the sale price does not support the conclusion that proximity to the wind turbines had a negative impact on the value of the 478th Avenue property.

ADJUSTMENT GRID MATCHED PAIR NO. 2

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
2B	20485 475th Ave. Brookings, South Dakota	-	-	◦	-	-	◦	-	-	-
+	Positive adjustment based on comparable being inferior in comparison to property #2A									
-	Negative adjustment based on comparable being superior in comparison to property #2A									
◦	No adjustment necessary									

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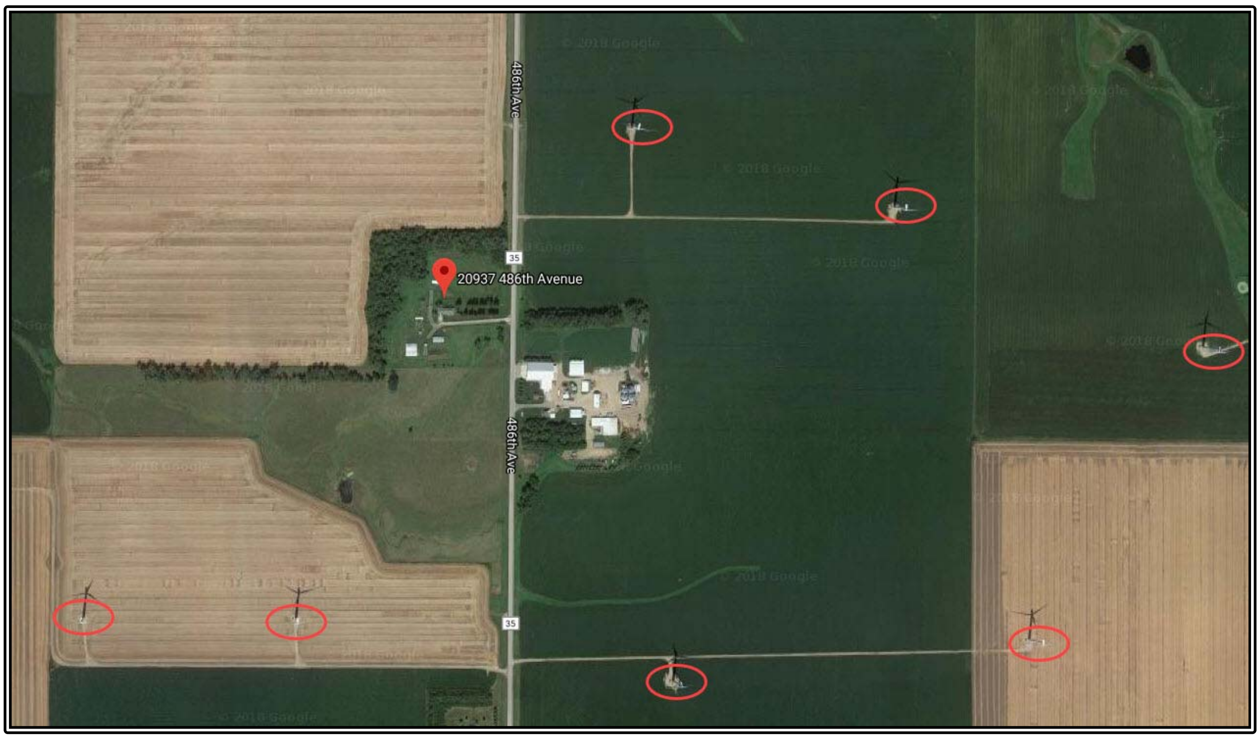
South Dakota Analysis - Brookings County Matched Pair No. 3

A property located at 20937 486th Avenue, Elkton, South Dakota, sold in December 2011 for $175,000. The nearest turbine is approximately 1,433 feet to the northeast of this property.

This property is compared with a similar property located at 518 West 44th Street S, Brookings, South Dakota, that sold in October 2017, which is not located proximate to any wind turbines. The salient details of these two properties are summarized in the table below.

The following aerial map illustrates the relationship of the 486th Avenue property to the closest wind turbines.



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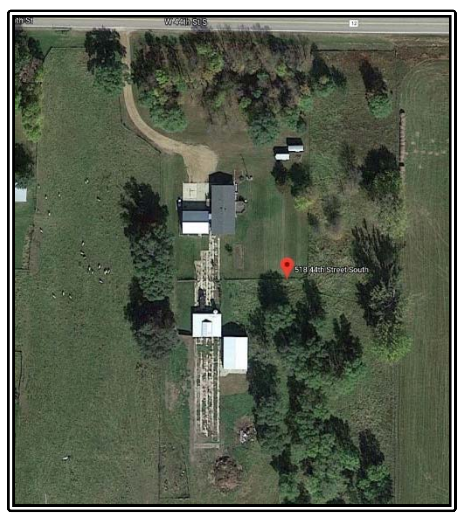
BROOKINGS COUNTY MATCHED PAIR NO. 3

	3A - Proximate to a Wind Turbine	3B - Not Proximate to a Wind Turbine
Address	20937 486th Ave. Elkton, SD 57026	518 W. 44th St. S Brookings, SD 57006
Distance from Turbine	1,433 Feet	N/A
Sale Date	December 1, 2011	October 9, 2017
Sale Price	$175,000	$175,900
Sale Price/Sq. Ft. (A.G.)	$79.26	$104.70
Year Built	1918	1990
Building Size (Sq. Ft.)	2,208	1,680
Lot Size (Acres)	14.28	4.55
Style	Two-story, frame (vinyl) 4 bedrooms, 2 bath	One-story; frame (vinyl) 3 bedrooms, 2 bath
Basement	Partial	Crawlspace
Utilities	Central air; Forced-air heat; Well & septic	Central air; Forced-air heat; Well & septic
Other	2-car attached garage	2-car detached garage

20937 486th Avenue



518 W. 44th Street S

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The 486th Avenue property is a two-story house and the 44th Street South property is a one-story house, and the 486th Avenue has an extra bedroom. The superior style and number of bedrooms of the 486th Avenue property requires an upward adjustment. In the case of the outbuildings, both properties have a two-car garage. The 44th Street South building is of newer construction than 486th Avenue property, which is 100 years old. Both properties are considered to be in normal condition by the Brookings County Assessor. A downward adjustment of 44th Street South is required for its newer vintage, as well as a downward adjustment of 44th Street South for its superior market conditions. The 486th Avenue property is situated on a much larger lot than that of the 44th Street South property requiring an upward adjustment; however, both lots are surrounded by agricultural and pasture land, which mitigates the size differential to some degree.

Considering the adjustments noted in the following table for the newer vintage and superior market conditions of the 44th Street South property, the difference in the sale price does not support the conclusion that proximity to the wind turbines had a negative impact on the value of the 486th Avenue property.

ADJUSTMENT GRID MATCHED PAIR NO. 3

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
3B	518 W. 44th St. S. Brookings, South Dakota	-	-	+	+	○	+	+	○	○
+	Positive adjustment based on comparable being inferior in comparison to property #3A									
-	Negative adjustment based on comparable being superior in comparison to property #3A									
○	No adjustment necessary									

South Dakota Analysis - Brookings County Matched Pair No. 4

A property located at 19636 475th Avenue, Toronto, South Dakota, sold in November 2013 for $530,000. The nearest turbine is approximately 2,309 feet to the southeast of this property.

This property is compared with a similar property located at 46246 214th Street, Volga, South Dakota, that sold in December 2016, which is not located proximate to any wind turbines. The salient details of these two properties are summarized in the table below.

The following aerial map illustrates the relationship of the 475th Avenue property to the closest wind turbines.

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BROOKINGS COUNTY MATCHED PAIR NO. 4

	4A - Proximate to a Wind Turbine	4B - Not Proximate to a Wind Turbine
Address	19636 475th Avenue. Toronto, SD 57268	46246 214th Street. Volga, SD 57071
Distance from Turbine	2,309 Feet	N/A
Sale Date	November 21, 2013	December 21, 2016
Sale Price	$530,000	$317,000
Sale Price/Sq. Ft. (A.G.)	$151.60	$182.81
Year Built	1989	2001
Building Size (Sq. Ft.)	3,496	1,734
Lot Size (Acres)	13.00	10.43
Style	One-story; frame (vinyl) 5 bedrooms, 3 bath	One-story; frame (vinyl) 4 bedrooms, 3 bath
Basement	Partial	Full
Utilities	Central air; Forced-air heat; Well & septic	Central air; Geothermal heat; Well & septic
Other	3-car attached garage; two commercial utility buildings; gazebo	1-car attached garage; 2-car detached garage

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19636 475th Avenue

46246 214th Street

Both the 475th Avenue property and the 214th Street property are one-story ranch style houses. In the case of the outbuildings, the 475th Avenue property is superior with two large commercial-style utility buildings and a three-car attached garage compared to the 214th Street property with a two-car detached garage and a one-car attached garage. The superiority of the 475th Avenue buildings requires an upward adjustment. The 214th Street building is of newer construction than 475th Avenue property. Both properties are considered to be in normal condition by the Brookings County Assessor. A downward adjustment of 214th Street is required for its newer vintage, as well as a downward adjustment of 214th Street for its superior market conditions. The 475th Avenue property is situated on a larger lot than that of the 214th Street property requiring an upward adjustment; however, both lots are surrounded by agricultural and pasture land, which mitigates the size differential to some degree.

Considering the adjustments noted in the following table for the newer vintage and superior market conditions of the 214th Street property, the difference in the sale price does not support the conclusion that proximity to the wind turbines had a negative impact on the value of the 475th Avenue property.

ADJUSTMENT GRID MATCHED PAIR NO. 4

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
4B	46246 214th St. Volga, South Dakota	-	-	+	+	◦	◦	-	-	+
+	Positive adjustment based on comparable being inferior in comparison to property #4A									
-	Negative adjustment based on comparable being superior in comparison to property #4A									
◦	No adjustment necessary									

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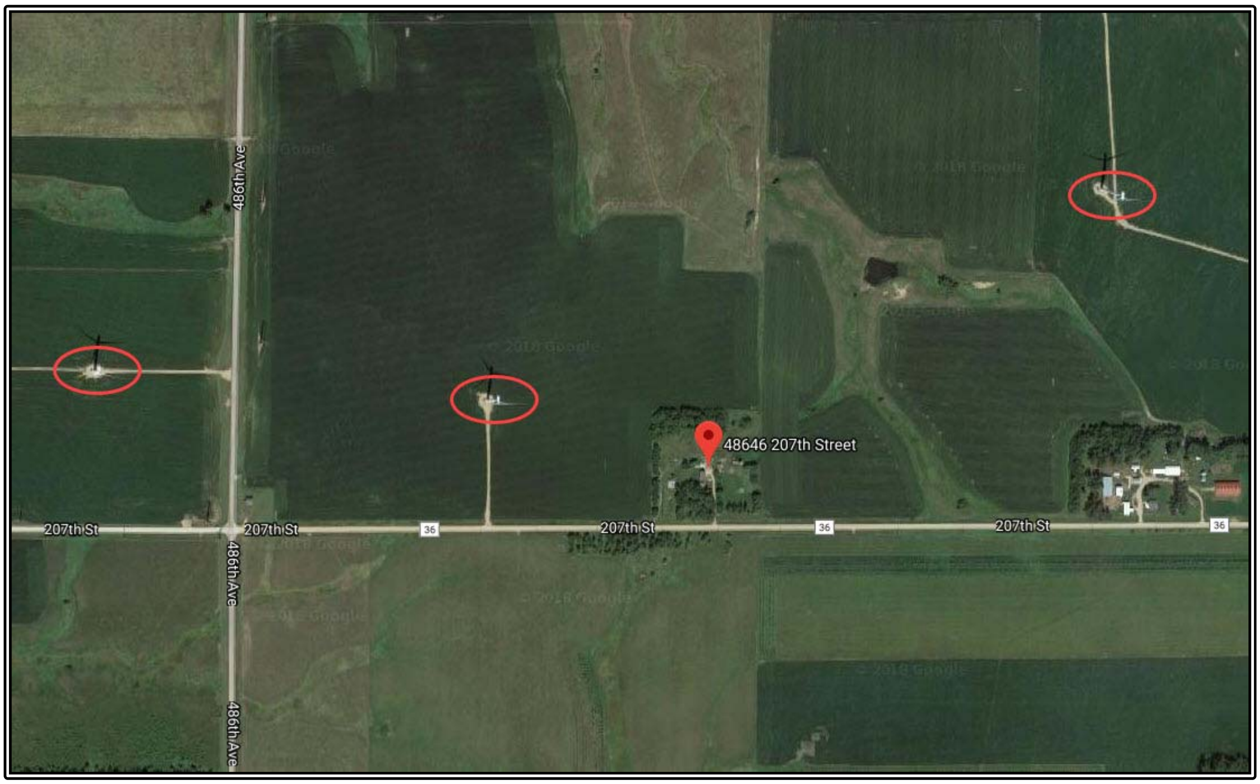
South Dakota Analysis - Brookings County Matched Pair No. 5

A property located at 48646 207th Street, Elkton, South Dakota, sold in March 2014 for $190,000. The nearest turbine is approximately 1,118 feet to the west of this property.

This property is compared with a similar property located at 5705 Rathum Loop, Brookings, South Dakota, that sold in June 2015, which is not located proximate to any wind turbines. The salient details of these two properties are summarized in the table below.

The following aerial map illustrates the relationship of the 207th Street property to the closest wind turbines.



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BROOKINGS COUNTY MATCHED PAIR NO. 5

	5A - Proximate to a Wind Turbine	**5B - Not Proximate to a Wind Turbine**
Address	48646 207th Street. Elkton, SD 57026	5705 Rathum Loop Brookings, SD 57006
Distance from Turbine	1,118 Feet	N/A
Sale Date	March 26, 2014	June 5, 2015
Sale Price	$190,000	$142,000
Sale Price/Sq. Ft. (A.G.)	$87.96	$68.33
Year Built	1936	1973
Building Size (Sq. Ft.)	2,160	2,078
Lot Size (Acres)	6.95	0.49
Style	Two-story, frame (vinyl) 3 bedrooms, 3 bath	One-story; frame (vinyl) 3 bedrooms, 1 bath
Basement	Partial	Crawlspace/Partially finished
Utilities	Central air; Forced-air heat; Well & septic	Central air; Forced-air heat; Well & septic
Other	1-car attached garage; 2-car detached garage	1-car attached garage; 3-car detached garage; patio, deck, utility buildings

48646 207th Street

5705 Rathum Loop

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Although the 207th Street property is a two-story house and the Rathum Loop property is a ranch-style house, the two houses are of equivalent size. However, an upward adjustment to Rathum Loop is required for the superior building style of 207th Street property. In the case of the Rathum Loop property, there are utility buildings, a detached three-car garage, and a one-car attached garage. In comparison, the 207th Street property has an attached one-car garage and a detached two-car garage. A downward adjustment for the superior outbuildings of Rathum Loop is required. Although the Rathum Loop building is of newer construction, it is still approximately 50 years old. The 207th Street property is closer to 80 years old. Both properties are considered to be in normal condition by the Brookings County Assessor. A downward adjustment of Rathum Loop is required for its newer vintage, as well as a downward adjustment of Rathum Loop for its superior market conditions. The 207th Street property is situated on a much larger lot than that of the Rathum Loop property requiring an upward adjustment; however, both lots are surrounded by agricultural and pasture land, which mitigates the size differential to some degree. The Rathum Loop property has a superior location to the 207th Street property due to its close proximity to the town of Brookings, requiring a downward adjustment.

Considering the adjustments noted in the following table for the newer vintage and superior market conditions, yet smaller lot size of the Rathum Loop property, the difference in the sale price does not support the conclusion that proximity to the wind turbines had a negative impact on the value of the 207th Street property.

ADJUSTMENT GRID MATCHED PAIR NO. 5

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
5B	5705 Rathum Loop Brookings, South Dakota	-	-	◦	+	-	+	◦	◦	-

+ Positive adjustment based on comparable being inferior in comparison to property #5A

- Negative adjustment based on comparable being superior in comparison to property #5A

◦ No adjustment necessary

South Dakota Analysis - Brookings County Matched Pair No. 6

A property located at 20922 485th Avenue, Elkton, South Dakota, sold in August 2010 for $180,000. The nearest turbine is approximately 1,959 feet to the south, as well as twelve other turbines within approximately a half mile to the east, of this property.

This property is compared with a similar property located at 46464 218th Street, Volga, South Dakota, that sold in November 2014, which is not located proximate to any wind turbines. The salient details of these two properties are summarized in the table below.

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The following aerial map illustrates the relationship of the 485th Avenue property to the closest wind turbines.

BROOKINGS COUNTY MATCHED PAIR NO. 6

	6A - Proximate to a Wind Turbine	6B - Not Proximate to a Wind Turbine
Address	20922 485th Avenue. Elkton, SD 57026	46464 218th Street. Volga, SD 57071
Distance from Turbine	1,959 Feet	N/A
Sale Date	August 4, 2010	November 14, 2014
Sale Price	$180,000	$190,600
Sale Price/Sq. Ft. (A.G.)	$107.14	$113.45
Year Built	1992	1918
Building Size (Sq. Ft.)	1,680	1,680
Lot Size (Acres)	13.35	15.00
Style	One-story; frame (vinyl) 4 bedrooms, 2 bath	Two-story; frame (vinyl) 5 bedrooms, 2 bath
Basement	Partial	Full
Utilities	Central air; Geothermal heat; Well & septic	Central air; Forced-air heat; Well & septic
Other	1-car attached garage	1-car detached garage

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20922 485th Avenue

46464 218th Street

The 218th Street property is a two-story house with five bedrooms and the 485th Avenue property is a one-story ranch style house with four bedrooms. The superior style of the 218th Street property requires a downward adjustment. In the case of the outbuildings, both properties have a one-car garage. The 485th Avenue building is of newer construction than the 218th Street property, which is 100 years old. Both properties are considered to be in normal condition by the Brookings County Assessor. An upward adjustment of 218th Street is required for 485th Avenue's newer vintage, as well as a downward adjustment of 218th Street for its superior market conditions. The 218th Street property is situated on a larger lot than that of the 485th Avenue property requiring an upward adjustment; however, both lots are surrounded by agricultural and pasture land, which mitigates the size differential to some degree.

Considering the adjustments noted in the following table for the older vintage, yet superior market conditions of the 218th Street property, the difference in the sale price does not support the conclusion that proximity to the wind turbines had a negative impact on the value of the 485th Avenue property.

ADJUSTMENT GRID MATCHED PAIR NO. 6

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
6B	46464 218th St. Volga, South Dakota	-	+	◦	◦	◦	-	-	+	◦
+	Positive adjustment based on comparable being inferior in comparison to property #7A									
-	Negative adjustment based on comparable being superior in comparison to property #7A									
◦	No adjustment necessary									

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Matched Pair Analysis- Minnesota, Iowa, and Illinois Counties

In addition to analyzing sales in the subject project area, we have researched sales in proximity to several existing wind farms in rural areas of Minnesota, Iowa, and Illinois, due to the lack of data in South Dakota and similarity in land use to rural areas of the region, in order to discover whether residential property values in these areas were impacted by their locations. The following are the results of the most recent of these studies. Location adjustments were not considered for the matched pairs in Minnesota, Iowa, and Illinois.

As with the Brookings County research, details of these sales are retained in the MaRous & Company office files; maps in the addenda to this report illustrate the location of these matched pairs. Unless otherwise indicated, none of the purchasers in these transactions appear to own any other property in proximity, and none of the transactions appear to have a wind turbine lease associated with the property.

Minnesota Analysis - Freeborn County Matched Pair No. 1

Freeborn County, Minnesota, is located north adjacent to central Iowa. Matched Pair No. 1 considers the sale of a property in the footprint of the Bent Tree Wind Farm in Freeborn County, which has been operational since February 2011. The house is located at 69525 305th Street, Hartland, sold in March 2016. This house is approximately 2,375 feet from the nearest turbine; there are several turbines located to the south and southeast.

This sale is compared with a similar property located at 70308 240th Street, Albert Lea, that sold in May 2016. Wind turbines are visible from the house, but the turbines are more than 1.5 miles away. The location is very rural in nature. Market conditions are considered to be substantially similar at the dates of sale. The salient details of these two properties are summarized in the table below.

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FREEBORN COUNTY MATCHED PAIR NO. 1

	1A - Proximate to a Wind Turbine	1B - Not Proximate to a Wind Turbine
Address	69525 305th Street. Hartland, MN 56042	70308 240th Street. Albert Lea, MN 56007
Distance from Turbine	2,375 (nearest)	NA
Sale Date	March 31, 2016	May 16, 2016
Sale Price	$89,000	$100,000
Sale Price/Sq. Ft. (A.G.)	$57.12	$61.80
Year Built	1880	1925
Building Size (Sq. Ft.)	1,558	1,618
Lot Size (Acres)	5.51	4.01
Style	Farm house; frame (vinyl) 3 or 4 bedrooms, 2 bath	Farm house; frame (vinyl) 3 bedrooms, 2 bath
Basement	Full, unfinished	Partial, unfinished
Utilities	No central air; propane heat; Well & septic	Central air; natural gas heat; Well & septic
Other	2-car detached garage; deck, outbuildings	2.5-car detached garage; deck, outbuildings

69525 305th Street

70308 240th Street

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Both properties are older, farm-house style and of frame construction with vinyl siding. They are somewhat similar in size. However, the 240th Street house is superior to the 305th Street house in condition; it is classified by the Assessor as being in better condition and is described in the online listing as having been renovated recently. The 305th Street house does not have central air conditioning, and does not have natural gas available; however, the 240th Street house has both. Both the central air conditioning and the availability of natural gas are considered superior factors for 240th Street requiring a downward adjustment. An upward adjustment is made for the full basement of 305th Street compared to the partial basement of 240th Street.

The house on 240th Street has a site size approximately 1.5 acres smaller than that of the 305th Street house. However, this is more than offset by its location on a hard-surface road, as well as the proximity to Interstate 90 access and to the city of Albert Lea.

ADJUSTMENT GRID MATCHED PAIR NO. 1

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
1B	70308 240th St. Albert Lea, Minnesota	◦	-	◦	◦	-	◦	+	-	◦

+ Positive adjustment based on comparable being inferior in comparison to property #7A

- Negative adjustment based on comparable being superior in comparison to property #7A

◦ No adjustment necessary

Iowa Analysis - Hancock County Matched Pair No. 1

Hancock County is located in northern Iowa and is a largely rural county, primarily agricultural in nature. The county has two areas of wind turbines, the Hancock County wind farm in the southeast portion of Hancock County and the Crystal Lake Energy Center in the northwest portion of Hancock County.

Crystal Lake I Wind Farm is located in Hancock County in north central Iowa and consists of 100 turbines that began commercial operations in 2008. Phases II and III located primarily in Winnebago County, added another 80 and 44 turbines, respectively, and began operations in approximately 2009. A property located at 2685 Ford Avenue, Britt, sold in May 2016, for $155,400. The sale previously sold in October 2012 for $150,000. The nearest turbine is approximately 2,000 feet to the north and west of this property.

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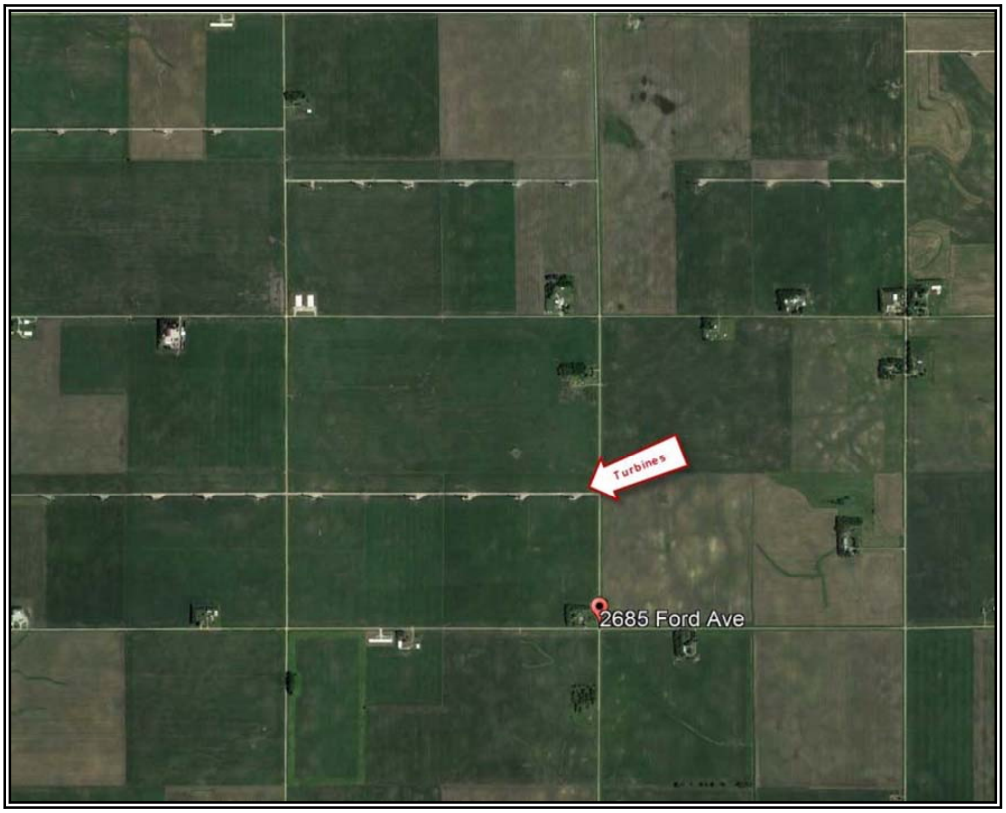
The following aerial map illustrates the relationship of the Ford Avenue property to the closest wind turbines.



This property is compared with a similar property located at 2855 Taft Avenue that sold in December 2014 and is not located proximate to any wind turbines. Market conditions between December 2014 and May 2016 are considered to have been stable to improving in this area of Iowa. The salient details of these two properties are summarized in the table below.

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HANCOCK COUNTY MATCHED PAIR NO. 1

	1A - Proximate to a Wind Turbine	1B - Not Proximate to a Wind Turbine
Address	2685 Ford Ave. Britt, IA 50423	2855 Taft Ave. Garner, IA 50438
Distance from Turbine	2,020 (nearest)	NA
Sale Date	May 20, 2016	December 22, 2014
Sale Price	$155,400	$190,000
Sale Price/Sq. Ft. (A.G.)	$81.62	$94.25
Year Built	1959	1975
Building Size (Sq. Ft.)	1,904	2,016
Lot Size (Acres)	2.08	1.22
Style	Ranch; frame (metal siding) 3 bedrooms, 2 bath	Split level; frame 3 bedrooms, 2 bath
Basement	Full, finished	None; slab
Utilities	Central air; Well & septic	In-wall air; Electric heat; Well & septic
Other	2-car attached garage; 1-car detached garage; patio, porch, shed	2.5-car attached garage; patio, deck, utility buildings

2685 Ford Avenue

2855 Taft Avenue

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Although the Ford Avenue property technically is a ranch-style house, and the Taft Avenue property is a split-level-style house, both properties have lower levels that comprise a family room and an additional room. An upward adjustment for the superior market condition of the Ford Avenue property is made. In the case of the Ford Avenue property, the additional lower-level room is a kitchen, and the basement square footage is not included in the building size and an upward adjustment is made for this feature. In the case of the Taft Avenue property, the lower level is not below grade, and the area, which includes a family room and a bedroom, is included in the square footage. The Taft Avenue building is of newer construction and a downward adjustment is made; however, the Ford Avenue property has been adequately maintained. Both properties are considered to be in normal condition by the Hancock County Assessor. An upward adjustment is made for the central air of Ford Avenue compared to the in-wall air conditioning of Taft Avenue. The Ford Avenue property is situated on a larger lot than that of the Taft Avenue property; however, both lots have wooded areas along the rear property line, which mitigate the size differential to a large degree.

ADJUSTMENT GRID MATCHED PAIR NO. 1

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
1B	2855 Taft Ave. Garner, Iowa	+	-	◦	◦	-	+	-	+	◦
+	Positive adjustment based on comparable being inferior in comparison to property #7A									
-	Negative adjustment based on comparable being superior in comparison to property #7A									
◦	No adjustment necessary									

When the adjustments noted above for newer construction and the superior above-grade location of the second family room are made to the sale price of the Taft Avenue house, the two properties have essentially the same per square foot value. In other words, the higher per foot sales price for the Taft Avenue house is justified by its superior condition and location. Thus, the difference in the sale price does not support the conclusion that proximity to the wind turbines had a negative impact on the value of the Ford Avenue property.

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Illinois Analysis - Macon County Matched Pair No. 1

Matched Pair #1 considers the recent sale of a property located at 8873 North Glasgow Road, Warrensburg, that is 1,855 feet from the nearest wind turbine located within the subject, the Twin Forks Wind Farm, with approximately four additional turbines visible from the property to the north and west.

This sale is compared with a similar property located at 1511 Hunters View Drive, Mount Zion, that sold in June 2013. The location is in a suburban setting, but the area is still very rural in nature. The salient details of these two properties are summarized in the table below.

MACON COUNTY MATCHED PAIR NO. 1

	1A - Proximate to a Wind Turbine	1A - Prior Sale	1B - Not Proximate to a Wind Turbine
Address	8873 North Glasgow Rd. Warrensburg, IL 62573	8873 North Glasgow Rd. Warrensburg, IL 62573	1511 Hunters View Dr. Mount Zion, IL 62549
Distance from Turbine	1,855 (nearest)	NA	NA
Sale Date	June 12, 2017	March 25, 2014	June 31, 2013
Sale Price	$214,000	$184,000	$193,000
Sale Price/Sq. Ft. (A.G.)	$124.35	$106.91	$91.90
Year Built	2006	2006	2006
Building Size (Sq. Ft.)	1,721	1,721	2,100
Lot Size (Acres)	1.04	1.35	0.21
Style	1-story, frame (vinyl) 4 bedrooms, 2 bath	1-story, frame (vinyl) 3 bedrooms, 2 bath	2-story, frame (vinyl/brick) 4 bedrooms; 2.1 bath
Basement	Full; partially finished	Full; unfinished	Full; finished
Utilities	Geothermal heat & cooling; Well & septic	Geothermal heat & cooling; Well & septic	Central Air; Forced-air heat; Public Sewer
Other	2.5-car attached garage; front porch and deck	2.5-car attached garage; front porch	3-car attached garage; patio

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8873 North Glasgow Road

1511 Hunters View Drive

The house at 8873 North Glasgow Road, is located approximately 8 miles northwest of Decatur, in a rural area. According to the Macon County Assessor's records, this house previously sold in March 2014 for $184,000. This indicates an increase in value of approximately 16 percent during a period where residential sale prices generally were not increasing. There is no lease for a wind turbine on this property. According to the most recent selling broker, there was an issue with the well test; the yard was dug up to find the well and to treat the problem. The yard has since returned to normal condition. The broker also stated that the house is in excellent condition and showed very well. The sellers added a wrap-around deck and finished part of the basement to add a fourth bedroom. The seller was being relocated and was offered a low price for the relocation fee; the sellers put the house on the market on their own and were able to sell it almost immediately for greater than the asking price. The broker stated that the turbine being installed proximate to the property is a possible reason for the quick sale at a higher price, which indicates that having a turbine close to this property potentially had a positive effect on the sale.

The house on Hunters View Drive, has a similar, rural location, yet is situated in a suburban setting, and is approximately 4 miles south of Decatur. Although this house sits on a smaller lot than the Glasgow Road property, this is offset by the extra bedroom and by the second floor. The property is not near a wind farm.

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ADJUSTMENT GRID MATCHED PAIR NO. 1

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
1B	1511 Hunters View Drive Mount Zion, Illinois	+	◦	-	+	-	◦	◦	+	◦

+ Positive adjustment based on comparable being inferior in comparison to property #7A

- Negative adjustment based on comparable being superior in comparison to property #7A

◦ No adjustment necessary

The comparison will be made to the March 2014 date of sale because it is most similar in time to the sale date of the Hunters View Drive property.

Road property. Downward adjustments are made for the superior building size of the Hunters View Drive property. When the adjustments noted above are made to the sale price of the Glasgow Road house, the two properties have essentially the same per square foot value. Therefore, although the Hunters View Drive house is larger, the higher per foot sales price for the Glasgow Road house is justified by its superior condition and amenities, and its larger lot size. Thus, the difference in the sales price does not support the conclusion that there is any diminution in value resulting from the proximity of the Glasgow Road property to wind turbines. This is further supported by the subsequent sale of the Glasgow Road property, at which time the 2017 sale price increased by $17.44 per square foot over the 2014 sale price.
the 2017 sale price increased by $17.44 per square foot over the 2014 sale price.

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Illinois Analysis - McLean County Matched Pair No. 1

McLean County Matched Pair No. 1 considers the sale of a house located at 29394 E 850 North Road, Ellsworth, that sold in November 2015 for $207,000. This house is located approximately 1,865 feet from the nearest turbine, and there are several wind turbines visible to the north and east. The following photograph is of the wind turbines visible from the house, with the majority visible in the distance.

This property is compared with a similar property located at 26298 E 1000 North Road, Downs, that sold in March 2015 for $220,000. This property is not located near wind turbines; however, there are some visible more than 1 mile to the east. Market conditions are considered to be similar. Both properties are situated in rural locations. The salient details of these two properties are summarized in the table below.

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MCLEAN COUNTY MATCHED PAIR NO. 1

	1A - Proximate to a Wind Turbine	1B - Not Proximate to a Wind Turbine
Address	29394 E 850 North Rd. Ellsworth, IL 61737	26298 E 1000 North Rd. Downs, IL 61736
Distance from Turbine	1,865 (nearest)	N/A
Sale Date	November 17, 2015	March 11, 2015
Sale Price	$207,000	$220,000
Sale Price/Sq. Ft. (A.G.)	$86.25	$82.71
Year Built	1978	1978
Building Size (Sq. Ft.)	2,400	2,660
Lot Size (Acres)	1.70	2.49
Style	Two-story, frame (vinyl/brick) 4 bedrooms; 2 bath	Two-story, frame (vinyl) 4 bedrooms; 2 bath
Basement	Full, finished	Full, finished
Utilities	Central air; Propane heat; Well & septic	Central air; Propane heat; Well & septic
Other	2.-car detached garage; patio, deck, small shed	2.5-car attached garage; large storage shed

29394 E 850 North Road

26298 E 1000 North Rd.

Both houses are of similar construction type, vintage, and size. Both had been updated recently, with the house at 29394 E 850 North Road having been updated more extensively than the other. Both have finished basements; however, basement build-out in the house at 26298 E 1000 North Road is not completely finished. The house at 26298 E 1000 North Road has a large shed with a drive-in door. The superior interior features and the larger shed are offset by the approximately ½-acre larger site size of the property at 26298 E 1000 North Road. Both houses are located on paved roads.

ADJUSTMENT GRID MATCHED PAIR NO. 1

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
1B	26298 E 1000 North Rd. Dow ns, Illinois	◦	◦	◦	-	◦	◦	◦	◦	-
+	Positive adjustment based on comparable being inferior in comparison to property #7A									
-	Negative adjustment based on comparable being superior in comparison to property #7A									
◦	No adjustment necessary									

The analysis of the sales at 29394 E 850 North Road and at 26298 E 1000 North Road does not support a finding that the proximity to the wind turbines had a negative impact on value.

Illinois Analysis - McLean County Matched Pair No. 2

McLean County Matched Pair No. 2 considers the sale of a house located at 25156 E 1400 North Road, Ellsworth, that sold in November 2015 for $196,000. This house is located approximately 2,210 feet from the nearest turbine, but there are several turbines proximate to the south, southeast, and southwest.

The following photograph is of the wind turbines visible from the property.

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This property is compared with a similar property located at 787 E 1300 North Road, Sibley, that sold in March 2015 for $125,000. This property is not located near wind turbines. Market conditions are considered to be similar. Although this property is located in Ford County, both properties have similar, rural locations. The salient details of these two properties are summarized in the table below.

MCLEAN COUNTY MATCHED PAIR NO. 2

	2A - Proximate to a Wind Turbine	2B - Not Proximate to a Wind Turbine
Address	25156 E 1400 North Rd. Ellsworth, IL 61737	787 E 1300 North Rd. Sibley, IL 61773
Distance from Turbine	2,210 (nearest)	N/A
Sale Date	November 1, 2015	March 13, 2015
Sale Price	$196,000	$125,000
Sale Price/Sq. Ft. (A.G.)	$66.58	$49.56
Year Built	1890	1900
Building Size (Sq. Ft.)	2,944	2,522
Lot Size (Acres)	4.14	3.36
Style	1.5-story, frame (vinyl) 4 bedrooms; 2 bath	Two-story, frame (vinyl) 4 bedrooms; 2 bath
Basement	Full, finished	Full, partially finished
Utilities	Central air; Propane heat; Well & septic	Central air; Propane heat; Well & septic
Other	1-car attached garage; porch; machine shop	2.-car detached garage; deck, large shed

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25156 E 1400 North Road

787 E 1300 North Road

Both houses are of similar construction type, vintage, and size. Both have been remodeled in the recent past. The E 1400 North Road house has a large freestanding garage/machine shed that has water and electricity, which is superior to the older shed on the site of the E 1300 North Road house. Also, the site size of the E 1400 North Road house is approximately ¾ acre larger than the E 1300 North Road house. Both factors are reflected in its higher sale price.

ADJUSTMENT GRID MATCHED PAIR NO. 2

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
2B	787 E 1300 North Rd. Sibley, Illinois	◦	◦	+	+	◦	◦	◦	◦	◦
+	Positive adjustment based on comparable being inferior in comparison to property #7A									
-	Negative adjustment based on comparable being superior in comparison to property #7A									
◦	No adjustment necessary									

The analysis of the sales at 25156 E 1400 North Road and 787 E 1300 North Road does not support a finding that the proximity to the wind turbines had a negative impact on value.

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Illinois Analysis - McLean County Matched Pair No. 3

McLean County Matched Pair No. 3 considers the sale of a house located at 25017 E 1400 North Road, Ellsworth, that sold in September 2015 for $159,000. This house is located approximately 1,573 feet from the nearest turbine, and there are several turbines proximate to the south, southeast, and southwest.

The following photograph is of the wind turbines visible from the property.

This property is compared with a similar property located at 10837 Yankee Town Road, Farmer City, that sold in October 2016 for $134,000. This property is not located near wind turbines. Market conditions are considered to be slightly superior at the date of sale of this property. Although this house is located in DeWitt County, both properties have similar rural locations. The salient details of these two properties are summarized in the table below.

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MCLEAN COUNTY MATCHED PAIR NO. 3

	3A - Proximate to a Wind Turbine	3B - Not Proximate to a Wind Turbine
Address	25017 E 1400 North Rd. Ellsworth, IL 61737	10837 Yankee Town Rd. Farmer City, IL 61842
Distance from Turbine	1,573 (nearest)	N/A
Sale Date	September 3, 2015	October 3, 2016
Sale Price	$159,000	$134,000
Sale Price/Sq. Ft. (A.G.)	$81.45	$68.37
Year Built	1880	1908
Building Size (Sq. Ft.)	1,952	1,960
Lot Size (Acres)	2.87	4.00
Style	Two-story, frame (vinyl) 4 bedrooms; 2 bath	Two-story, frame (vinyl) 4 bedrooms; 2 bath
Basement	Full, finished	Full, finished
Utilities	Central air; Propane heat; Well & septic	Central air; Propane heat; Well & septic
Other	No separate garage; large shed with drive-in doors; other farm buildings	No separate garage; large shed with drive-in doors; other farm buildings

25017 E 1400 North Road

10837 Yankee Town Road

Both houses are of similar construction type, vintage, and size. Both have been remodeled and updated. Neither property has a garage; both have large buildings with drive-in doors for cars and other equipment. Both properties have other farm buildings on the site. The Yankee Town Road house has a site that is approximately 1.25 acres larger than that of the E1400 North Road house.

ADJUSTMENT GRID MATCHED PAIR NO. 3

SALE NO.	ADDRESS	SALE DATE	YEAR BUILT	BUILDING SIZE	LOT SIZE	LOCATION	STYLE	BASEMENT	UTILITIES	OUT-BUILDINGS
3B	10837 Yankee Town Rd. Farmer City, Illinois	-	◦	◦	-	◦	◦	◦	◦	◦
+	Positive adjustment based on comparable being inferior in comparison to property #7A									
-	Negative adjustment based on comparable being superior in comparison to property #7A									
◦	No adjustment necessary									

The analysis of the sales at 25017 E 1400 North Road and 10837 Yankee Town Road does not support a finding that the proximity to wind turbines had a negative impact on value.

Matched Pair Analysis Conclusions

Based on these matched pairs and sales/resales of properties proximate to wind turbines, there does not appear to have been any measurable negative impact on surrounding property values due to the proximity of a wind farm.

Agricultural Land Values

Agricultural land values are typically tied to the productivity of the land and to the commodity prices of crops like corn and soy beans. Other factors include favorable interest rates, and the supply of land compared to the number of buyers. The most recent "Ag Letter" for the 9th District, which includes South Dakota, and is published by the Federal Reserve of Minneapolis, indicated a modest 3 percent increase in agricultural land values after 3 years of mild downward year-over-year changes.

The South Dakota Agricultural Land Trends 1991-2016 produced by South Dakota State University[5] reported agricultural land values in Bon Homme County and Hutchinson County averaged $5,089 per acre in 2016, and $5,326 per acre in 2015. The reported land values in Charles Mix County averaged $4,563 per acre in 2016, and $4,580 per acre in 2015. A more recent survey covering the period between February 2016, and February 2017[6] land value in Bon Homme County and Hutchinson County averaged $5,427 per acre, and Charles Mix County averaged $4,425 per acre. The most likely buyer of agricultural land in South Dakota is an existing farmer or investor, with neighboring farmers paying higher prices than investors. The prognosis appears to be for stable land values. The following table and map illustrate overall average values as of February 1, 2017, by region.

[5] https://igrow.org/up/resources/07-3007-2016.pdf 2016 SDSU South Dakota Farm Real Estate Survey
[6] https://igrow.org/up/resources/07-3007-2017.pdf 2017 SDSU South Dakota Farm Real Estate Survey

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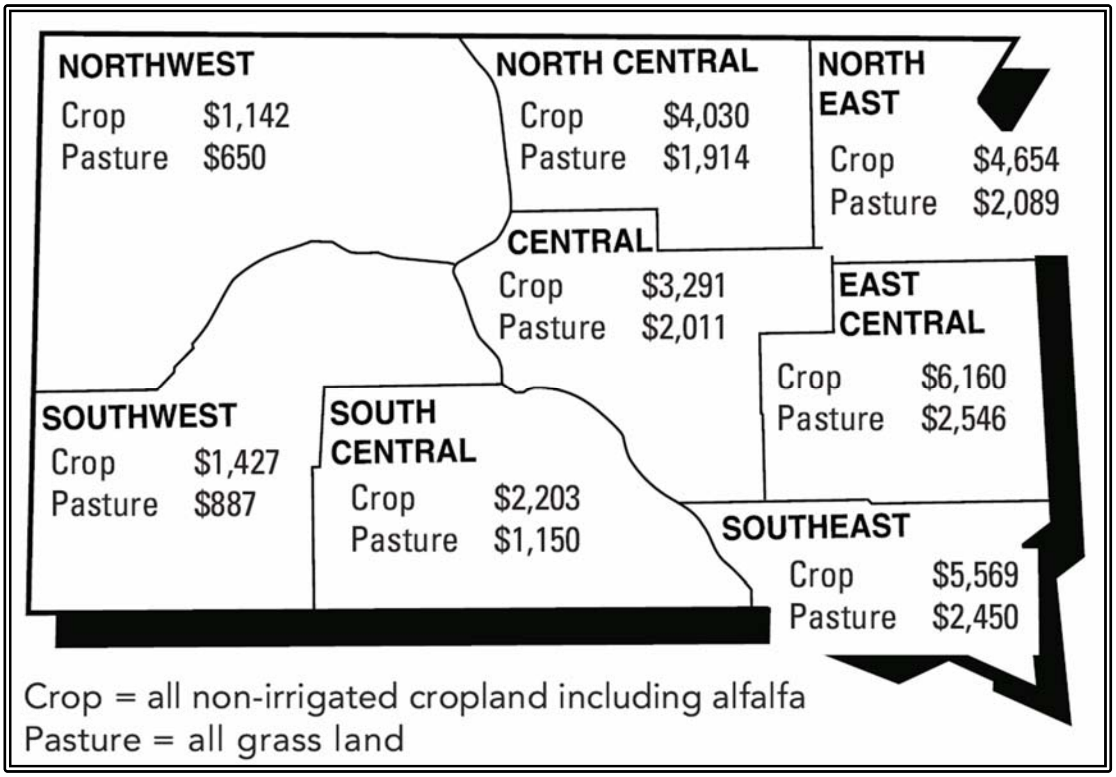

Table 3. Average reported value and annual percentage change in value of South Dakota agricultural land by type of land by region, February 2013-2017.

Type of Land	Southeast	East Central	Northeast	North Central	Central	South Central	Southwest	Northwest	STATE
	dollars per acre								
Nonirrigated Cropland									
Average value, 2017*	$5,569	$6,160	$4,654	$4,030	$3,291	$2,203	$1,427	$1,142	$3,903
Average value, 2016	$5,653	$6,116	$4,613	$4,177	$3,843	$2,168	$1,264	$1,187	$4,094
Average value, 2015	$5,887	$6,329	$5,066	$4,275	$3,895	$2,283	$1,347	$1,193	$4,265
Average value, 2014	$6,331	$7,114	$5,291	$4,614	$3,953	$2,087	$820	$870	$4,478
Average value, 2013	$5,903	$6,828	$4,843	$4,562	$3,580	$1,994	$900	$792	$4,249
Annual % change 17/16	-1.5%	0.7%	0.9%	-3.5%	-14.4%	1.6%	12.9%	-3.8%	-4.7%
Pasture/ Rangeland**									
Average value, 2017**	$2,450	$2,546	$2,089	$1,914	$2,011	$1,150	$887	$650	$1,215
Average value, 2016	$2,566	$2,781	$2,028	$1,957	$2,219	$1,330	$715	$760	$1,222
Average value, 2015	$2,719	$2,727	$2,136	$1,758	$2,100	$1,338	$851	$630	$1,187
Average value, 2014	$2,698	$2,861	$1,859	$1,600	$1,828	$1,187	$571	$436	$987
Average value, 2013	$2,308	$2,765	$1,759	$1,473	$1,636	$994	$529	$444	$909
Annual % change 17/16	-4.5%	-8.5%	3.0%	-2.2%	-9.4%	-13.5%	24.1%	-14.5%	-0.6%

Source: 2017 and earlier South Dakota Farm Real Estate Market Surveys
*cropland now includes all alfalfa acres
** 2017 pasture land variable has been redefined and includes all grass acres
Statewide average land values are based on 2002 land use weights

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The following table summarizes a small sample size of most recent agricultural land sales larger than 70 acres in the southeast region of South Dakota nearest to the proposed Prevailing Wind Park. There were limited recent agricultural land sales in Bon Homme County, Charles Mix County, or Hutchinson County.

**RECENT LAND SALES SUMMARY
IN THE AREA NEAREST TO THE PROPOSED PREVAILING WIND PARK**

No.	Location	Sale Price	Sale Date	Land Area (Acres)	NCCPIS*	Sale Price Per Acre
1	297th St. & 430th Ave. Lesterville, South Dakota					
	Land Sale #1 - 1 Parcel	$100,651	3/14	73.19	34.2	$1,375.20
2	300th St. & 431st Ave. Lesterville, South Dakota					
	Land Sale #2 - 2 Parcels	$122,500	9/14	244.49	47.0	$501.04
3	298th St. & 431st Ave. Lesterville, South Dakota					
	Land Sale #3 - 1 Parcel	$790,000	4/15	153.18	34.7	$5,157.33
4	44221 SD Rte. 46 Irene, South Dakota					
	Land Sale #3 - 1 Parcel	$944,500	2/18	153.25	44.6	$6,163.13

*National Commodity Crop Productivity Index - based on AcreValue.com GIS informational map. The NCCPI uses a scale of 0 to 100, with 0 having a lower productivity potential and 100 a higher potential. This scale was developed using soil chemical and physical properties, water availability, climate, and landscape values. The NCCPI has indexes for corn, wheat and cotton (USDA, 2008)

Agricultural Land Sales and Wind Farms

The above land sales reveal that the agricultural land near the area of the proposed project footprint is below average for the southeast region of South Dakota and adding wind turbines and land leases should only benefit the land prices and productivity. There was a lack of significant data to discover any sales of South Dakota farmland in which the transaction included a wind turbine, and upon closer inspection, the existing wind farms are located in fairly remote areas of the state with few or no residential houses within 3 miles. However, there were a few sales in Freeborn County, Minnesota, which is home to the Bent Tree Wind Farm and has similar demographics to the Prevailing Wind Park. The following table summarizes the three sales in 2015 and 2016 of farmland with turbine leases. Although this survey is not exhaustive, it appears that the turbines may have had a positive impact on the sale price.

AGRICULTURAL LAND VALUES WITH TURBINES - FREEBORN COUNTY

	2015			2016		
	Number of Sales	Range in Sale $/Acre	Average Sale $/Acre	Number of Sales	Range in Sale $/Acre	Average Sale $/Acre
Bent Tree Wind Farm	2	$7,011 to $9,502	$8,257	1	$7,011	$7,011
County Average			$6,547			$6,416

Wind turbines typically are considered to be of significant benefit to farmers; Franklin County, Iowa reported lowering real estate taxes for the county as a whole because of the taxes generated by the wind turbines in that county. Support for good prices comes from the lack of land for sale, stable commodity prices, and low interest rates. Marginal land in areas where wind turbines are located or proposed is popular with investors.[7]

Although there has been no study of the impact of wind turbines on agricultural land sales for South Dakota that I could discover, a report in Illinois, the *2016 Illinois Land Values and Lease Trends*, indicated that the impact of wind turbine leases is being felt in McLean, Livingston, and Woodford counties, where turbine leases have provided "income diversification, beyond agriculture, which makes these tracts more attractive to an outside investor."[8] Further, they noted that "investors are still paying a little more of a premium for the wind turbines just as they had in the past few years."[9] The *2018 Illinois Farmland Values and Lease Trends* states that, in the state of Illinois, agricultural land values have been stable to slightly down with an optimistic view that economic challenges of higher corn prices will be overcome by the greater production of the record setting harvests throughout 2016 to 2018.

Overall, it appears that there is little or no relationship between agricultural land values and the location of wind farms, with productivity being the driving force behind land values. However, wind farm lease revenue does appear to add to the marketability and value.

Real Estate Professionals

Real estate professionals were contacted to discuss market conditions, specific market transactions, and to investigate whether they had experience with, or knowledge of any impact of wind farms on residential property values. Jim Aesoph of Aesoph Real Estate, Inc. is a broker with 27 years of experience in northeast South Dakota. MaRous and Company contacted Mr. Aesoph due to his highly regarded reputation in the region. He stated that he contacted the assessors of the adjacent Codington, Grant, and Roberts counties to discuss land prices in each respective county, and each of them informed Jim that they are not aware of any effect on land prices due to new wind projects in the area. He also stated that 5 years ago land prices were roughly $6,000 per acre, and now the average acre price is approximately $4,000. The reduction in land prices, he mentions, is not due to the wind project, but due to the production of corn on the land.

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[7] http://www.agriculture.com/farm-management/farm-land/farmland-sales-hard-to-find-as-growers-hold-tight-keeping-land-value Accessed September 18, 2017.

[8] Klein, David E., and Schnitkey, Gary, 2016 Illinois Land Values and Lease Trends, Illinois Society of Professional Farm Managers and Rural Appraisers, Page 38.

[9] Ibid. Page 42.

Interviews were conducted with six auctioneers throughout South Dakota. Marshall Hansen of Bob Hansen Auction stated that while turbines closer to home could possibly keep a buyer away, in areas of low population the development of turbines have a positive effect on the area. Mr. Hansen also stated that chemicals, such as insecticides, pose a larger impact on wildlife and gamebirds than turbines. Lenny Burlage of Burlage-Peterson Auctions stated that turbines do not negatively affect residential values but can affect each individual person differently. Jackson Hagerfeld of Advantage Land Company stated that he does see any impact on land from wind turbines, and the recent land sale prices are driven up by the limited amount of properties on the market. Jim Thorpe of Thorpe Realty & Auction stated that turbine leases have positively impacted landowners with turbines on their land. Mr. Thorpe also stated that he has noticed a movement of buyers from larger cities buying properties that are being sold off by the aging population that are moving out of the area. Jeff Juffer of Juffer Incorporated stated that from the existing turbines within the Beethoven Wind Farm footprint have not had any effect, positive or negative, on the local market. Mr. Juffer also states that Avon and the immediate surrounding area is lacking in industry and would benefit from an outside influence to attract businesses to the area. Lastly, Glen Peterson of Peterson Auctioneers states that in the past two years there has been a demand for land that is not dependent on if a turbine is on the land or not, which can be assumed that turbines do not affect land sales in any way, positively or negatively.

Local real estate appraiser and auctioneer Gregg Hubner published a book that attempted to reveal the negative aspects of the wind industry. In summary, the book discusses his opinion on what is important to people living in the southeast region of South Dakota, and how wind turbines and the wind industry as a whole disrupt their way of life.

Mr. Hubner attempts to prove why the wind industry is harmful by breaking down parts of energy acts instituted by congress. He accuses investors, such as Warren Buffett, of claiming wind is safe but then hiding dangerous facts in order to make money for themselves while hurting the local residents, as well as accusing the wind companies of being deceptive, "scamming" local residents, giving and taking bribes, and bringing in a non-local workforce from other parts of the country or other parts of the world. He unsuccessfully attempts to show that climate change is not real, which would mean that there is not a need for renewable energy sources, such as wind, and uses secondhand data that started at the Massachusetts Institute of Technology but was conservatively skewed by the only media source Mr. Hubner used throughout the book. He also attempts to use case studies and certain medical reports, in which most of these reports have been proven to be a form of pseudoscience, to explain environmental and health effects caused by proximity of turbines. Upon reading and performing a detailed fact checking of this book we find that there is no data in Mr. Hubner's book that could prove any negative impact on market value of real estate caused by the proximity to wind turbines.

Rick Mummert of Ron Holton Real Estate reported that residential conditions in both Freeborn and Mower counties in Minnesota had been stable through the last 3 years, primarily due to the very rural nature of the area; however, the area is benefitting from the low interest rates. He reported that the Highway 14 corridor had experienced increases in residential values; in his opinion, the difference was due to the more developed nature of the area and the availability of jobs.

Interviews with brokers proximate to wind farms in Illinois yielded similar results. Although a number of them wished to remain anonymous, they stated that they did not believe that the proximity to wind turbines had any bearing on the sale prices of residential properties in the area.

Michael Crowley, Sr., SRA of Real Estate Consultants, Ltd., Spring Valley, Illinois, has had extensive experience with wind farm development in Central Illinois, including projects in Bureau, Whiteside, and Lee counties. Mr. Crowley has been unable to document any loss in property values attributable to the proximity of wind turbines.

South Dakota Assessors Survey - November 2017

In November 2017, and updated in April 2018, my office conducted a survey of the supervisor of assessments or a deputy supervisor in eight counties in South Dakota in which wind farms with more than 25 turbines currently are operational, and South Dakota has more than seven wind farms with a combine total of 400 wind turbines. As of 2016, the AWEA reported there were approximately 14 wind projects with a combined total of approximately 583 wind turbines in the state with additional farms being added each year. The interviews were intended to allow the assessment officials to share their experience regarding the wind farm(s) impact upon the market values and/or assessed values of surrounding properties. The detailed analysis is attached in the addenda at the end of this report. The following is a summary of the results of that survey:

- Without exception, the interviewees reported that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm facility. In some counties, this results from the very rural nature of the area in which the projects are located;
- In the past 5 years, the only assessor’s office to have experienced a real estate tax appeal based upon wind farm-related concerns was Aurora County, but the appeal was denied by the county. There have been no reductions in assessed valuations related to wind turbines;
- As the available market data does not support the claim of a negative impact upon residential or agricultural values, residential and agricultural assessed values have fluctuated consistently within counties as influenced by market conditions, with no regard for proximity to a wind farm;
- Virtually all assessors volunteered that the wind farms provided positive economic benefits to their counties and, in fact, had a positive impact on real estate values.

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Iowa Assessors Survey - August/September 2017

In August and September 2017 my office conducted a survey of the supervisor of assessments or a staff member in 26 counties in Iowa in which wind farms with more than 25 turbines currently are operational. As of 2016, the AWEA reported there were approximately 107 wind projects with a combined total of approximately 4,143 wind turbines in the state with additional farms being added each year. The interviews were intended to allow the assessment officials to share their experience regarding the wind farm(s) impact upon the market values and/or assessed values of surrounding properties. The following is a summary of the results of that survey:

- Without exception, the interviewees reported that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm facility. In some counties, this results from the very rural nature of the area in which the projects are located;
- In the past 18 months, the assessor's offices have not experienced a real estate tax appeal based upon wind farm-related concerns. There have been no reductions in assessed valuations related to wind turbines;
- As the available market data do not support the claim of a negative impact upon residential values, residential assessed values have fluctuated consistently within counties as influenced by market conditions, with no regard for proximity to a wind farm;
- Virtually all assessors volunteered that the wind farms provided positive economic benefits to their counties and, in fact, had a positive impact on real estate values;
- Agricultural properties are taxed based upon a productivity formula that is not impacted by market data and external influences.

Minnesota Assessors Survey - January 2017

In late January 2017, my office conducted a survey of the supervisor of assessments or a deputy supervisor in eight Minnesota counties where large numbers of wind turbines currently are operational. There are several counties with small numbers of wind turbines that were not included in the survey. As of 2015, the AWEA reported there were approximately 97 wind projects with a combined total of approximately 2,400 wind turbines in the state with additional farms being added each year. The interviews were intended to allow the assessment officials to share their experience regarding the wind farm(s) impact upon the market values and/or assessed values of surrounding properties. The following is a summary of the results of that survey:

- With one exception, the interviewees reported that there was no market evidence to support a finding that there has been a negative impact upon residential property values as a result of the development of and the proximity to a wind farm facility. In some counties, the assessors believed this to be the result of the very rural nature of the area in which the projects are located;

- The exception, the Dodge County Assessor, reported receiving two complaints from residential property owners regarding the value impact of proximity to wind turbines; however, the Assessor was unable to find data to support the contentions;
- Without exception, where there was sufficient data to analyze, the County Assessors reported that both residential and agricultural assessed property values within the wind farm footprints have fluctuated consistently within counties as influenced by market conditions, with no regard for proximity to a wind farm.

Bruce Nielson, Lincoln County Assessor reported a recent residential transaction in a township in which wind turbines are located that sold $70,000 higher than the assessor's opinion of market value.

Illinois Assessors Survey - Updated October 6 - 19, 2016

In March 2015, and updated in October 2016, my office conducted a survey of the supervisor of assessments or a staff member in 18 counties in Illinois in which wind farms currently are operational. As of 2016, the AWEA reported there were approximately 48 wind projects with a combined total of approximately 2,579 wind turbines in the state with additional farms being added each year. The interviews were intended to allow the assessment officials to share their experience regarding the wind farm(s) impact upon the market values and/or assessed values of surrounding properties. The detailed analysis is attached in the addenda at the end of this report. The following is a summary of the results of that survey:

- Without exception, the interviewees reported that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm facility. In some counties, this results from the very rural nature of the area in which the projects are located;
- In the past 18 months, the assessor's offices have not experienced a real estate tax appeal based upon wind farm-related concerns. There have been no reductions in assessed valuations related to wind turbines;[10]
- As the available market data do not support the claim of a negative impact upon residential values, residential assessed values have fluctuated consistently within counties as influenced by market conditions, with no regard for proximity to a wind farm;
- Agricultural properties are taxed based upon a productivity formula that is not impacted by market data and external influences.

[10] A law suit was apparently filed in 2013 against the Supervisor of Assessments in Vermilion County by a homeowner proximate to wind turbines; however, there has been no further action on the matter.

Literature Review

I am familiar with several academic and peer-reviewed studies of the impact of wind turbines on residential property values. There are no peer reviewed studies for the state of South Dakota, however the following studies are consistent with our findings in South Dakota.[11] These are summarized below:

Municipal Property Assessment Corporation (MPAC) Study, Ontario, Canada

This study originally was conducted in 2008 and was updated in 2012 and 2016. The conclusions in all three studies are similar: "there is *no statistically significant impact on sale prices* of residential properties in these market areas resulting from proximity to an IWT [Industrial Wind Turbine], when analyzing sale prices." (2012 Study, Page 5; emphasis in original) Using 2,051 properties and generally accepted time adjustment techniques, MPAC "cannot conclude any loss in price due to the proximity of an IWT." (2012 Study, Page 29) Further, Appendix G of the 2012 MPAC report "Re-sale Analysis" states in the "Summary of Findings" "MPAC's own re-sale analysis using a generally accepted methodology for time adjustment factors indicates no loss in price based on proximity to the nearest IWT."

Lawrence Berkeley National Laboratory (LBNL) Studies, Nationwide, 2009, and 2013

The 2009 study included analysis of 7,489 sales within 10 miles of 11 wind farms and 125 post-construction sales within 1 mile of a wind turbine. The study used rural settings and wind farms of more than 50 turbines, and considered area stigma, scenic vista sigma, and nuisance stigma in varying distances from a wind turbine. The 2013 LBNL study included 51,276 sales located in nine states and proximate to 67 wind farms, and 376 post-construction sales within 1 mile of a wind turbine. Like the 2009 study, all were located in rural settings and near wind farms of more than 50 turbines. This study concentrated on nuisance stigma in varying distances from a wind turbine. The study found no statistically significant evidence that turbines affect sale prices. Neither study found statistical evidence that home values near turbines were affected.

University of Rhode Island, Rhode Island, 2013

Structured similarly to the LBNL studies, this study included 48,554 total sales proximate to 10 wind farms, and 412 post-construction sales within 1 mile of a turbine. These wind farms were mostly small facilities in urban settings. The study included nuisance and scenic vista stigmas. Page 421 of the report stated, "Both the whole sample analysis and the repeat sales analysis indicate that houses within a half mile had essentially no price change ..." after the turbines were erected.

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[11] Although I have read these studies, the substance of these summaries was taken from a seminar conducted by the Appraisal Institute on March 5, 2015.

University of Guelph, Melancthon Township, Ontario, Canada, 2013

This study analyzed two wind farms in the township, using 5,414 total sales and 18 post-construction sales within 1 kilometer of a wind turbine. The study included nuisance and scenic vista stigmas. Page 365 of the study stated that "These results do not corroborate the concerns regarding potential negative impacts of turbines on property values."

University of Connecticut/LBNL, Massachusetts, 2014

This study included 312,677 total sales proximate to 26 wind farms, and 1,503 post-construction sales within 1 mile of a wind turbine. These wind farms were located in urban settings and primarily were proximate to small wind farms. The study included wind turbines and other environmental amenities/disamenities (including beaches and open spaces/landfills, prisons, highways, major road, and transmission lines) together, for nuisance stigma. "Although the study found the effects from a variety of negative features ... and positive features ... the study found no net effects due to the arrival of turbines."

These studies had a combined number of 2,500 transactions within 1 mile of operating turbines and found no evidence of value impact.

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Conclusions

As a result of the market impact analysis undertaken, I concluded that there is no market data indicating the project will have a negative impact on either rural residential or agricultural property values in the surrounding area. Further, market data from South Dakota, as well as other states, supports the conclusion that the project will not have a negative impact on rural residential or agricultural property values in the surrounding area. Finally, for agricultural properties that host turbines, the additional income from the wind lease may increase the value and marketability of those properties. These conclusions are based on the following:

- The proposed use will meet or exceed all the required development and operating standards;
- Controls are in place to insure on-going compliance;
- There are significant financial benefits to the local economy and to the local taxing bodies from the development of the proposed wind farm;
- The proposed wind farm will create well-paid jobs in the area which will benefit overall market demand;
- An analysis of recent residential sales proximate to existing wind farms did not support any finding that proximity to a wind turbine had a negative impact on property values;
- An analysis of agricultural land values in Iowa did not support any finding that agricultural land values are negatively impacted by the proximity to wind turbines;
- Reports from Minnesota, Iowa, and Illinois indicate that wind turbine leases add value to agricultural land; and
- A survey of County Assessors in 8 South Dakota counties, 26 Iowa counties, 8 Minnesota counties, and 18 Illinois counties in which wind farms with more than 25 turbines are located determined that there was no market evidence to support a negative impact upon residential property values as a result of the development of and the proximity to a wind farm, and that there were no reductions in assessed valuation.

This report is based on market conditions existing as of June 11, 2018. This market impact study has been prepared specifically for the use of the client and to potentially support an application to allow the development of the Prevailing Wind Park in Bon Homme County, Charles Mix County, & Hutchinson County, South Dakota. Any other use or user of this report is considered to be unintended.

Respectfully submitted,

MaRous & Company

Michael S. MaRous, MAI, CRE
South Dakota Certified General #1641-T-2018 (9/14/18 expiration)
Illinois Certified General - #553.000141 (9/19 expiration)

CERTIFICATE OF REPORT

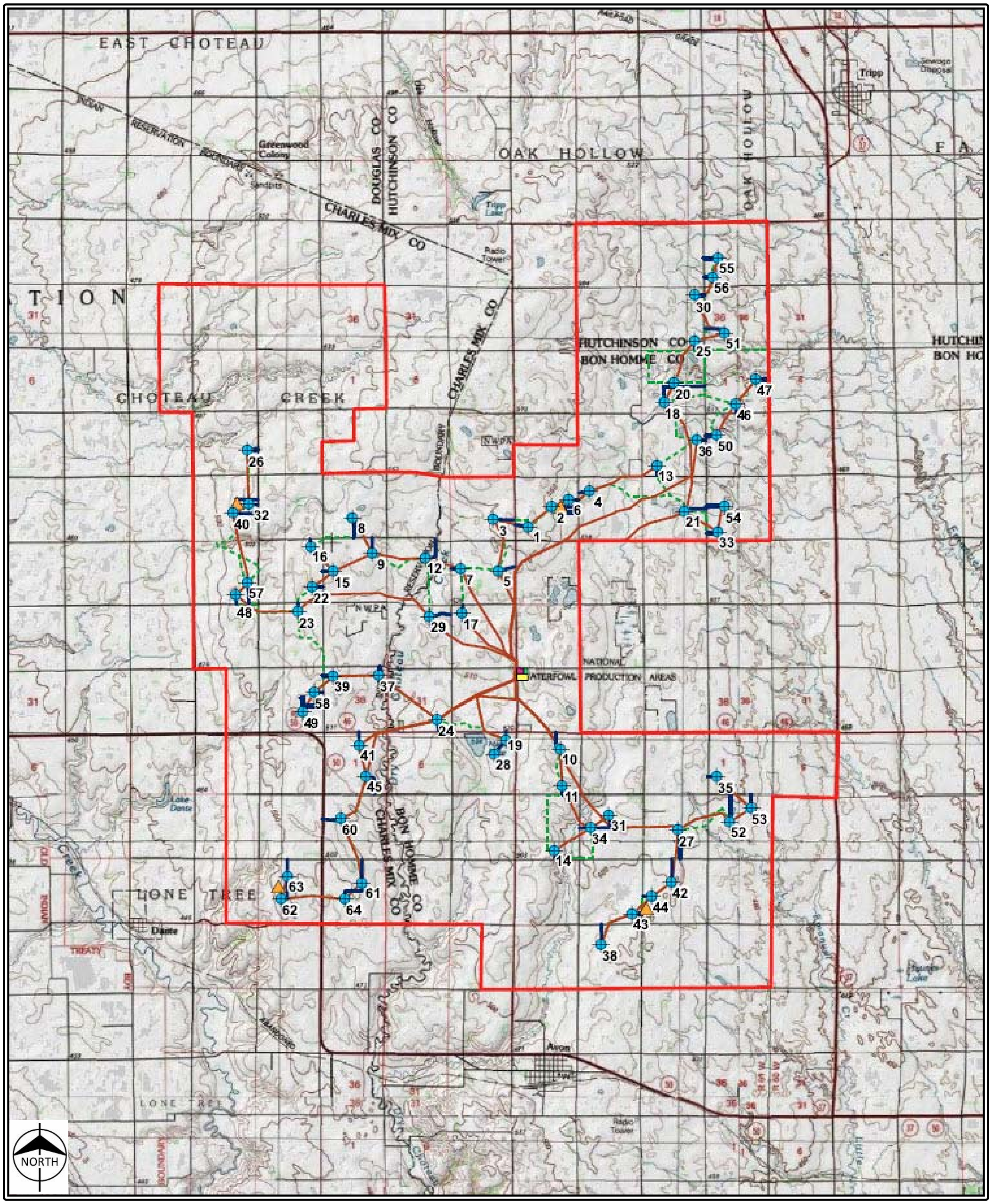
I do hereby certify that:

1. The statements of fact contained in this report are true and correct;
2. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are my personal, impartial, and unbiased professional analyses, opinions, conclusions, and recommendations:
3. I have no present or prospective personal interest in the property that is the subject of this report and no personal interest with respect to the parties involved;
4. I have performed no services, as an appraiser or in any other capacity, regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment;
5. I have no bias with respect to the property that is the subject of the work under review or to the parties involved with this assignment;
6. My engagement in this assignment was not contingent upon developing or reporting predetermined results;
7. My compensation for completing this assignment is not contingent upon the development or reporting of predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal consulting assignment;
9. My analyses, opinions, and conclusions were developed, and this report has been prepared in conformity with the *Uniform Standards of Professional Appraisal Practice;*
10. I have made a personal inspection of the subject of the work under review;
11. Joseph M. MaRous provided significant appraisal review assistance to the person signing this certification;
12. The reported analysis, opinions, and conclusions were developed, and this report has been prepared, in conformity with the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Foundation;
12. The use of the report is subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives; and
13. As of the date of this report, Michael S. MaRous, MAI, CRE, has completed the continuing education requirements for Designated Members of the Appraisal Institute.

Respectfully submitted,
MaRous & Company

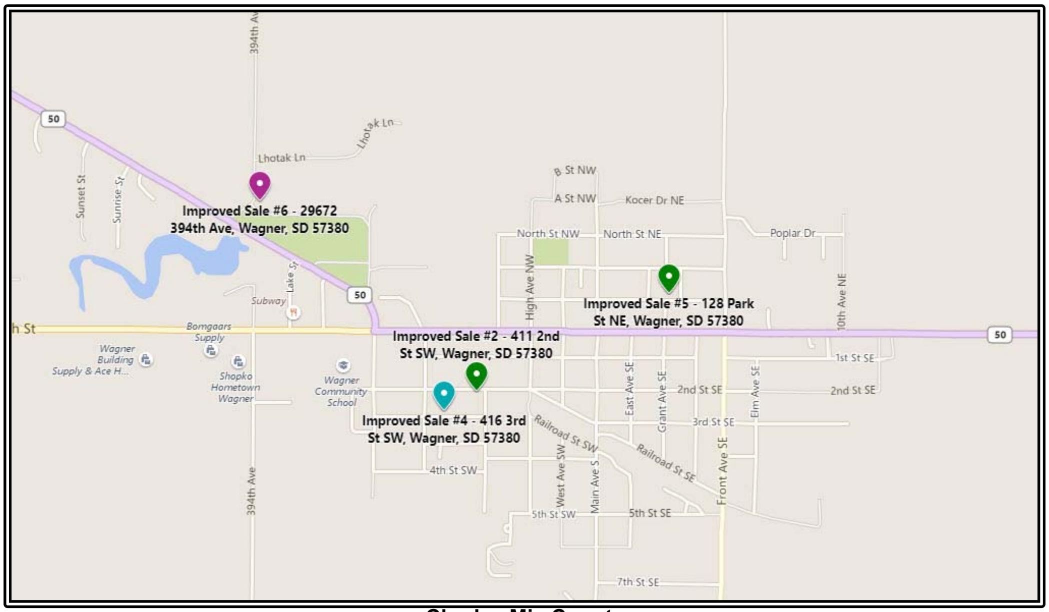
Michael S. MaRous, MAI, CRE
South Dakota Certified General #1641-T-2018 (9/14/18 expiration)
Illinois Certified General - #553.000141 (9/19 expiration)

ADDENDA

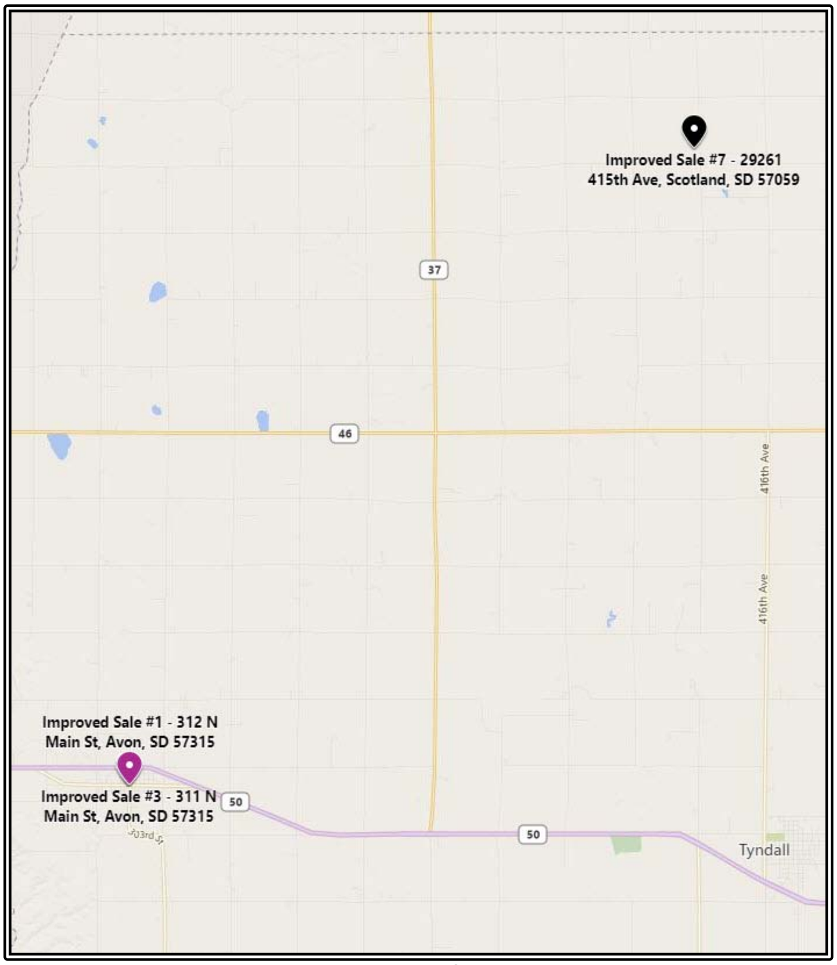


* SDPUC Application, Figure 2 - Configuration/Topographic Map

PROPOSED PREVAILING WIND PARK FOOTPRINT

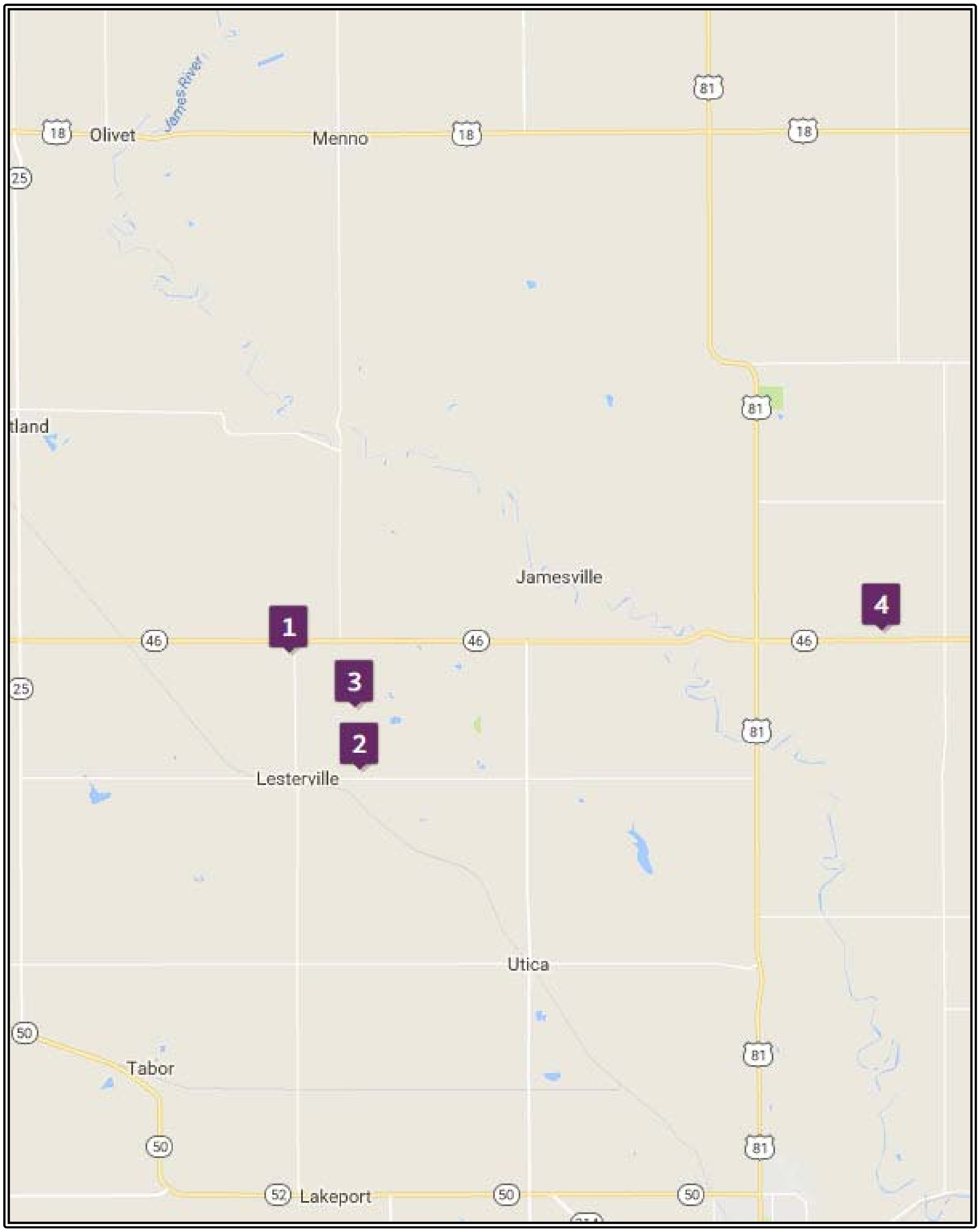


Charles Mix County

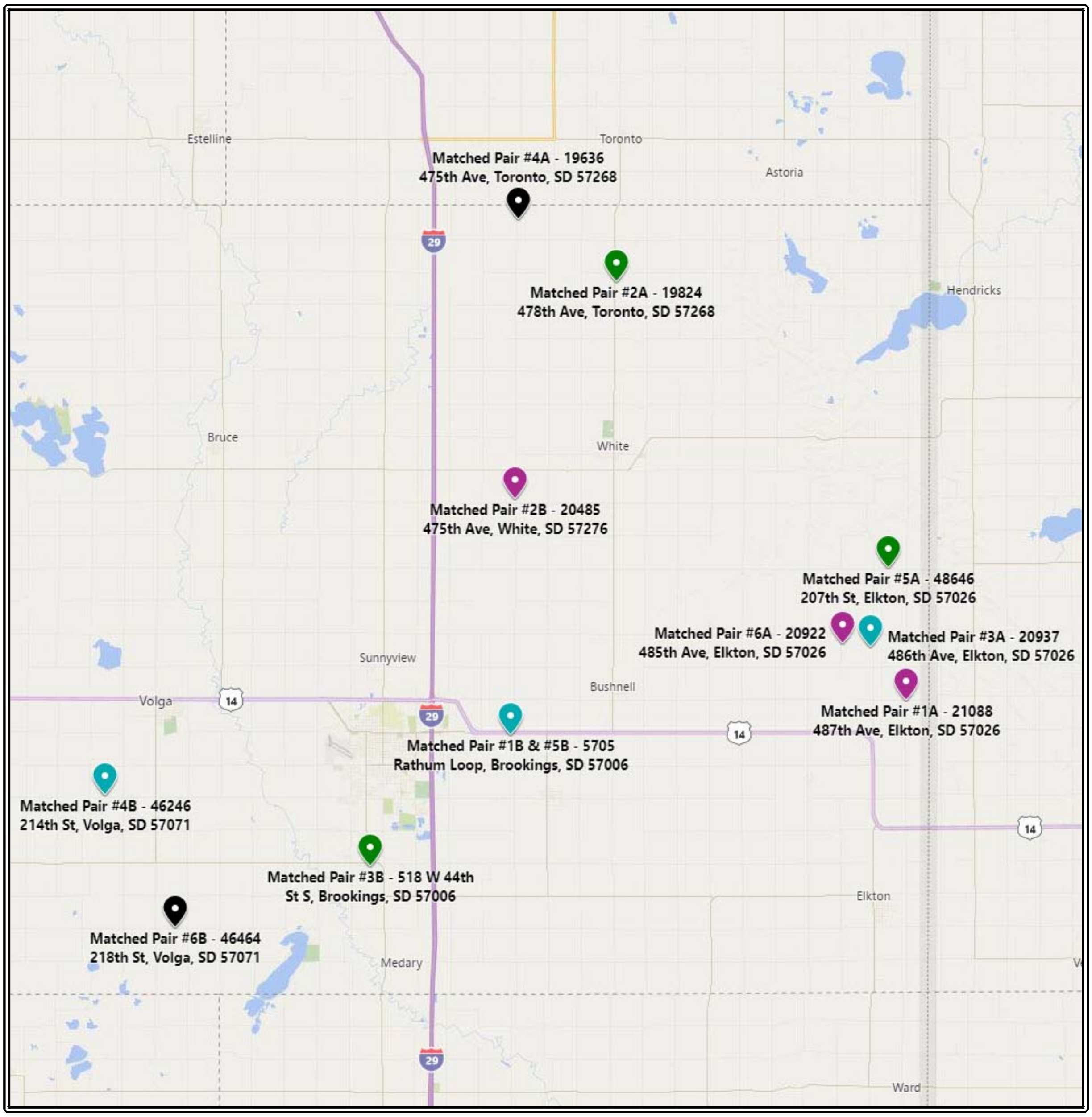


Bon Homme County

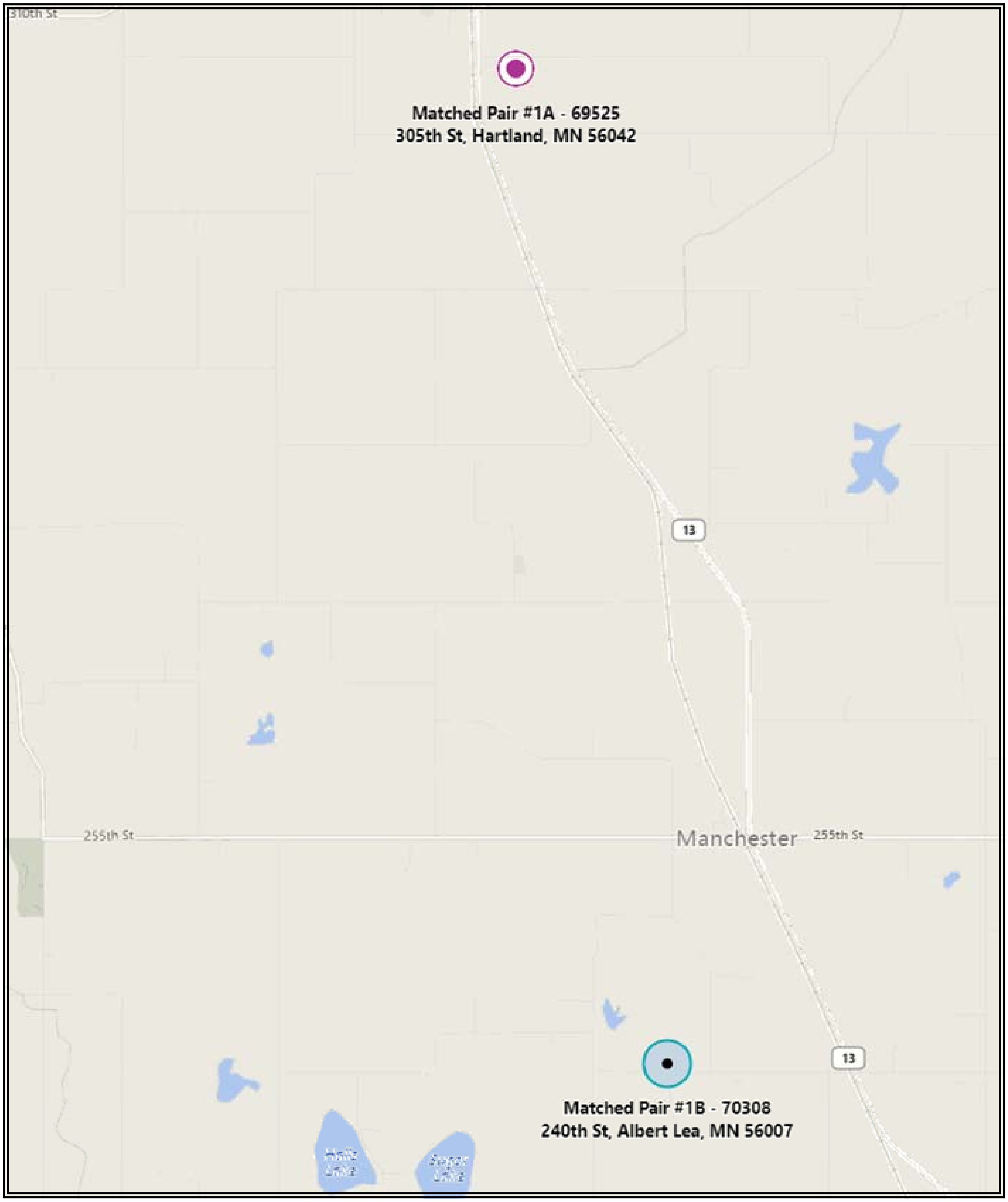
RECENT SINGLE-FAMILY RESIDENTIAL SALES LOCATION MAP



LAND SALES LOCATION MAP

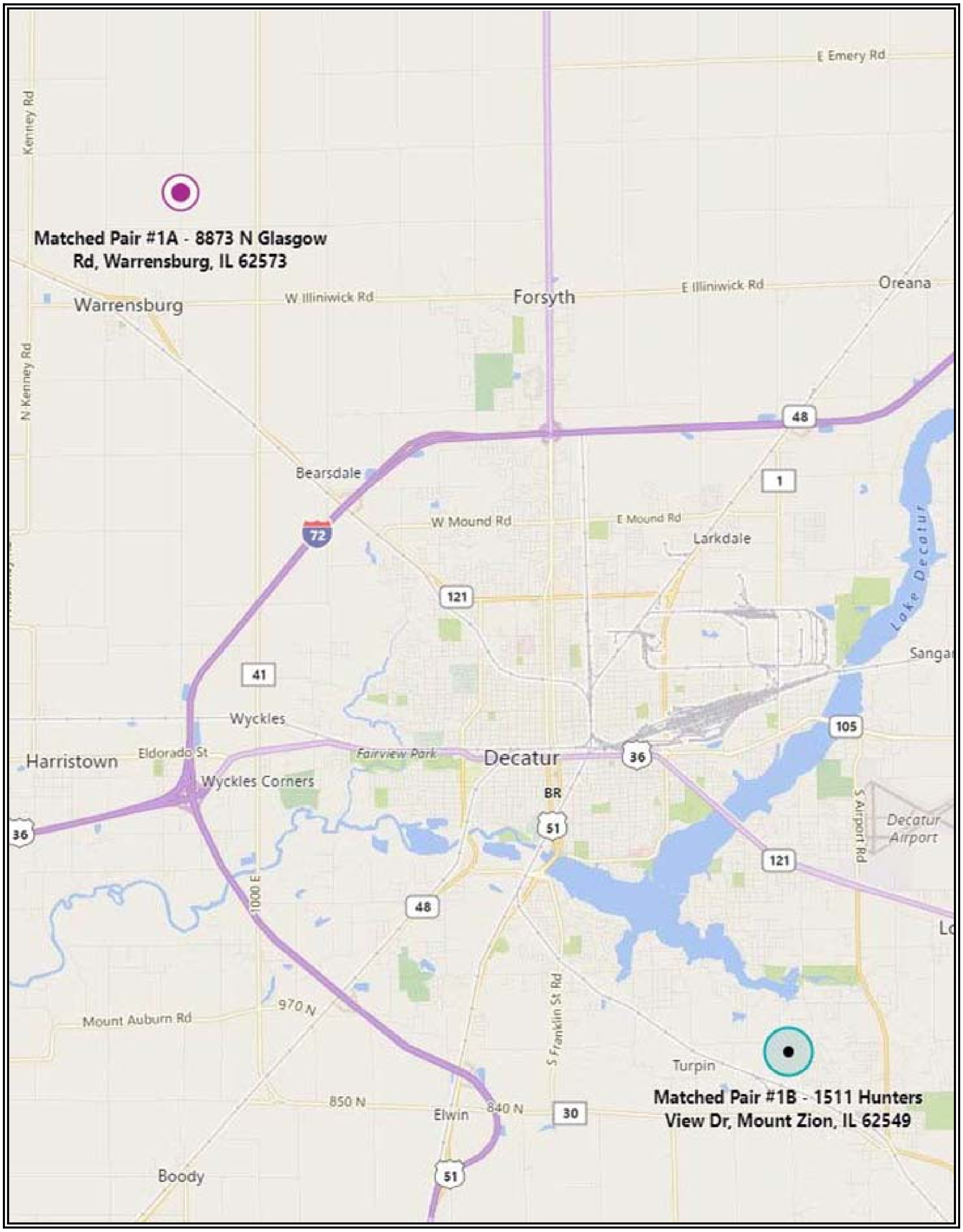


BROOKINGS COUNTY, SOUTH DAKOTA MATCHED PAIR LOCATION MAP

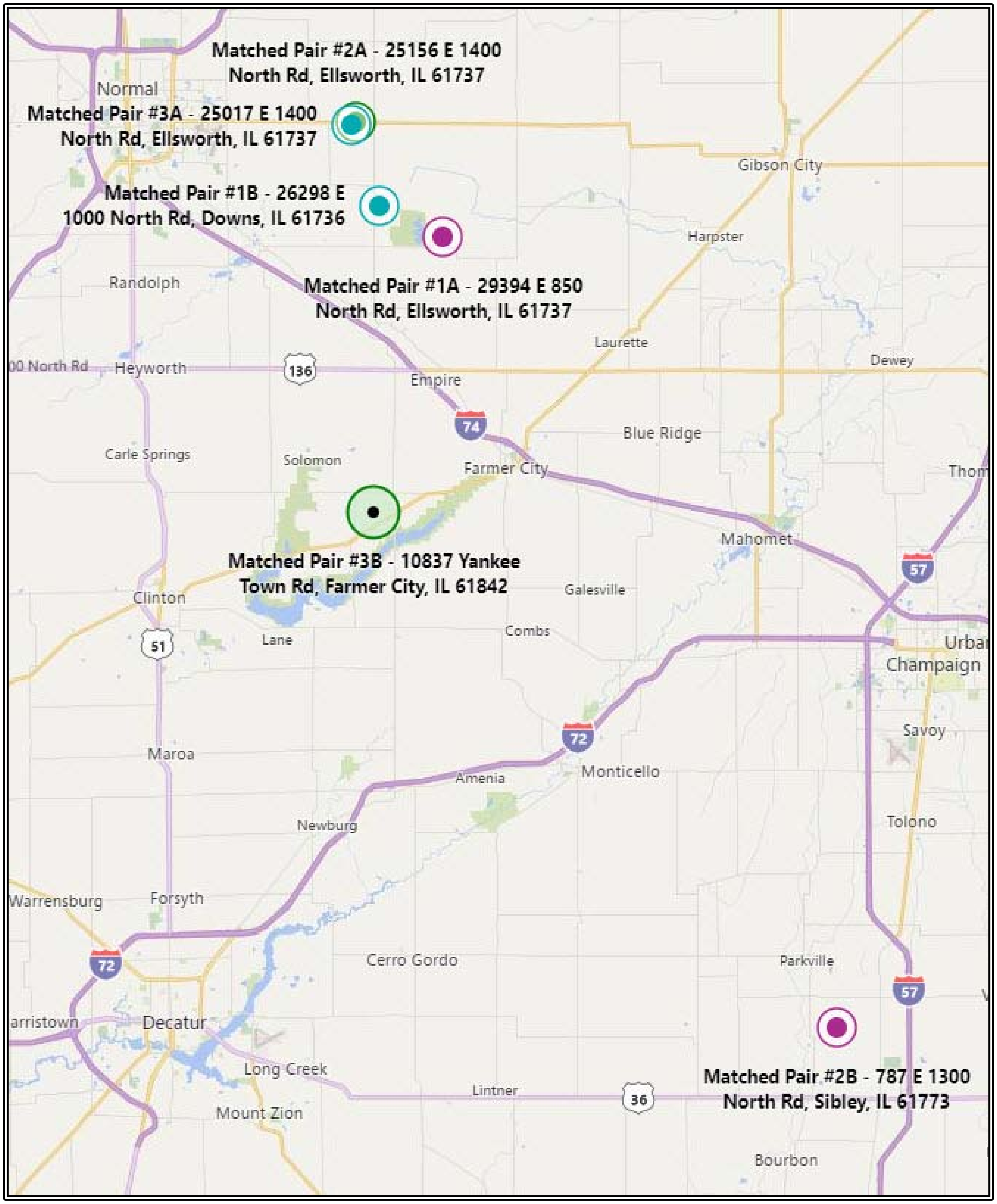


FREEBORN COUNTY, MINNESOTA MATCHED PAIR LOCATION MAP

HANCOCK COUNTY, IOWA MATCHED PAIR LOCATION MAP



MACON COUNTY, ILLINOIS MATCHED PAIR LOCATION MAP



McLEAN COUNTY, ILLINOIS MATCHED PAIR LOCATION MAP

IMPROVED SALE PHOTOGRAPHS

312 Main Street North

411 2nd Street Southwest

311 Main Street North

416 3rd Street Southwest

128 Park Street Northeast

29672 394th Avenue

29261 415th Avenue

South Dakota County Assessor Survey Analysis

A survey of assessors in 8 counties in South Dakota which wind farms currently are operational has been undertaken. The supervisors or deputy supervisors of assessments were interviewed. The interviews were intended to allow the assessment officials to share their experiences regarding the impact of the wind farm(s) upon the market values and/or the assessed values of surrounding properties. The interviews were conversational, but thoroughly discussed residential and agricultural values and impacts. The interviews were conducted on November 7, 2017, and updated April 12, 2018.

Conclusions of the Study

Based on these interviews:

- Without exception, the interviewees reported that there was no market evidence to support a negative impact upon residential property values as a result of the development of, and the proximity to, a wind farm facility. In some counties, this results from the very rural nature of the area in which the projects are located.
- In the past 18 months, two assessor's offices have experienced a real estate tax appeal based upon wind farm-related concerns, but the appeals were denied by both counties, Aurora County and Campbell County. As of the date of this report, there are more than 7 wind farms with 400 wind turbines within these counties. There have been no reductions in assessed valuations related to wind turbines.
- Residential assessed values have fluctuated consistently countywide as influenced by market conditions, with no regard for proximity to a wind farm.
- Agricultural properties are taxed based upon a productivity formula that is not impacted by market data and by external influences.

Scope of Project

The supervisors or deputy supervisors of assessments were interviewed. Each of the interviewees was familiar with the wind farm(s) located within their respective county. The following is the list of County Supervisors of Assessments contacted:

1. Aurora County	Ms. Leah Vissia	605-942-7164
2. Brookings County	Mr. Jacob Brehmer (Deputy)	605-696-8220
3. Campbell County	Ms. Jill Hoogeveen	605-955-3577
4. Charles Mix County	Ms. Denise Weber	605-487-7382
5. Day County	Ms. Dari Schlotte	605-345-9502
6. Hyde County	Ms. Carrie Stevenson	605-852-2070
7. Jerauld County	Ms. Janice Bender	605-539-9701
8. McPherson County	Ms. Lanette Butler	605-439-3663

A map indicating the number of wind farms in each of these counties is included in this memorandum. A second map illustrates the number of the wind farms located in each of these counties.

Residential Market Values

Without exception, the interviewees reported that there was no market evidence to support a negative impact upon residential property values as a result of the development of, and the proximity to, a wind farm facility. Either as a request by a county board, in an attempt to appropriately assess newly constructed residences, or to support current assessed values, the supervisors of assessments have been particularly attentive to market activity in the area of the wind farms.

Aurora, Brookings, Day, and McPherson Counties' Supervisors of Assessments all stated that a majority of the wind turbines were placed with grazing and pasture land used for raising cattle. Each one of the assessors made it a point to note that they had personally witnessed the cows grazing right alongside turbines, indicating that the turbines had no effect, of any kind, on the animals.

Ms. Lanette Butler, the McPherson County Supervisor of Assessments, lives proximate to wind farm and is a participating land owner with five wind turbines on her property. She also stated that she is a former employee of Acciona Energia (owner of Tatanka Wind) prior to becoming the McPherson County Supervisor of Assessments and has been pleased with the work the company performs and the strict policies the company carries out for noise and wildlife safety. She also stated that the only way the turbines are audibly noticeable is on very quiet days with very minimal wind.

Residential Assessed Values, Complaints/Tax Appeal Filings

The assessors reported that there have been no successful tax appeal filings based upon wind farm issues. Although there have been two counties with tax appeals that were denied by the county boards in Aurora County and Campbell County

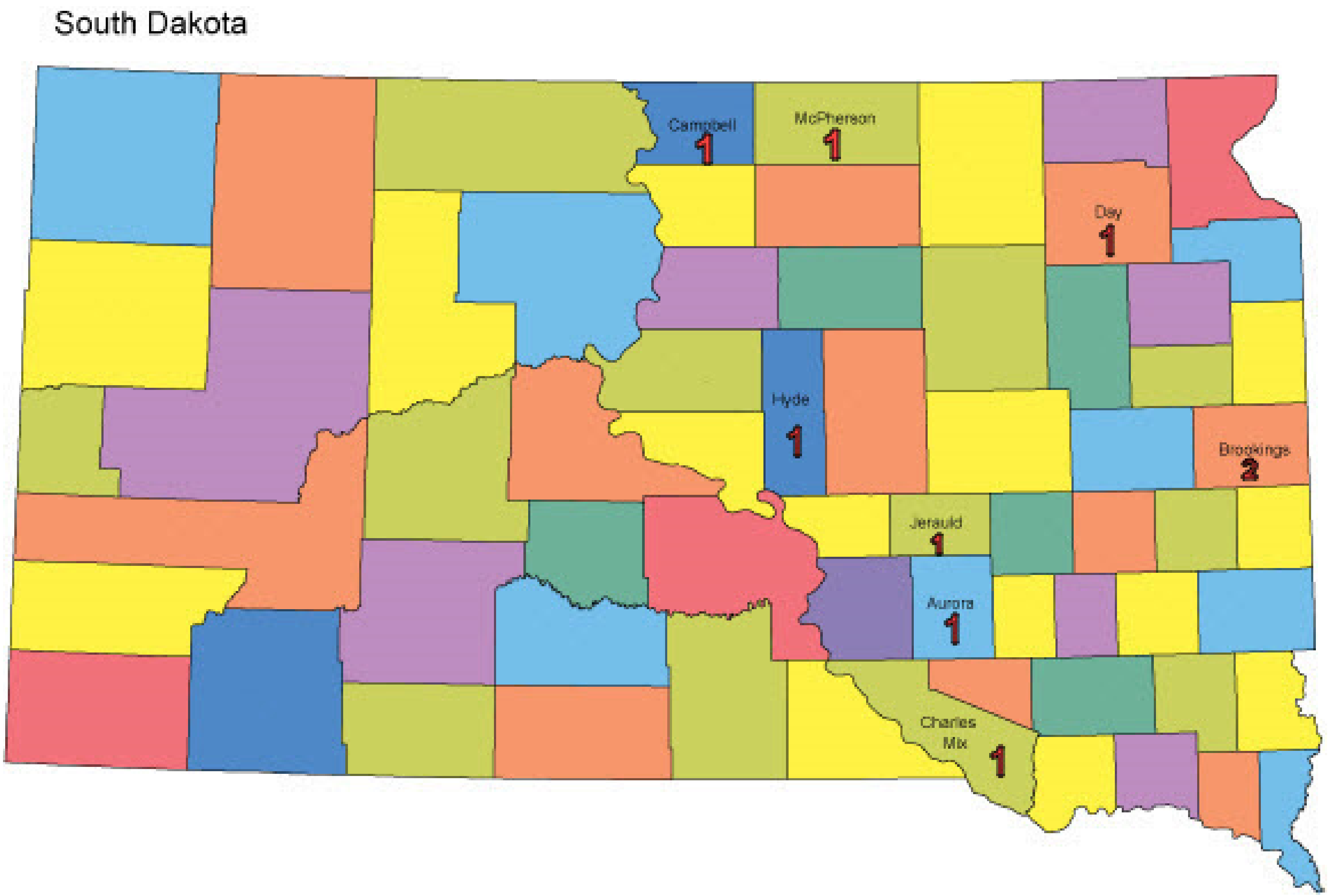
Ms. Carrie Stevenson, the Hyde County Supervisor of Assessments, did mention that the morning on the day the survey was taken Hyde County held its County Commissioners meeting. The topic of some of the meeting revolved around wind farms in the county. In attendance were approximately 30 residents, or a little over 2% of the total population of Hyde County. These residents showed up to voice their various complaints to the County Commissioners. The complaints were listened to and validated, yet in the end, there were no changes to property values given.

Consistently, the assessors reported that whatever initial concern there may have been regarding property values during the planning and approval stages of the various wind farms dissipated once the wind farm was constructed. Repeatedly, the assessors would state that the revenue that would come into the county and to each individual farmer would outweigh any initial concern that the residents would have about the wind farms joining their communities.

Agricultural Values/Assessed Values

The assessed values of agricultural properties are established based upon a productivity formula and are not driven by market data. Reportedly, assessed values of agricultural properties have been steady or increasing in recent years and are projected to continue increasing for the near future. The assessors reported that no major complaints have been received and/or no tax appeal filings have been filed for agricultural properties within the wind farm footprint.

Based on this survey, it does not appear that the Supervisors of Assessments in the 6 surveyed in South Dakota have reason to believe that the location of wind turbines in their county has had a negative impact on property values.



Map of South Dakota Counties Surveyed

Wind Farm Count by County

25 Turbines or Higher

Note: As depicted on this map from the AWEA, as of the date of this survey, the locations of certain wind farms are approximations. In some instances, the wind farms are incorrectly shown to be located in adjacent counties. This map also shows the locations of smaller wind farms, but for the accuracy of this study we have only focused on the farms with 25 turbines or higher.

MICHAEL S. MAROUS
STATEMENT OF QUALIFICATIONS

Michael S. MaRous, MAI, CRE, is president and owner of MaRous and Company. He has appraised more than $15 billion worth of primarily investment-grade real estate in more than 25 states. In addition to providing documented appraisals, he has served as an expert witness in litigation proceedings for many law firms; financial institutions; corporations; builders and developers; architects; local, state, county, and federal governments and agencies; and school districts in the Chicago metropolitan area. His experience in partial interest, condemnation, damage impact, easement (including aerial and subsurface), marital dissolutions, bankruptcy proceedings, and other valuation issues is extensive. He has provided highest and best use, marketability, and feasibility studies for a variety of properties. Many of the largest redevelopment areas and public projects, including Interstate 355, the Chicago O'Hare International Airport expansion, the Chicago Midway International Airport expansion, and the McCormick Place expansion, are part of Mr. MaRous' experience. Mr. MaRous also has experience in regard to mediation and arbitration proceedings. Also, he has purchased and developed real estate for his own account.

APPRAISAL AND CONSULTATION EXPERIENCE

Industrial Properties

Business Parks
Distribution Centers
Manufacturing Facilities
Research Facilities
Self-storage Facilities
Warehouses

Commercial Properties

Auto Sales/Service Facilities
Banquet Halls
Big Box Stores
Gasoline Stations
Hotels and Motels
Office Buildings
Restaurants
Shopping Centers
Theaters

Special-Purpose Properties

Bowling Alleys
Cemeteries
Farms
Golf Courses
Lumber Yards
Nurseries
Riverboat Gambling Facilities
Schools
Stadium Expansion Issues
Tank Farms
Underground Gas Aquifers
Utility Corridors
Waste Transfer Facilities
Wind Farms

Residential Properties

Apartment Complexes
Condominium Conversions
Condominium Developments
Single-family Residences
Subdivision Developments
Townhouse Developments

Vacant Land

Agricultural
Alleys
Commercial
Easements
Industrial
Residential
Rights of Way
Streets
Vacations

Clients

Corporations
Financial Institutions
Law Firms
Not-for-profit Associations
Private Parties
Public Entities

EDUCATION

B.S., Urban Land Economics, University of Illinois, Urbana-Champaign
Continuing education seminars and programs through the Appraisal Institute and the American Society of Real Estate Counselors, and real estate brokerage classes

PUBLIC SERVICE

Mayor, City of Park Ridge, Illinois (2003-2005)
Alderman, City of Park Ridge, including Liaison to the Zoning Board of Appeals and Planning and Zoning and Chairman of the Finance and Public Safety Committees (1997-2005)

PROFESSIONAL AFFILIATIONS AND LICENSES

Appraisal Institute, MAI designation, Number 6159
Counselors of Real Estate, CRE designation
Illinois Certified General Real Estate Appraiser, License Number 553.000141 (9/19)
Indiana Certified General Real Estate Appraiser, License Number CG41600008 (6/18)
Wisconsin Certified General Real Estate Appraiser, License Number 1874-10 (12/19)
Minnesota Certified General Real Estate Appraiser, License Number 40330656 (8/18)
Pennsylvania Certified General Real Estate Appraiser, License Number GA004181 (6/19)
Iowa Certified General Real Estate Appraiser, License Number CG03468 (6/19)
South Dakota Certified General Real Estate Appraiser, License Number 1467CG (9/18)
Licensed Real Estate Broker (Illinois)

PROFESSIONAL ACTIVITIES

Mr. MaRous is past president of the Chicago Chapter of the Appraisal Institute. He is former chair and vice chair of the National Publications Committee and has sat on the board of The Appraisal Journal. In addition, he has served on and/or chaired more than 15 other committees of the Appraisal Institute, the Society of Real Estate Appraisers, and the American Institute of Real Estate Appraisers.

Mr. MaRous served as chair of the Midwest Chapter of the Counselors of Real Estate in 2006 and 2007 and has served on the National CRE Board since 2011. He sat on the Midwest Chapter Board of Directors, the Editorial Board of Real Estate Issues, and on various other committees.

Mr. MaRous also is past president of the Illinois Coalition of Appraisal Professionals. He also has been involved with many other professional associations, including the Real Estate Counseling Group of America, the Northwest Suburban Real Estate Board, the National Association of Real Estate Boards, and the Northern Illinois Commercial Association of Realtors.

PUBLICATIONS AND PROFESSIONAL RECOGNITION

Mr. MaRous has spoken at more than 20 programs and seminars related to real estate appraisal and valuation.

Author

"Low-income Housing in Our Backyards," *The Appraisal Journal*, January 1996
"The Appraisal Institute Moves Forward," *Illinois Real Estate Magazine*, December 1993
"Chicago Chapter, Appraisal Institute," *Northern Illinois Real Estate Magazine*, February 1993
"Independent Appraisals Can Help Protect Your Financial Base," *Illinois School Board Journal*, November-December 1990
"What Real Estate Appraisals Can Do for School Districts," *School Business Affairs*, October 1990

Awards

Appraisal Institute - George L. Schmutz Memorial Award, 2001
Chicago Chapter of the Appraisal Institute – Heritage Award, 2000
Chicago Chapter of the Appraisal Institute - Herman O. Walther, 1987 (Distinguished Chapter Member)

Reviewer or Citation in the Following Books

Rural Property Valuation, 2017
Real Estate Damages, 1999, 2008, and 2016
Golf Property Analysis and Valuation, 2016
Dictionary of Real Estate Appraisal, Fourth Edition, 2002 and Sixth Edition, 2015
Market Analysis for Real Estate, 2005 and 2014
Appraisal of Real Estate, Twelfth Edition, 2001, Thirteenth Edition, 2008, Fourteenth Edition, 2013
Shopping Center Appraisal and Analysis, 2009
Subdivision Valuation, 2008
Valuation of Apartment Properties, 2007
Valuation of Billboards, 2006
Appraising Industrial Properties, 2005
Valuation of Market Studies for Affordable Housing, 2005
Valuing Undivided Interest in Real Property: Partnerships and Cotenancies, 2004
Analysis and Valuation of Golf Courses and Country Clubs, 2003
Valuing Contaminated Properties: An Appraisal Institute Anthology, 2002
Hotels and Motels: Valuation and Market Studies, 2001
Land Valuation: Adjustment Procedures and Assignments, 2001
Appraisal of Rural Property, Second Edition, 2000
Capitalization Theory and Techniques, Study Guide, Second Edition, 2000
Guide to Appraisal Valuation Modeling Land, 2000
Appraising Residential Properties, Third Edition, 1999
Business of Show Business: The Valuation of Movie Theaters, 1999
GIS in Real Estate: Integrating, Analyzing and Presenting Locational Information, 1998
Market Analysis for Valuation Appraisals, 1995

REPRESENTATIVE WORK OF MICHAEL S. MAROUS

Headquarters/Corporate Office Facilities in Illinois

Fortune 500 corporation facility, 200,000 sq. ft., Libertyville
Corporate headquarters, 300,000 sq. ft. and 500,000 sq. ft., Chicago
Fortune 500 corporation facility, 450,000 sq. ft., Northfield
Major airline headquarters, 1,100,000 million sq. ft. on 47 acres, Elk Grove Village
Former communications facility, 1,400,000 million sq. ft. on 62 acres, Skokie and Niles
Corporate Headquarters, 1,500,000+ sq. ft., Lake County
Former Sears Headquarters Redevelopment Project, Chicago

Office Buildings in Chicago

401 South LaSalle Street, 140,000 sq. ft.
134 North LaSalle Street, 260,000 sq. ft.
333 North Michigan Avenue, 260,000 sq. ft.
171 West Randolph Street, 360,000 sq. ft.
20 West Kinzie Street, 405,000 sq. ft.
55 East Washington Street, 500,000 sq. ft.
10 South LaSalle Street, 870,000 sq. ft.
222 West Adams Street, 1,000,000 sq. ft.
141 West Jackson Boulevard, 1,065,000 sq. ft.
333 South Wabash Avenue, 1,125,000 sq. ft.
155 North Wacker Drive, 1,406,000 sq. ft.
70 West Madison Street, 1,430,000 sq. ft.
111 South Wacker Drive, 1,454,000 sq. ft.
175 West Jackson Boulevard, 1,450,000 sq. ft.
227 West Monroe Street, 1,800,000 sq. ft.
10 South Dearborn Street, 1,900,000 sq. ft.

Hotels in Chicago

One West Wacker Drive (Renaissance Chicago Hotel)
10 East Grand Avenue (Hilton Garden Inn)
106 East Superior Street (Peninsula Hotel)
120 East Delaware Place (Four Seasons)
140 East Walton Place (The Drake Hotel)
160 East Pearson Street (Ritz Carlton)
301 East North Water Street (Sheraton Hotel)
320 North Dearborn Street (Westin Chicago River North)
401 North Wabash Avenue (Trump Tower)
505 North Michigan Avenue (Hotel InterContinental)
676 North Michigan Avenue (Omni Chicago Hotel)
800 North Michigan Avenue (The Park Hyatt)

Large Industrial Properties in Illinois

Large industrial complexes, 400,000 sq. ft., 87th Street and Greenwood Avenue, Chicago
Distribution warehouse, 580,000 sq. ft. on 62 acres, Champaign
Publishing house, 700,000 sq. ft. on 195 acres, U.S. Route 45, Mattoon
AM Chicago International, 700,000± sq. ft. on 41 acres, 1800 West Central Road, Mount Prospect
Nestlé distribution center, 860,000 sq. ft. on 153 acres, DeKalb
U.S. Government Services Administration distribution facility, 860,000 sq. ft., 76th Street and Kostner Avenue, Chicago
Fortune 500 company distribution center, 1,000,000 sq. ft., Elk Grove Village
Caterpillar Distribution Facility, 2,231,000 sq. ft., Morton
Self-storage facilities, various Chicago metropolitan locations

Airport Related Properties

Mr. MaRous has performed valuations on more than 100 parcels in and around Chicago O'Hare International Airport, Chicago Midway International Airport, Palwaukee Municipal Airport, Chicago Aurora Airport, DuPage Airport, and Lambert-St. Louis International Airport

Vacant Land in Illinois

15 acres, office, Northbrook
20 acres, residential, Glenview
25 acres, Hinsdale
55 acres, mixed-use, Darien
68 acres, Roosevelt Road and the Chicago River
75 acres, I-88 at I-355, Downers Grove
100± acres, various uses, Lake County
100 acres, Western Springs
140 acres, Flossmoor
142 acres, residential, Lake County
160 acres, residential, Cary
200 acres, mixed-use, Bartlett
250 acres, Island Lake
450 acres, residential, Wauconda
475± acres, various uses, Lake County
650 acres, Hawthorne Woods
650 acres, Waukegan/Libertyville
800 acres, Woodridge
900 acres, Matteson
1,000± acres, Batavia area
2,000± acres, Northern Lake County
5,000 acres, southwest suburban Chicago area
Landfill expansion, Lake County

Retail Facilities

20 Community shopping centers, various Chicago metropolitan locations
Big-box uses, various Chicago metropolitan locations and the Midwest
Gasoline Stations, various Chicago metropolitan locations
More than 50 single-tenant retail facilities larger than 80,000 sq. ft., various Midwest metropolitan locations

Residential Projects

Federal Square townhouse development project, 118 units, $15,000,000+ sq. ft. project, Dearborn Place, Chicago
Marketability and feasibility study, 219 East Lake Shore Drive, Chicago
Riverview II, Chicago; Old Town East and West, Chicago; Museum Park Lofts II, Museum Park Tower 4, University Commons, Two River Place, River Place on the Park, Chicago;
Timber Trails, Western Springs, Illinois

Market Impact Studies

Land-fill projects in various locations
Quarry expansions in Boone and Kendall counties
Commercial development and/or parking lots in various communities
Zoning changes in various communities
Waste transfer stations in various communities

Energy Projects

Oakwood Hills Energy Center, McHenry County Illinois, market impact analysis
Walnut Ridge Wind Farm, Bureau County, Illinois, market impact analysis
Radford's Run Wind Farm, Macon County, Illinois, market impact analysis
Twin Groves Wind Farm, McLean County, Illinois, market impact analysis
Otter Creek Wind Farm, LaSalle County, Illinois, market impact analysis
Pleasant Ridge Wind Farm, Livingston County, Illinois, consulting
Commonwealth Edison, high tension lines, market impact analysis
Lackawanna Power Plant, Lackawanna County, Pennsylvania, market impact analysis
Brookhaven, New York, solar energy production facility, consulting

Business and Industrial Parks

Chevy Chase Business Park, 30 acres, Buffalo Grove
Carol Point Business Center, 300-acre industrial park, Carol Stream, $125,000,000+ project
Internationale Centre, approximately 1,000 acre-multiuse business park, Woodridge

Properties in Other States

330,000 sq. ft., Newport Beach, California
Former government depot/warehouse and distribution center, 2,500,000 sq. ft. on 100+ acres, Ohio
Shopping Center, St. Louis, Missouri
Office Building, Clayton, Missouri
Condominium Development, New York, New York
Hormel Foods, various Midwest locations
Wisconsin Properties including Lowes, Menards, Milwaukee Zoo, CVS Pharmacy's in Milwaukee, Dairyland Race Track, Major Industrial Property in Manawa, Class A Office Buildings and Vacant Land

REPRESENTATIVE CLIENT LISTING OF MICHAEL S. MAROUS

Law Firms

Alschuler, Simantz & Hem LLC
Ancel, Glink, Diamond, Bush, DiClanni & Krafthefer
Arnstein & Lehr LLP
Berger, Newmark & Fenchel P.C.
Berger Schatz
Botti Law Firm, P.C.
Carmody MacDonald P.C.
Carr Law Firm
Crane, Heyman, Simon, Welch &
Clar Daley & Georges, Ltd.
Day, Robert & Morrison, P.C.
Dentons US LLP
DiMonte & Lizak LLC
DLA Piper
Dreyer, Foote, Streit, Furgason & Slocum, P.A.
Drinker, Biddle & Reath LLP
Figliulo & Silverman, P.C.
Foran, O'Toole & Burke LLC
Franczek Radelet P.C.
Fredrikson & Byron, P.A.
Freeborn & Peters LLP
Gould & Ratner LLP
Greenberg Traurig LLP
Helm & Wagner
Robert Hill Law, Ltd.
Hinshaw & Culbertson LLP
Holland & Knight LLP
Ice Miller LLP
Jenner & Block
Katz & Stefani, LLC
Kinnally, Flaherty, Krentz, Loran,
Hodge & Mazur PC
Kirkland & Ellis LLP
Klein, Thorpe & Jenkins, Ltd.
McDermott, Will & Emery
Mayer Brown
Michael Best & Friedrich LLP
Morrison & Morrison, Ltd.
Bryan E. Mraz & Associates
Neal, Gerber & Eisenberg, LLP
Neal & Leroy LLC
O'Donnell Haddad LLC
Prendergast & DelPrincipe
Rathje & Woodward, LLC
Righeimer, Martin & Cinquino, P.C.
Robbins, Salomon & Patt, Ltd.
Rosenfeld Hafron Shapiro & Farmer
Rosenthal, Murphey, Coblentz &
Donahue Rubin & Associates, P.C.
Ryan and Ryan, P.C.
Reed Smith LLP
Sarnoff & Baccash
Scariano, Himes & Petrarca, Chtd.
Schiff Hardin LLP
Schiller, DuCanto & Fleck LLP
Schirott, Luetkehans & Garner, LLC
Schuyler, Roche & Crisham, P.C.
Sidley Austin LLP
Storino, Ramello & Durkin
Thomas M. Tully & Associates
Thompson Coburn, LLP
Tuttle, Vedral & Collins, P.C.
Vedder Price
von Briesen & Roper, SC
Winston & Strawn LLP
Worsek & Vihon LLP

Financial Institutions

AmericaUnited Bank Trust
BMO Harris Bank
Charter One
Citibank
Cole Taylor Bank
First Bank of Highland Park
First Financial Northwest Bank
First Midwest Bank
First State Financial
Glenview State Bank
Itasca Bank & Trust Co.
Lake Forest Bank & Trust Co.
MB Financial Bank
Midwest Bank
Northern Trust
Northview Bank & Trust
The Private Bank
Wintrust

Corporations

Advocate Health Care System Alliance
Property Consultants American Stores
Company Archdiocese of Chicago
Arthur J. Rogers and Company
Avangrid Renewables, LLC
BHE Renewables
BP Amoco Oil Company
Christopher B. Burke Engineering, Ltd.
Cambridge Homes
Canadian National Railroad
Capital Realty Services, Inc.
Chicago Cubs
Children's Memorial Hospital
Chrysler Realty Corporation
Citgo Petroleum Corporation
CorLands
CVS
Edward R. James Partners, LLC
Enterprise Development Corporation
Enterprise Leasing Company
Exxon Mobil Corporation
Hamilton Partners
Hollister Corporation
Imperial Realty Company
Invenergy LLC
Kimco Realty Corporation
Kinder Morgan, Inc.
Lakewood Homes
Lowe's Companies, Inc.
Loyola University Health System
Marathon Oil Corporation
Meijer, Inc.
Menards
Mesirow Stein Real Estate, Inc.
Paradigm Tax Group
Prime Group Realty Trust
Public Storage Corporation
RREEF Corporation
Shell Oil Company
Union Pacific Railroad Company
United Airlines, Inc.

Public Entities

Illinois Local Governments and Agencies

Village of Arlington Heights
Village of Barrington
Village of Bartlett
Village of Bellwood
Village of Brookfield
Village of Burr Ridge
City of Canton
Village of Cary
City of Chicago
Village of Deer Park
City of Des Plaines
Des Plaines Park District
Downers Grove Park District
City of Elgin
Elk Grove Village
City of Elmhurst
Village of Elmwood Park
City of Evanston
Village of Forest Park
Village of Franklin Park
Village of Glenview
Glenview Park District
Village of Harwood Heights
City of Highland Park
Village of Hinsdale
Village of Inverness
Village of Kenilworth
Village of Kildeer
Village of Lake Zurich
Leyden Township
Village of Lincolnshire
Village of Lincolnwood
Village of Morton Grove
Village of Mount Prospect
Village of North Aurora
Village of Northbrook
City of North Chicago
Village of Northfield
Northfield Township
Village of Oak Brook
Village of Orland Park
City of Palos Hills
City of Peoria
City of Prospect Heights
City of Rolling Meadows
Village of Rosemont
City of St. Charles
Village of Schaumburg
Village of Schiller Park
Village of Skokie
Village of South Barrington
Village of Streamwood
Metropolitan Water Reclamation District of Greater Chicago
City of Waukegan
Village of Wheeling
Village of Wilmette
Village of Willowbrook
Village of Winnetka
Village of Woodridge

County Governments and Agencies

Boone County State's Attorney's Office
Forest Preserve of Cook County
Cook County State's Attorney's Office
DuPage County Board of Review
Forest Preserve District of DuPage County
Kane County
Kendall County Board of Review
Lake County
Lake County Forest Preserve District
Lake County State's Attorney's Office
Morton Township
Peoria County

State and Federal Government Agencies

Federal Deposit Insurance Corporation
U.S. General Services Administration
Illinois Housing Development Authority
Illinois State Toll Highway Authority
Internal Revenue Service
The U.S. Postal Service

Schools

Argo Community High School District No. 217
Arlington Heights District No. 25
Township High School District No. 214, Arlington Heights
Barrington Community Unit District No. 220
Chicago Board of Education
Chicago Ridge District No. 127½
College of Lake County
Community Consolidated School District No. 15
Community Consolidated School District No. 146
Community School District No. 200
Consolidated High School District No. 230
Darien District No. 61
DePaul University
Elk Grove Community Consolidated District No. 59
Elmhurst Community Unit School District No. 205
Glen Ellyn School District No. 41
Glenbard High School District No. 87
Indian Springs School District No. 109
LaGrange School District No. 105
Lake Forest Academy
Leyden Community High School District No. 212
Loyola University
Lyons Township High School District No. 204
Maine Township High School District No. 207
Niles Elementary District No. 71
North Shore District No. 112, Highland Park
Northwestern University
Orland Park School District No. 135
Palatine High School District #211
Rhodes School District No. 84-1/2
Riverside-Brookfield High School District No. 208
Rosalind Franklin University
Roselle School District No. 12
Schaumburg Community Consolidated District No. 54
Sunset Ridge School District No. 29
Township High School District No. 211
Township High School District No. 214
Triton College
University of Illinois
Wheeling Community Consolidated District No. 21
Wilmette District No. 39

JOSEPH M. MaROUS
STATEMENT OF QUALIFICATIONS

Joseph M. MaRous is an Energy Consultant with MaRous and Company, with a focus on the renewable and alternative energy industry.

EDUCATION

Purdue University - West Lafayette, Indiana
Bachelor of Science – Building Construction Management
Focus in residential and green build construction

CERTIFICATIONS

Certified Green Build Professional
OSHA Safety Certified
USPAP Certified

CONSTRUCTION

Professional in the construction industry for 10 years

- Residential
- Commercial
- Industrial
- Municipal
- Tenant Improvement
- Schools
- Media Studios
- Automobile Dealerships

MaROUS & COMPANY

Wind Projects

- Illinois
- Iowa
- South Dakota
- New York

Solar Projects

- Maryland
- Wisconsin

- Vacant Land
- Auto Dealerships
- Religious Facilities
- Residential
- Commercial
- Retail

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Impact of Industrial Wind Turbines on Residential Property Assessment In Ontario

2012 Assessment Base Year Study

MUNICIPAL PROPERTY ASSESSMENT CORPORATION

www.mpac.ca

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ABSTRACT

The Municipal Property Assessment Corporation (MPAC) commissioned this study of the effects of industrial wind turbines (IWT) on the current value of property in proximity to the turbines. Over the last few years, the subject of IWTs has been the subject of a number of reports and studies – both in Canada and worldwide. Past and current studies undertaken by both academics as well as real estate and health professionals have focused on the potential impacts of IWTs on property value and health. Given MPAC's legislated mandate, this report focuses on the potential impact of IWTs on property values.

MPAC's study concludes that 2012 Current Value Assessments (CVA) of properties located within proximity to an IWT are assessed at their current value and are equitably assessed in relation to homes at greater distances. No adjustments are required for 2012 CVAs. This finding is consistent with MPAC's 2008 CVA report. The 2012 CVA study also found that there is no statistically significant impact on sale prices of residential properties in these market areas resulting from proximity to an IWT. The study underwent a rigorous independent third-party peer review and includes appendices describing the study parameters and documenting the analyses.

AUTHORS OF THIS REPORT

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Brian Guerin is Director, Valuation – Assessment Standards and Mass Appraisal, Office of the Chief Assessor with the Municipal Property Assessment Corporation. Mr. Guerin has almost 20 years of property assessment experience in the province of Ontario overseeing the mass appraisal of nearly five million properties. Since 1999, he has been responsible for the development of all mass appraisal models used in the valuation of all property types through seven province-wide assessment updates. He holds an honours degree in Mathematics from Carleton University and is a Chartered Valuation Surveyor with the Royal Institution of Chartered Surveyors and is an accredited member of the Institute of Municipal Assessors.

Jason Moore, BAS (Hon), MBA, UBC Certificate of Real Property Assessment

Jason Moore is Valuation Manager - Assessment Standards and Mass Appraisal, Office of the Chief Assessor with the Municipal Property Assessment Corporation. Mr. Moore oversees the mass appraisal of approximately 1.8 million properties across 12 MPAC field offices including the regions of Durham, York, Halton, Peel, Niagara and cities of

Hamilton, Brantford and Brant as well as Norfolk Counties. He is also responsible for the valuation and data collection procedures for residential and farm property types. Mr. Moore has given several presentations and training sessions on mass appraisal and regression analysis as well as specific residential and farm issues. He has a Masters, Business Administration from McMaster University.

Jamie Stata, BA, UBC Certificate of Real Property Assessment

Jamie Stata is a Property Valuation Specialist - Assessment Standards and Mass Appraisal, Office of the Chief Assessor with the Municipal Property Assessment Corporation. Mr. Stata has nearly 25 years of property assessment experience in the province of Ontario. He currently conducts the valuation of residential development land across six counties in Southwestern Ontario and has completed the mass appraisal analysis for Huron, Perth, Gray and Bruce counties over the past five province-wide assessment updates. He has completed research on the combined valuation of residential and commercial properties as well as recently led a project team researching the acquisition of new cost estimates on farm buildings. Mr. Stata has presented at the International Association of Assessing Officers Annual Conference on Assessment Administration as well as the Mass Appraisal Valuation Symposium conducted by the International Property Tax Institute.

Scott Bradfield, BSC (Hon)

Scott Bradfield is a Mass Appraisal Analyst with Assessment Standards and Mass Appraisal, Office of the Chief Assessor, Municipal Property Assessment Corporation. Mr. Bradfield has over a decade of experience in regression and statistical analysis for property appraisal and is currently responsible for all mass appraisal work for three MPAC field offices responsible for the cities of Hamilton, Brandford and Brant as well as Haldimand and Norfolk Counties. He is also MPAC's subject matter expert for residential valuation and data collection and has led several research projects for the corporation. Mr. Bradfield holds an honours Statistics degree from McMaster University.

EXECUTIVE SUMMARY

This report provides the results of the Municipal Property Assessment Corporation's (MPAC) study of the ***Impact of Industrial Wind Turbines on Residential Property Assessment in Ontario (2012 Assessment Base Year Study).***

Background

MPAC is responsible for accurately assessing and classifying property in Ontario for the purposes of municipal and education taxation. In Ontario, property assessments are updated on the basis of a four-year assessment cycle. The last province-wide Assessment Update took place in 2012 when MPAC updated the assessments of Ontario's nearly five million properties to reflect the legislated valuation date of January 1, 2012. Assessments updated for the 2012 base year are in effect for the 2013-2016 property tax years. Ontario's assessment phase-in program prescribes that assessment increases are phased in over a four-year period. Any decreases in assessment are applied immediately.

When assessing any property, MPAC relies on the real estate market to indicate what influence a factor, such as Industrial Wind Turbines (IWT), may have on a property's value. MPAC does this through the ongoing study and analysis of the market including the investigation of sales transactions. This market analysis typically reveals whether or not a factor has a negative, positive, or no impact on a property's value.

Over the last few years, the subject of IWTs has been the subject of a number of reports and studies – both in Canada and worldwide. Past and current studies undertaken by both academics as well as real estate and health professionals have focused on the potential impacts of IWTs on property value and health. Given MPAC's legislative mandate, this report focuses on the potential impact of IWTs on property value.

MPAC has completed two reviews of the impact of IWTs: 2008 and 2012 Base Year Studies.

2008 Base Year Study

In 2008, MPAC undertook a study looking at the impact of IWTs on residential assessments using the 2008 base year. The 2008 study concluded that the presence of industrial wind turbines that are either abutting or in proximity to a property did not have a positive or negative impact on the value of assessments.

2012 Base Year Study

In response to the growing presence of IWTs in Ontario as well as requests for information from stakeholders, MPAC undertook a new study using the 2012 assessment base year to provide a thorough examination of the impact of IWTs on residential property assessment.

Specifically, the study examined the following two statements:

1. Determine if residential properties in close proximity to IWTs are assessed equitably in relation to residential properties located at a greater distance. In this report, this is referred to as ***Study 1 – Equity of Residential Assessments in Proximity to Industrial Wind Turbines.***

2. Determine if sale prices of residential properties are affected by the presence of an IWT in close proximity. In this report, this is referred to as ***Study 2 – Effect of Industrial Wind Turbines on Residential Sale Prices.***

Study 2 was added to the original scope of the review to respond to enquiries MPAC received from stakeholders and interested parties.

To conduct these studies, MPAC considered 15 market areas with sufficient sales to allow for analysis and applied industry standard mass appraisal techniques and internationally accepted ratio study standards.

To determine equity of assessments of properties within close proximity to an IWT, MPAC conducted an Assessment-to-Sale Ratio (ASR) study. An individual ASR is calculated by dividing the assessed value of each property by its time adjusted sale price. A ratio study is conducted to first establish the level of appraisal for a group of properties and equity is determined by comparing the level of appraisal with other groups of properties. If a group of properties is assessed at market value, the median ASR will lie between 0.95-1.05. By definition, equity is said to exist if there is 5% or less difference between property categories (or groups of properties) as per International Association of Assessing Officers (IAAO) ratio study standards.

The level of appraisal for properties within 1 km of an IWT is 1.034. The level of appraisal for properties at greater distance (1-2 km, 2-5 km and over 5 km) range from 0.989 to 0.992, a 4.2- 4.5% differential, which is below the 5% noted above.

Conclusions

Following MPAC's review, it was concluded that 2012 CVAs of properties located within proximity of an IWT <u>are assessed at their current value</u> and <u>are equitably assessed</u> in relation to homes at greater distances. No adjustments are required for 2012 CVAs. This finding is consistent with MPAC's 2008 CVA report.

MPAC's findings also concluded that there is <u>no statistically significant impact on sale prices</u> of residential properties in these market areas resulting from proximity to an IWT, when analysing sale prices.

In addition to the results shared in this report, MPAC also commissioned an internationally recognized expert in the field of mass appraisal and ratio studies to review the report and its findings. This expert has confirmed the findings in this report (Appendix A).

As MPAC works towards the next province-wide Assessment Update in 2016, qualified valuation staff will continue to study and analyse the Ontario real estate market including investigation of sales transactions to determine the impact of various factors – including IWTs – have on a property's value.

INTRODUCTION

The topic of wind energy is front and centre in the minds of a large number of Ontarians, particularly those living in rural areas of the province. There has been extensive reporting on the numerous aspects of this new development, be it in the reports of health effects, the approval process for siting IWTs, or the potential for property devaluation due to the perceived stigma attached to these developments.

Several studies, based on both scientific and non-empirical methods, have been completed by academics and real estate professionals to determine whether or not an adverse effect on sales prices exists with the presence of an IWT on a nearby property. In a recent study in the United States[1], released by the Berkeley National Laboratory and prepared for the U.S. Department of Energy, results indicate a minimal impact on property values as a result of being in close proximity to IWTs. One Ontario case study[2], released in 2013, argues that properties in Ontario are devalued by as much as 30-35%.

Current studies on both the valuation impact and health effects are underway by the University of Guelph[3] and Health Canada[4].

Prior to undertaking this study, MPAC conducted a study using 2008 base year Current Value Assessments (CVA), to determine whether residential properties located near IWTs were equitably assessed when compared to properties at a greater distance. The study was based on very limited sales information as there were a limited number of industrial wind turbines in the province at that time. As a result, it was difficult to draw meaningful conclusions with the 2008 study. Based on the available sale information, no adjustment to value was required for the 2008 CVA.

In conducting this current study, MPAC had additional sales data to review than it did in 2008. In addition to more sales, MPAC also received Requests for Reconsideration from the owners of 83 properties where proximity to IWTs was listed as a concern following the 2012 province-wide Assessment Update.

[1] Ben Hoen et al, "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States", Berkeley National Laboratory, August 2013

[2] Ben Lansink, "Case Studies: Diminution / Change in Price Melancthon and Clear Creek Wind Turbine Analyses, Municipal Property Assessment Corporation (MPAC) Current Value Changes," Lansink Appraisals and Consulting, February 2013

[3] R Vyn and R McCullough, "The Effects of Wind Turbines on Property Values in Ontario: Does Perception Match Empirical Evidence?", Canadian Journal of Agricultural Economics, forthcoming

[4] http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/index-eng.php

PURPOSE OF THIS REPORT

This 2012 base year report has been written to provide a thorough examination of the impact of IWTs on residential property assessment. Specifically, the report examines the following two statements:

1. Determine if residential properties in close proximity to IWTs are assessed equitably in relation to residential properties located at a greater distance. In this report, this is referred to as ***Study 1 – Equity of Residential Assessments in Proximity to Industrial Wind Turbines.***

2. Determine if sale prices of residential properties are impacted by the presence of an IWT in close proximity. In this report, this is referred to as ***Study 2 – Effect of Industrial Wind Turbines on Residential Sale Prices.***

Study 2 was added to the original scope of the review to respond to enquiries MPAC received from stakeholders and interested parties.

LEGISLATION

Sections of the *Assessment Act* relevant to this study include the following:

Section 1 (1): "current value" means, in relation to land, the amount of money the fee simple, if unencumbered, would realize if sold at arm's length by a willing seller to a willing buyer; ("valeur actuelle").

Section 19 (1): The assessment of land shall be based on its current value.

VALUATION OF RESIDENTIAL PROPERTIES

To estimate value of residential properties, MPAC applies the Direct Comparison Approach (DCA) in a mass appraisal environment. DCA estimates the current value of a subject property by adjusting the sale price of comparable properties for differences between the comparable properties and the subject property. Mass appraisal is the valuation of a group of properties as of a given date using standardized processes, employing common data, and allowing for statistical testing.

Multiple Regression Analysis

The DCA approach to value in a mass appraisal setting uses industry standard Computer Assisted Mass Appraisal (CAMA) techniques and, in particular, a statistical tool known as Multiple Regression Analysis (MRA).

Regression analysis is a statistical technique used to analyse data in order to predict the value of one variable, such as market value, based on known data (e.g., living area, lot size, quality, location, etc.). If only one variable is used, such as living area, the procedure is called Simple Regression Analysis. When two or more variables are used in the analysis, the procedure is called Multiple Regression Analysis.

MRA estimates the value of one variable (i.e., the dependent variable) based on the information from the available data (i.e., the independent variables). Assessing authorities, such as MPAC, develop an equation that estimates current value based on the sale prices and property characteristics of sold properties. The equation, or valuation model, provides the best estimate of current value in statistical terms since it reduces the overall error between sale price and predicted value (estimated current value) to the lowest possible amount in dollar terms.

Market Areas

In Ontario, MPAC has defined 130 residential market areas. Market areas are geographic areas subject to the same economic influences. One valuation model is built for each market area. A market area could be a section of a large city, like Toronto, a medium size city like Niagara Falls or a cluster of smaller towns. Also, it could be the rural residential properties with a county or a group of lakes in a recreational waterfront area such as Muskoka or the Kawartha Lakes.

Key Factors Affecting Value

Approximately 85% of the current value of a property can be attributed to the following five property characteristics: location, building area, construction quality, lot size and age of the home adjusted for renovations and additions. Other features that may be adjusted for include; water frontage, building amenities (e.g., basement area, basement finish, bathrooms, fireplaces, heating, air conditioning), secondary structures (e.g., garages, in-ground pools), site features (e.g., abutting green space, abutting a ravine, abutting a commercial property, topography, corner lot, traffic pattern). Not all features will enter every market model; therefore, value influences will differ across the province.

Legislated Valuation Date

All estimates of current value represent market conditions as of January 1, 2012, the legislated valuation date for the 2013-2016 property tax years. As a result, part of MPAC's analysis is to determine the amount of inflation or deflation in each market area and adjust sale prices for time in relation to the legislated valuation date.

Sales Ratio Study

Once each valuation model has been developed, it is tested to ensure equity, accuracy and uniformity using a sales ratio study. A sales ratio study ensures that the overall level of appraisal of the market area is within corporate and industry standards for accuracy and uniformity. The second aspect of the sales ratio study is to ensure that equity has been achieved across all major property characteristics.

Application of Valuation Model

Once the statistical testing has been completed, and the valuation model for each market area has been deemed appropriate, it is applied to all the applicable properties in the market area and individual value review commences by qualified valuation staff. The purpose of this exercise is to reconcile the value estimates to ensure that a fair and equitable assessment has been placed on each property. These efforts tend to focus on areas with few sales and properties with features that cannot be captured within mass appraisal models. This review work continues up until the Assessment Roll is provided to each municipality and will include sales before and after the valuation date.

Sales

For this study, sales in proximity to IWTs were found in 15 market areas.

Table 1 - MPAC Market Area Descriptions

Market Area	MPAC Region	Description
05RR030	05 – Kingston	Napanee, Loyalist Township, Frontenac/Lennox & Addington Counties South Rural/Waterfront
20RR010	20 – Brantford	Brant, Haldimand, Norfolk Counties - Rural/Waterfront
22RR010	22 – Kitchener	Dufferin & Wellington Counties - Rural
22UR020	22 – Kitchener	Dufferin County Villages
22UR030	22 – Kitchener	Wellington County Villages
23RR010	23 – London	Elgin, Middlesex & Oxford Counties - Rural
24RR010	24 – Goderich	Huron & Perth Counties - Rural/Waterfront
25RR010	25 – Owen Sound	Grey & Bruce Counties - Rural/Waterfront
25UR010	25 – Owen Sound	Grey & Bruce Counties - Urban
26RR010	26 – Chatham	Chatham-Kent - Rural/Wallaceburg
26RR030	26 – Chatham	Lambton County - Rural/Waterfront
27RR120	27 – Windsor	Essex County
27UR070	27 – Windsor	Lasalle, Tecumseh, Lakeshore Urban & Essex Urban
31RR010	31 – Sault Ste Marie	District of Algoma
31UR010	31 – Sault Ste Marie	Sault Ste. Marie/Prince Township

Adjustments for being in proximity to IWTs were not included when establishing CVAs for the 2008 or 2012 base year in any of these market areas.

INDUSTRIAL WIND TURBINES

2012 BASE YEAR ANALYSIS

Between 2008 and 2012, Ontario has seen a proliferation of wind turbine projects, with the introduction of the *Green Energy Act* in 2009, and the Feed-in-Tariff (FIT) program. This has resulted in a much larger set of available sales data for properties in proximity to these projects.

For the purposes of the 2012 base year study, MPAC has adopted a definition of an IWT to be one with a capacity of at least 1.5 megawatts. This is consistent with the definition currently being used by Health Canada[5]. In instances where the generating capacity of the IWT was not available in MPAC's property assessment database, it was calculated by dividing the IWT legislated rate of $40,000 per megawatt (MW) into the assessed value of the IWT.

DATA COLLECTION

MPAC assigns a property code of 567 to represent IWTs. As per legislation in the Province of Ontario at the time of this report, IWTs are valued at $40,000/MW, plus the value of the associated land at the industrial tax class. MPAC analyzed sales within 5 km of any IWT with a generating capacity of 1.5 MW or higher.

To ensure MPAC's inventory of IWTs was as complete as possible, geographic co-ordinates were acquired from NAV Canada. Any IWTs identified by NAV Canada that had not yet been field inspected by MPAC were inspected by local staff and all relevant data keyed into MPAC's database. Any IWTs identified on MPAC's computer database that were not included on NAV Canada's database were inspected by local MPAC staff and the GPS co-ordinates were collected. MPAC staff then process controlled all IWT co-ordinates to ensure accuracy (e.g., co-ordinates not placing the IWTs on the correct property). Of the 1,185 IWTs in MPAC's database after this exercise, only 28 had a capacity below 1.5 MW, leaving 1,157 IWTs for review. The distribution across MPAC's market areas is as follows:

Table 2 - Count of IWTs by Market Area

Market Area	MPAC Region	Description	IWT Count	Property Count
05RR030	05 – Kingston	Napanee, Loyalist Township, Frontenac/Lennox & Addington Counties South Rural/Waterfront	86	63
20RR010	20 – Brantford	Brant, Haldimand, Norfolk Counties - Rural/Waterfront	53	42
22RR010	22 – Kitchener	Dufferin & Wellington Counties - Rural	163	107
23RR010	23 – London	Elgin, Middlesex & Oxford Counties - Rural	37	26
24RR010	24 – Goderich	Huron & Perth Counties - Rural/Waterfront	21	18
25RR010	25 – Owen Sound	Grey & Bruce Counties - Rural/Waterfront	167	136
26RR010	26 – Chatham	Chatham-Kent - Rural/Wallaceburg	325	247
26RR030	26 – Chatham	Lambton County - Rural/Waterfront	10	8
27RR120	27 – Windsor	Essex County	170	145
31RR010	31 – Sault Ste. Marie	District of Algoma	69	21
31UR010	31 – Sault Ste. Marie	Sault Ste. Marie/Prince Township	56	21
TOTAL			1,157	834

[5] http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/comments_part1-commentaires_partie1-eng.php#a16

As some properties had more than one IWT erected on them, the property count does not match the count of IWTs.

Virtually all IWTs are erected on vacant lots or farm properties, with almost 90% located on farms and the remainder on vacant lots.

The year of construction of IWTs in the database ranges from 2002 to 2013, with a market area breakdown as follows:

Table 3 - Typical Physical Characteristics of IWTs Across Ontario

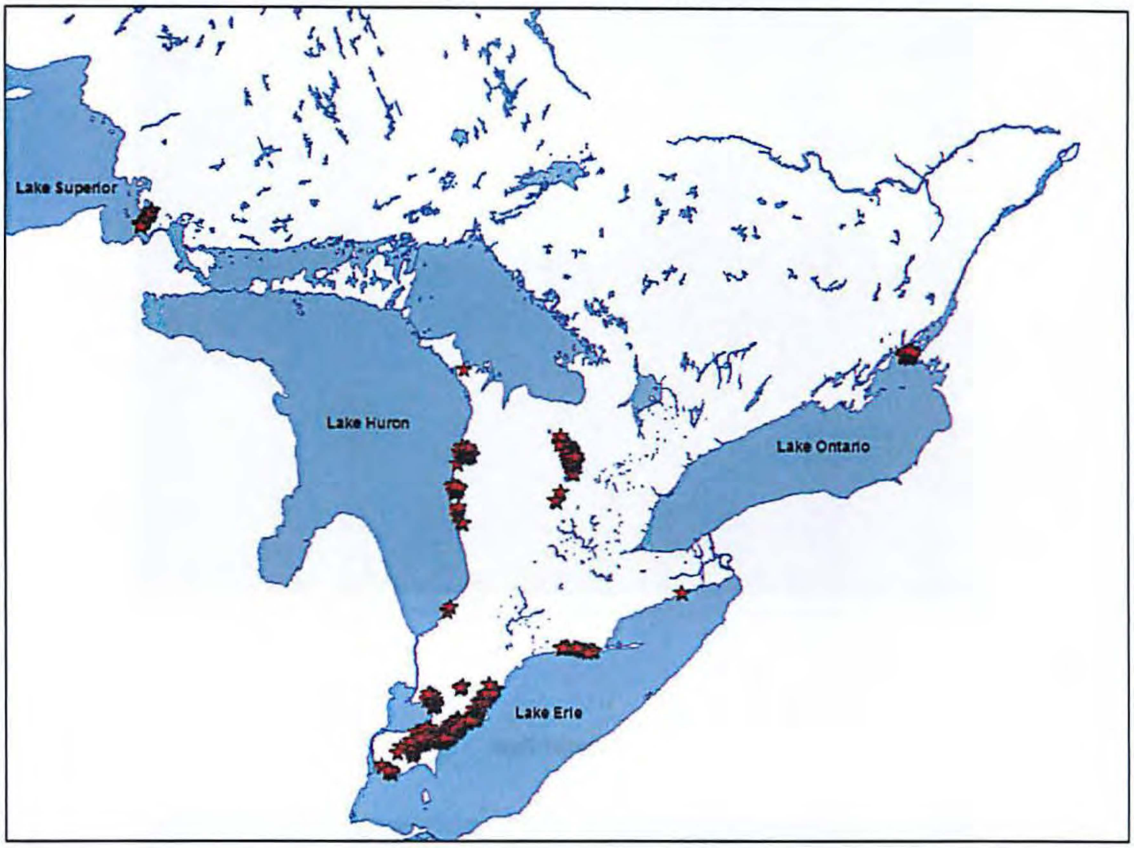
Market Area	MPAC Region	Median Year of Construction	Earliest Year of Construction	Latest Year of Construction	Median Generating Capacity	Minimum Generating Capacity	Maximum Generating Capacity
05RR030	05 - Kingston	2008	2008	2008	2.30	1.65	2.30
20RR010	20 -Brantford	2007	2007	2008	1.50	1.50	1.65
22RR010	22 - Kitchener	2008	2006	2012	1.50	1.50	2.40
23RR010	23 - London	2007	2006	2007	1.50	1.50	1.50
24RR010	24 - Goderich	2006	2006	2006	1.80	1.80	1.80
25RR010	25 – Owen Sound	2008	2002	2012	1.65	1.60	2.30
26RR010	26 – Chatham	2010	2008	2013	2.00	1.50	2.50
26RR030	26 – Chatham	2008	2008	2009	1.65	1.50	1.65
27RR120	27 – Windsor	2010	2010	2010	2.30	1.65	2.30
31RR010	31 – Sault Ste. Marie	2006	2006	2006	1.50	1.50	1.50
31UR010	31 – Sault Ste. Marie	2006	2006	2006	1.50	1.50	1.50
OVERALL		2008	2002	2013	1.80	1.50	2.50

Refer to Table 1 for market area descriptions.

The following map shows the locations of the IWTs used in the analysis. *Appendix B* provides the work instructions for local MPAC staff when determining the GPS co-ordinates for each IWT used in the analyses.

Figure 1

Location of IWTs Across Ontario



SALES INVESTIGATIONS

For the purposes of this study, all sales where any portion of a property was within 2 km of one or more IWTs were flagged for inspection by MPAC. The sale was investigated to ensure it was an arm's length transaction and that the property data on file reflected what existed at the time of the sale. Also, GPS co-ordinates were collected from the corner of the residence nearest an IWT. Finally, where possible, pictures were taken from the residence towards the closest surrounding IWT(s). Once this step was completed, distance was once again calculated from the co-ordinates of the IWT to the co-ordinates of the corner of the residences nearest an IWT. This was the actual distance used in the study for sales within 2 km. *Appendix C* includes the work instructions for staff conducting the sales review for this project.

A view variable was created using the pictures and descriptions provided for sales within 2 km of an IWT. Three categories were created:

Full View

Partial View

No View

STUDY 1 – EQUITY OF RESIDENTIAL ASSESSMENTS IN PROXIMITY TO INDUSTRIAL WIND TURBINES

For this study, MPAC analyzed open market sales of improved residential properties from January 2009 through December 2012, in the market areas surrounding IWTs. A market area is defined as a geographic area, usually contiguous, subject to the same economic influences, where properties tend to increase or decrease in value together.

Sales Filters

To account for typical minimum sale amounts, any sale below $10,000 was removed in Southwestern or Eastern Ontario, and any sale below $5,000 was removed in Northern Ontario. Any sale on a property on which an IWT sits, was removed from analysis to avoid the potential influence that the income stream associated to such properties may offer. Cases where a property sold as a vacant lot and has since been built on, or a sale representing a built on property that is now a vacant lot, have also been removed from the analysis. There were five market areas with five or fewer sales and these were excluded from the analysis. To verify the validity of the remaining sales, any sale within 2 km of an IWT was field inspected and reviewed by staff from the local MPAC offices. Sales determined to be other than open market transactions, or suspect, were removed from analysis. For the sales outside of a 2 km buffer, those with extreme ratios of Current Value Assessment to sale price as defined by the International Association of Assessing Officers (IAAO) Standard on Ratio Studies[6], were also removed from analysis.

Assessment-to-Sale Ratio Study

To establish the level of appraisal and test for equity, MPAC looks at Assessment-to-Sale Ratio (ASR). The ASR is calculated by dividing the assessed value of each property by its time adjusted sale price.

One would expect to see a median ASR between 0.95-1.05 for a group of properties if they are assessed at market value. The median ASR of different categories of properties can be compared against one another to ensure that they align and therefore, the level of appraisal is equitable between each group. If the median ASR for a group of properties is higher than another group, this would indicate that it is assessed at a higher level of assessment.

Mean and median ASRs and their 95% confidence intervals were calculated for groups of view and distance variables. The median always divides the data into two equal parts and is less affected by extreme ratios than other measures of central tendency. Because of these properties, the median is the generally preferred measure of central tendency. When the mean or median is calculated on the data in a sample, the result is a point estimate, which is accurate for the sample but is only one indicator of the level of appraisal in the population. Confidence intervals around the measures of level provide indicators of the reliability of the sample statistics as predictors of the overall level of appraisal of the population. Note that noncompliance with appraisal level standards cannot be determined without the use of confidence intervals or hypothesis tests[7]. A confidence interval consists of two numbers (upper and lower limits) that bracket a calculated measure of central tendency for the sample; there is a specified degree of confidence that the calculated upper and lower limits bracket the true measure of central tendency for the population.

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[6] International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, pp. 53-54
[7] Ibid, p. 13

MPAC looked at three different data elements in determining if equity exists:

1. **Abutting a property with an IWT;**
2. **Distance to closest IWT; and,**
3. **View of an IWT.**

1. Abutting a Property with an IWT

There were 32 sales of properties that directly abutted a property with an IWT, 31 of which were within 1 km of an IWT as would be expected and one sale within 2 km (two large abutting lots). When looking at the 31 abutting properties within 1 km of an IWT in comparison to sales less than 1 km from an IWT that do not abut an IWT, the median ASR is actually lower for properties abutting an IWT (0.989 abutting vs. 1.040 not abutting). This indicates that there is no inequity between properties that abut an IWT and other properties within 1 km that do not physically abut an IWT.

When looking at all sales that abut a property with an IWT the median ASR is very near 1.00.

Table 4 - Abutting an IWT ASRs

	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Abutting Wind Turbine	32	1.002	0.929	1.121	98%

Based on all sales of properties abutting a property with an IWT there appears to be no difference between these abutting properties and sales that are a similar distance to a IWT but do not abut an IWT. See *__Appendix D1 - Abutting a Property with an IWT__* for statistical output.

2. DISTANCE TO CLOSEST IWT

A breakdown of the 41,424 sales used in the analysis, by distance, follows:

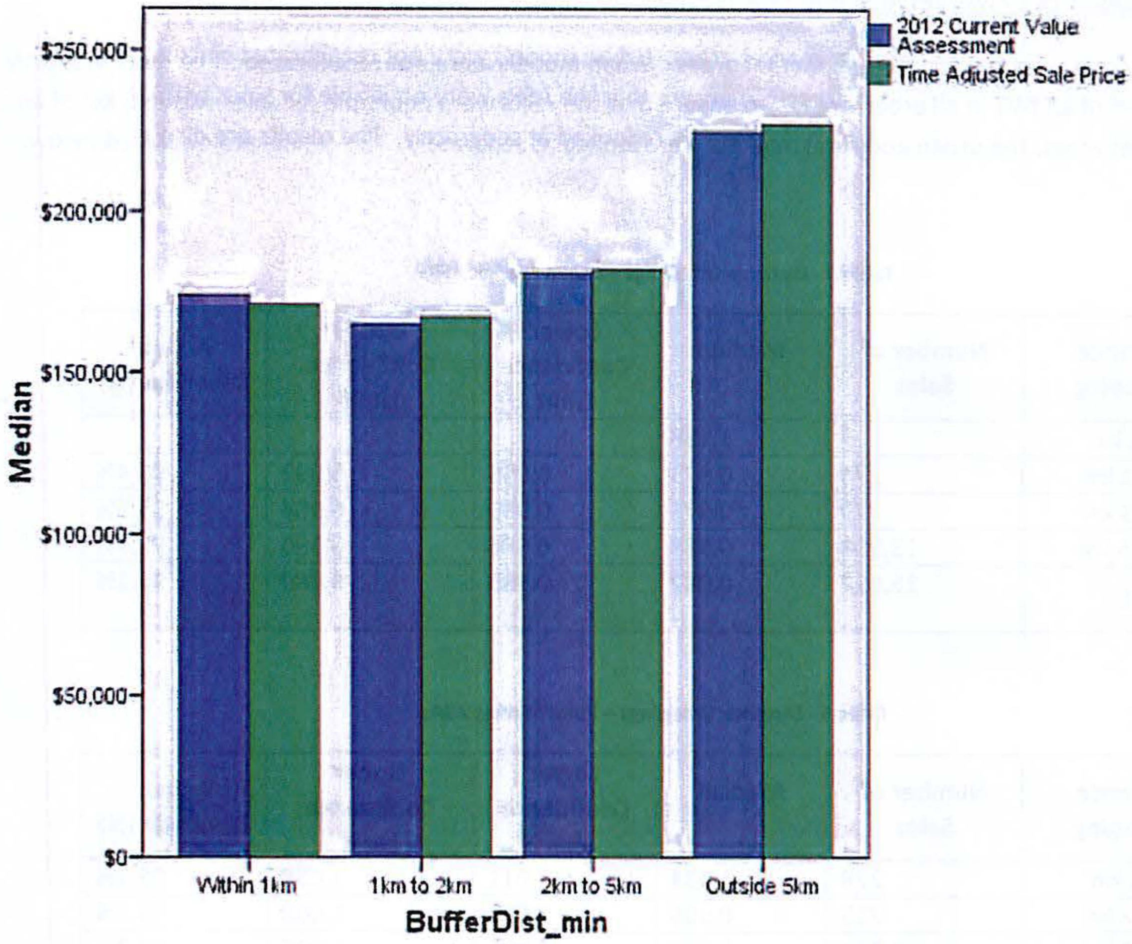
Table 5 - Distance Grouping by Market Area

Market Area	MPAC Region	Pre-Construction			Post Construction Sales			> 5 km
		< 1 km	1-2 km	2-5 km	< 1 km	1-2 km	2-5 km	
05RR030	05 - Kingston	0	0	0	13	7	8	2,606
20RR010	20 -Brantford	0	0	0	25	9	71	4,868
22RR010	22 - Kitchener	1	3	29	25	22	54	1,597
22UR020	22 - Kitchener	0	0	0	0	0	404	2,017
22UR030	22 - Kitchener	0	18	4	0	74	28	2,300
23RR010	23 - London	0	0	1	4	52	71	4,300
24RR010	24 - Goderich	0	0	0	2	3	98	786
25RR010	25 – Owen Sound	0	1	3	12	18	262	2,692
25UR010	25 – Owen Sound	0	0	0	0	16	161	4,180
26RR010	26 - Chatham	31	86	427	52	214	409	663
26RR030	26 - Chatham	0	0	0	1	23	76	1,942
27RR120	27 - Windsor	20	62	132	92	210	636	2,198
27UR070	27 - Windsor	0	29	32	1	125	147	2,660
31RR010	31 – Sault Ste. Marie	0	0	0	0	5	7	1,483
31UR010	31 – Sault Ste. Marie	0	0	0	0	12	3	2,801
TOTAL		52	199	628	227	790	2,435	37,093

Refer to Table 1 for market area descriptions.

Comparing the median assessed value to the median time adjusted sale amount by the distance categories the figures are very similar. The results for all sales are provided in the following graph.

Figure 2 - Comparison of CVA and Time Adjusted Sale Price by Distance Groupings



Appendix D2 - CVA and Tas-Amt Bar Charts contains a similar bar chart for each market area.

When broken into the distance categories, sales within 1 km of an IWT show a higher median ASR than the other groups.

Table 3 - Distance Grouping ASRs

Distance Grouping	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Within 1 km	279	1.034	1.011	1.057	95.8%
1 km to 2 km	989	0.989	0.979	1.000	95.1%
2 km to 5 km	3,063	0.992	0.988	0.997	95.3%
Outside 5 km	37,093	0.992	0.991	0.993	95.0%
OVERALL	**41,424**	**0.992**	**0.991**	**0.994**	**95.0%**

Sales of properties within 1 km of an IWT have a median ASR of 1.034 while the overall median for all sales outside of 5 km of an IWT is 0.992. This is a difference of 4.2%. Also, the median confidence interval does not overlap the confidence interval for the other groups. This indicates the difference is statistically significant. Sales between 1 km and

5 km away from an IWT appear to be assessed at the same level of appraisal as the sales greater than 5 km from an IWT. See *Appendix D3 - Distance by Market Area and Type* for ASR data for each market area.

In Study #2, regressions were run for all rural market areas. Urban models were not recalibrated since there was only one sale within 1 km of an IWT in all urban areas. To ensure that the ASRs were equitable for sales within 5 km of an IWT in urban market areas, the urban and rural markets were looked at separately. The results are displayed below.

Table 4 - Distance Groupings – Urban Market ASRs

Distance Grouping	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Within 1 km	1	1.138			
1 km to 2 km	274	0.975	0.955	0.992	95.4%
2 km to 5 km	779	0.976	0.969	0.984	95.5%
Outside 5 km	13,958	0.988	0.986	0.990	95.1%
OVERALL	**15,012**	**0.987**	**0.985**	**0.989**	**95.1%**

Table 5 - Distance Groupings – Rural Market ASRs

Distance Grouping	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Within 1 km	278	1.034	1.011	1.055	95.2%
1 km to 2 km	715	0.996	0.982	1.008	95.7%
2 km to 5 km	2,284	0.999	0.993	1.005	95.3%
Outside 5 km	23,135	0.995	0.993	0.997	95.1%
OVERALL	**26,412**	**0.996**	**0.994**	**0.997**	**95.0%**

In the urban markets, there is only one sale within 1 km of an IWT. The median ASRs for sales outside of 1 km are all below 1.00. They are slightly lower than the results for the rural market areas; however, the median ASRs outside 1 km in the rural market areas are still below 1.00. Based on these results, it appears that urban market areas are equitably assessed with regard to the distance to the closest IWT. Also, there is no significant difference between urban market areas and rural market areas regarding the influence of distance to the closest IWT. See *Appendix D3 - Distance by Market Area and Type* for ASR data for each market type.

3. View Of An IWT

When all sales within 2 km of the nearest IWT are analyzed together, the median ASR for full view is higher than the median ASR for properties with no view. However, there is correlation between full view and distance. Almost 75% of sales within 1 km of an IWT have a full view while only 25% of sales from 1 to 2 km to an IWT have a full view. As mentioned above, sales within 1 km of an IWT have a median ASR higher than the other distances. Therefore, the sales were split into two groups to perform the ratio study by view towards the closest IWT.

Table 6 - View Groupings – Sales within 1km ASRs

View	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Full View	190	1.032	1.001	1.060	95.0%
Partial View	33	1.005	0.952	1.057	96.5%
No View	56	1.064	0.998	1.092	95.6%
OVERALL	**279**	**1.034**	**1.011**	**1.057**	**95.8%**

Within 1 km, sales with no view have the highest median ASR (1.064 vs. 1.032 for full view) based on 56 sales. Partial view has the lowest median ASR at 1.005. This seems to indicate that view does not affect ASR for sales within 1 km of an IWT.

The ASR results for sales from 1 km to 2 km away from an IWT are:

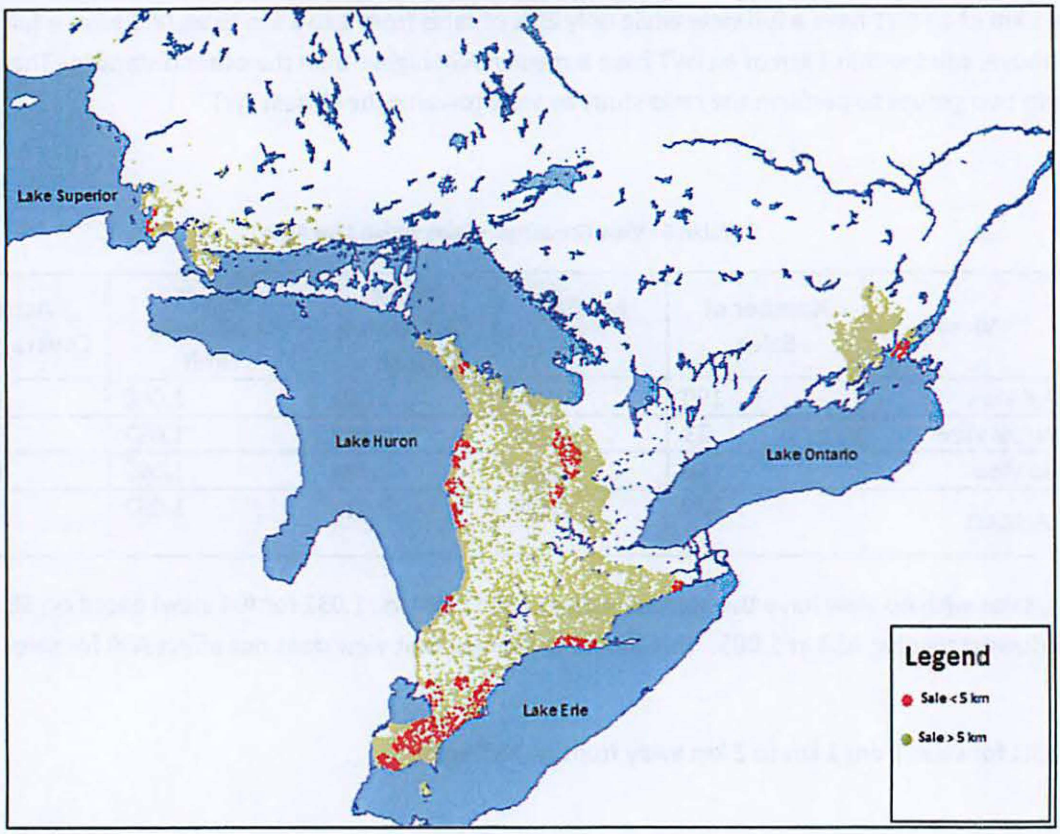
Table 7 - View Groupings – Sales 1km to 2km ASRs

View	Number of Sales	Median	Lower Confidence Limit	Upper Confidence Limit	Actual Coverage (%)
Full View	239	1.001	0.981	1.026	96.2%
Partial View	103	0.980	0.939	1.018	95.2%
No View	647	0.984	0.972	0.997	95.1%
OVERALL	**989**	**0.989**	**0.979**	**1.000**	**95.1%**

Properties with a full view of one or more IWTs have a median ASR of 1.001 while properties with a partial view have a median ASR of 0.980. Sales with no view have a median ASR of 0.984. There is a moderate difference between full view and no view of 1.7%. The confidence intervals of the three groups do overlap and all three groups have median ASRs close to 1.00. See *Appendix D4 - View All Sales and by Market Area* for ASR data for each market area.

Figure 3

Location of Sales Across Ontario



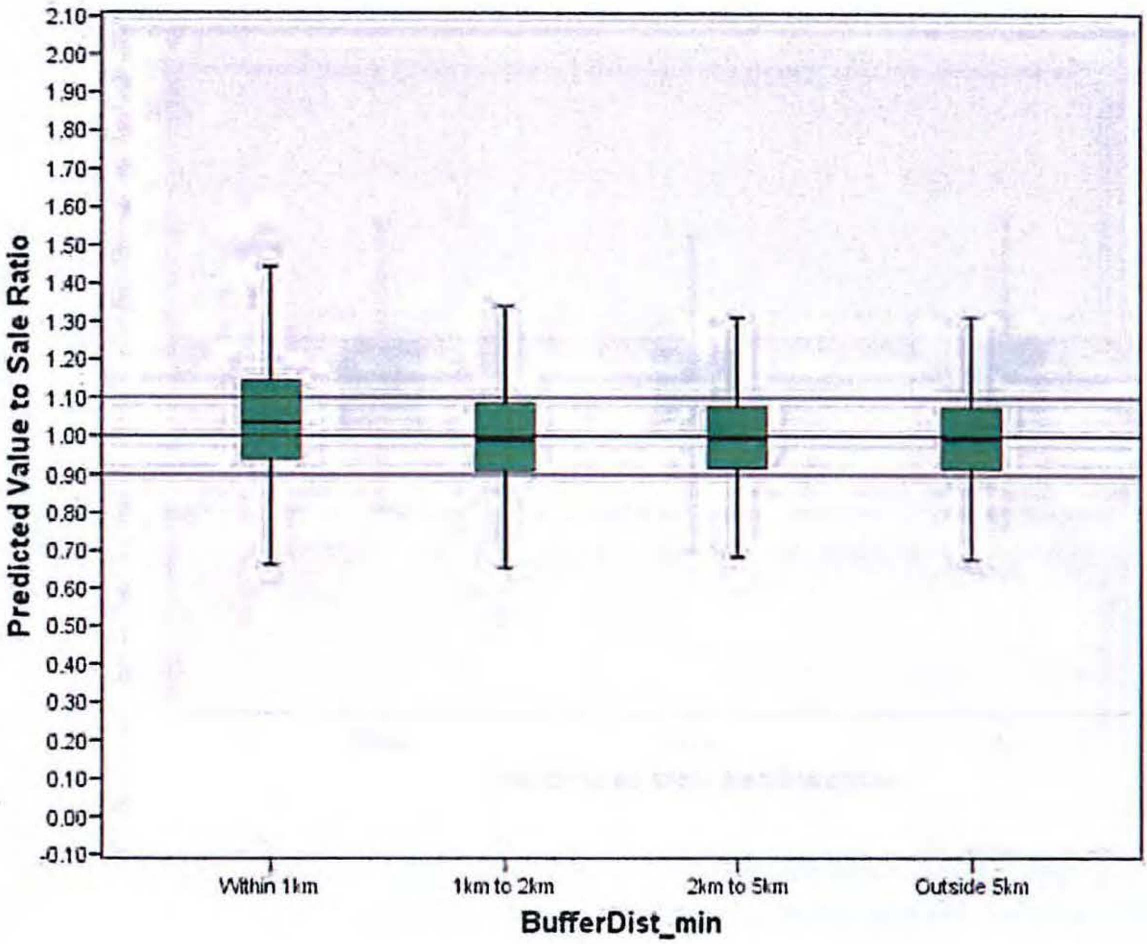
Summary of Findings

Section 9.2.1 of the IAAO Standard on Ratio Studies states:

"The level of appraisal of each stratum (class, neighborhood, age group, market areas, and the like) should be within 5 percent of the overall level of appraisal of the jurisdiction. For example, if the overall level of appraisal of the jurisdiction is 1.00, but the appraisal level for residential property is 0.93 and the appraisal level for commercial property is 1.06, the jurisdiction is not in compliance with this requirement. This test should be applied only to strata subject to compliance testing. It can be concluded that this standard has been met if 95 percent (two-tailed) confidence intervals about the chosen measures of central tendency for each of the strata fall within 5 percent of the overall level of appraisal calculated for the jurisdiction. Using the above example, if the upper confidence limit for the level of residential property is 0.97 and the lower confidence limit for commercial property is 1.01, the two strata are within the acceptable range."

Sales within 1 km of an IWT showed a level of appraisal that was higher than the median ASR of sales further away (median ASR of 1.034). The lower confidence level of sales within 1 km of an IWT is 1.011. This is well within 5% of the overall level of appraisal (1.011 – 0.992 = 1.9%). So, although sales within 1 km of an IWT do have a median ASR above the overall level, the difference is not great enough to require value adjustment according to IAAO guidelines. These findings are illustrated in the following box plot.

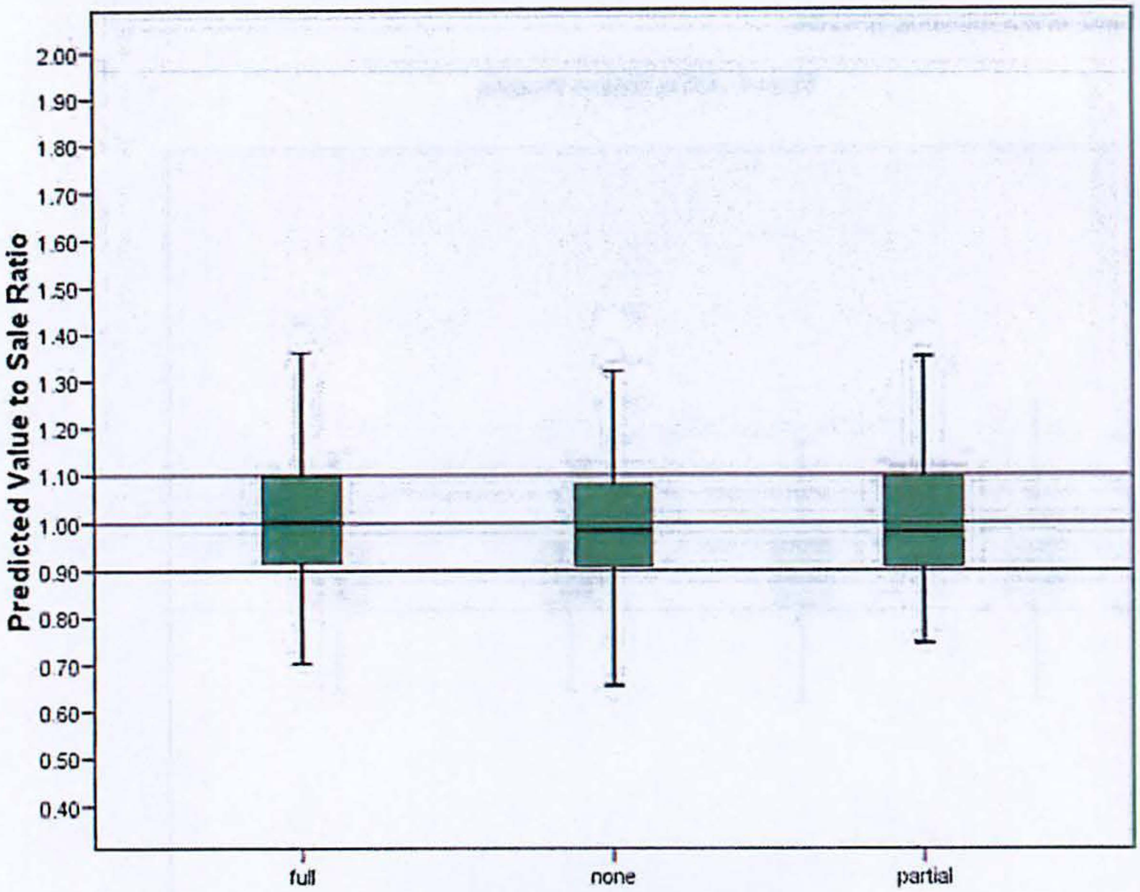
Figure 4 - ASR by Distance Grouping



The dark line within each box represents the median ASR. The lower and upper ends of the box represent the 25th and 75th percentiles, respectively. This box plot illustrates that the median ASR for sales within 1 km of an IWT is slightly higher than the other groups, but the boxes for all the groups overlap. See *Appendix D5 - Distance Boxplots* for additional graphs.

Also, between 1 km and 2 km some testing appeared to indicate a difference in the level of appraisal based on the view towards the closest IWT. The median ASR for properties with a full view is 1.001 while the median ASR for properties with No View is 0.984. This is a difference of 1.7%. This difference is well below 5% without reference to the confidence intervals. Again, based on IAAO standards, the difference between median ASRs does not approach the threshold to require an adjustment. This is also illustrated using the following box plots.

Figure 5 - ASR by View Grouping Sales 1km to 2km to an IWT



The median ASR for full view is slightly higher than the other two view categories but again there is a large amount of overlap among the three boxes. See *Appendix D6 - View Boxplots* for additional graphs.

In the IAAO Standard on Ratio Studies, 2013[8],, an equity decision making matrix is provided to allow a jurisdiction to determine if equity exists between groups of properties. This matrix has been populated for the two scenarios described above. The performance standard range is 0.95 to 1.05. Note that if the point estimate is outside of the performance standard range but the confidence interval does overlap the range, action is not required.

Table 8 - Decision Making Matrix

Scenario	Point Estimate	Confidence Interval (CI) Width	CI Overlaps Performance Standard Range	Point Estimate in Performance Standard Range	Action Required
<1 km to IWT	1.034	1.011 to 1.057	Yes	Yes	No
Full View 1 to 2 km to an IWT	1.001	0.981 to 1.026	Yes	Yes	No

[8] International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, p. 35

Therefore, based on the results of this analysis, there is no inequity with regards to distance to the closest IWT and view towards an IWT.

This finding is consistent with MPAC's 2008 study. ***MPAC's 2008 study is included as Appendix E*** **of this report.**

Our findings are also consistent with a third party review of this study conduct by Robert J. Gloudemans. Mr. Gloudemans is an independent internationally recognized mass appraisal consultant. MPAC provided Mr. Gloudemans with a dataset of all sales less than 5 km from the nearest IWT to conduct his analysis. ***Mr. Gloudemans' report is included as Appendix A.***

STUDY 2 – EFFECT OF PROXIMITY TO INDUSTRIAL WIND TURBINES ON RESIDENTIAL SALE PRICES

To determine if sale prices of residential properties are impacted by being in proximity to IWTs, three binary variables (0 – No, 1 – Yes) were created based on the following distance groupings:

IWT_1km - The home is within 1 km of the nearest IWT.

IWT_2km - The home is within 1-2 km of the nearest IWT.

IWT_5km - The centre of the lot is within 2-5 km of the nearest IWT.

The requirement for exact location of the house was assumed to be less important as distance to the nearest IWT increases and the centroid of the lot was deemed acceptable for the purposes of this study for properties further than 2 km away from the nearest IWT.

The regression models used to produce the January 1, 2012 Current Value Assessments were recalibrated with these variables included to determine whether they would enter the equation at a statistically significant level. The typical significance level for Multiple Regression Analysis is either 5% or 10%.

If one or more of the distance variables enters a regression analysis significantly, that is an indication that distance to an IWT affects sale prices in that market area and a value adjustment to the assessed value may be required.

SALES UTILIZED

Table 9 provides a breakdown of the distance grouping variables for each market area.

Table 9 - Distance Grouping by Market Area

		Pre-Construction			Post-Construction		
Market Area	MPAC Region	< 1 km	1-2 km	2-5 km	< 1 km	1-2 km	2-5 km
05RR030	05 - Kingston	0	0	0	7	6	10
20RR010	20 -Brantford	0	0	0	19	7	54
22RR010	22 - Kitchener	1	3	32	20	18	37
22UR020	22 - Kitchener	0	0	0	0	0	281
22UR030	22 - Kitchener	0	17	4	0	47	24
23RR010	23 - London	0	0	1	3	41	53
24RR010	24 - Goderich	0	0	0	2	2	74
25RR010	25 – Owen Sound	0	2	2	8	10	201
25UR010	25 – Owen Sound	0	0	0	0	14	109
26RR010	26 - Chatham	33	81	415	15	96	173
26RR030	26 - Chatham	0	0	0	0	23	60
27RR120	27 - Windsor	22	66	185	64	128	397
27UR070	27 - Windsor	0	30	33	1	78	84
31RR010	31 – Sault Ste. Marie	0	0	0	0	12	19
31UR010	31 – Sault Ste. Marie	0	0	0	0	8	4
TOTAL		56	199	672	142	490	1584

This table also indicates the number of sales occurring pre-construction and post construction periods. Pre-construction sales include sales one year prior to completion of the IWT.

Two market areas have sufficient sales to test distance groupings and state of IWT construction, namely *MPAC Region 26-Chatham* representing Lambton County – Rural/Waterfront (market area 26RR010) and *MPAC Region 27-Windsor* representing Essex County (market area 27RR120). Most market areas have sufficient sales within 1 km to test the value impact within that distance.

The sales period to develop valuation models ranges from December 2008 to December 2011 in these market areas. Table 10 provides a summary.

Table 10 - Market Area Sales Summary

Market Area	MPAC Region	Median House Square Footage (sq ft)	Median Age (years)	Median Lot Size (Acres)	Sale Date Range (year/month)	Median Time Adjusted Sale Price
05RR030	05 - Kingston	1,314	38	0.53	08/12 – 11/11	$219,918
20RR010	20 -Brantford	1,324	44	0.25	09/01 – 11/12	$218,254
22RR010	22 - Kitchener	1,729	33	1.32	09/01 – 11/12	$401,056
23RR010	23 - London	1,441	40	0.32	09/01 – 11/12	$230,697
24RR010	24 - Goderich	1,428	46	0.82	08/12 – 11/11	$246,041
25RR010	25 – Owen Sound	1,340	37	0.61	08/12 – 11/11	$219,375
26RR010	26 - Chatham	1,245	52	0.23	09/01 – 11/12	$129,842
26RR030	26 - Chatham	1,346	39	0.26	09/01 – 11/12	$176,225
27RR120	27 - Windsor	1,305	37	0.20	09/01 – 11/12	$170,238
31RR010	31 – Sault Ste. Marie	1,086	43	0.26	08/01 – 11/12	$85,065
OVERALL		1,332	39.5	0.29	09/01 – 11/12	$218,814

Refer to Table 1 for market area descriptions.

When reviewing sale counts for properties within 5 km of an IWT, it was determined that some sales occurred in the urban market areas; however, there were no sales of properties in these market areas within 1 km of an IWT. For the purposes of this study, only rural market areas that had sales within 1 km were studied.

Variables for each distance were added to the model for each market area. If the distance grouping variables entered the equation with 5% significance level (95% confidence level), it would indicate very strong statistical evidence that distance to the nearest IWT is impacting on sale prices.

Tables 11 and 12 provide the dollar adjustment and an indication if the variables entered the model with a 10%, 5% or 1% significance level. Typically, MPAC sets a 5% significance level for any property characteristic to be included in a valuation model in accordance with statistical practice.

Table 11 - Dollar Adjustments in Market Areas with Insufficient Pre-Construction Sales

Market Area	MPAC Region	< 1 km	1-2 km	2-5 km
05RR030	05 - Kingston	+$36,435**	DNE	+$31,832**
20RR010	20 -Brantford	DNE	DNE	DNE
22RR010	22 - Kitchener	DNE	DNE	DNE
23RR010	23 - London	DNE	DNE	-$21,021**
24RR010	24 - Goderich	DNE	DNE	DNE
25RR010	25 – Owen Sound	DNE	DNE	DNE
26RR030	26 - Chatham	DNE	DNE	+$12,261**
31RR010	31 – Sault Ste. Marie	DNE	DNE	DNE

,,*** indicate that the dollar adjustment is statistically significant at the 10%, 5% or 1% significance level, respectively (DNE = Did Not Enter)*

Table 12 - Dollar Adjustments in Market Areas with Sufficient Pre-Construction Sales

Market Area	MPAC Region	Pre-Construction Sales			Post Construction Sales		
		< 1 km	1-2 km	2-5 km	< 1 km	1-2 km	2-5 km
26RR010	26 - Chatham	-$6,451*	-$3,686*	DNE	DNE	DNE	DNE
27RR120	27 - Windsor	DNE	DNE	DNE	DNE	DNE	DNE

,,*** indicate that the dollar adjustment is statistically significant at the 10%, 5% or 1% significance level, respectively*

(DNE = Did Not Enter)

Appendix F includes the regression outputs referred to Tables 11 and 12.

Summary of Findings

Rural valuation models used for the 2012 base year were re-calibrated incorporating the three distance variables. With the exception of *MPAC Region 26-Chatham* representing Chatham-Kent – Rural/Wallaceburg (market area26RR010) and *MPAC Region 27– Windsor* representing Essex County (market area 27RR120), there were insufficient sales to study any potential difference in impact pre-construction and post-construction. In the case of market area 05RR030 (*MPAC Region 5-Kingston* representing Napanee, Loyalist Township, Frontenac/Lennox & Addington Counties South Rural/Waterfront), being within 1 km of an IWT entered the model as a positive value of $36,435. In this market area and the 26RR030 market area, the variable representing properties between 2 and 5 km from an IWT also entered positively.

Upon review of the sales database, it was determined that the IWT variables created for this study were highly correlated with the neighbourhood locational identifier. This strong correlation resulted in coefficients that did not make appraisal sense, and thus have been negated for the purposes of this study.

For market areas 26RR010 and 27RR120, sufficient sales data was evident to study the activity on both pre-construction and post-construction home sales. In neither instance did any of the variables enter the regression for 27RR120. For 26RR010, the variable identifying sales within 1 km of an IWT entered in the pre-construction period, and then only at the 10% significance level. The indicated coefficient was -$6,451. The variable representing sales between 1 and 2 km away from an IWT also entered at a coefficient of -$3,686, also only at the 10% significance level. In the post-construction period, no variable entered the regression for these areas. Thus, it can be assumed that any impact, no matter how marginal, was isolated in these areas to the post-announcement, pre-construction period.

In market area 23RR010 (*MPAC Region 23 – London* representing Elgin, Middlesex & Oxford Counties – Rural), the variable used to identify properties 2-5km away from an IWT entered the regression with a negative coefficient. After review of the sales database, it was determined that this variable was highly correlated with the neighbourhood locational identifier. This is borne out by the fact that neither of the other, closer, distance variables entered the regression.

With the exceptions noted above, no distance variables entered any regression equations for any of the other market areas.

To further confirm its findings, MPAC also conducted an additional analysis using approximately 2,000 sales and re-sales following similar logic to the Lansink study. The main differences between the February 2013 Lansink Study and MPAC's re-sale analysis is the sample size and the determination of the increase in the market between re-sales. Using 2,051 properties and generally accepted time adjustment techniques, MPAC cannot conclude any loss in price due to the proximity of an IWT. *Appendix G includes the re-sales analysis.*

LIST OF REPORT APPENDICES

GLOSSARY OF TERMS

Assessment Roll – An annual listing provided to each taxing authority in the Province of Ontario containing, among other things, the current value and tax classification of each property within the jurisdiction.

Assessment-to-Sale Ratio (ASR) – The ratio obtained by dividing the assessed value of a property by the time adjusted sale price of a property.

Base Year – The year that an estimate of a property's value is based on.

CVA – Current value assessment. The estimated value of a property based on a specific date.

Direct Comparison Approach to Value (aka Sales Comparison Approach to Value) – An approach to valuing a property which estimates the current value of a subject property by adjusting the sale price of comparable properties for differences between the comparable properties and the subject property.

Industrial Wind Turbine (IWT) – A wind turbine used to generate at least 1.5 MW of electricity.

GPS Co-ordinates – A set of two numbers that reference the latitude and longitude of a point on the Earth.

Market Area – A market area is defined as a geographic area, usually contiguous, subject to the same economic influences, where properties tend to increase or decrease in value together.

Market Model – Geographic areas subject to the same economic influences.

Mass Appraisal – The valuation of a group of properties as of a given date using standardized processes, employing common data, and allowing for statistical testing.

Median - The median of a group of numbers is the middle number after they have been sorted from lowest to highest. If you have an odd number of cases, the median is the middle value. If you have an even number of cases, the median is the value midway between the two middle values. The median, in comparison to the mean, is less sensitive to extreme values.

Megawatt (MW) – A unit of measure in energy generation or consumption.

MPAC – The Municipal Property Assessment Corporation. A body responsible for determining the correct market value and tax classification for all properties in the Province of Ontario, based on current value assessment.

Regression Analysis – A statistical technique used to analyse data in order to predict the value of one variable, such as market value, based on known data (e.g., living area, lot size, quality, location, etc.).

For more information about MPAC and how MPAC assesses properties, visit www.mpac.ca.

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Summary of Wind Turbine Analysis
Robert J. Gloudemans
December 4, 2013

At the request of the Municipal Property Assessment Corporation (MPAC), the author conducted an analysis of residential sales within 5 kilometers of wind turbines. The objective of the project was to determine the impact of location near a wind turbine on residential property values.

The analysis used improved residential sales in nine regions and eight market areas that occurred during calendar 2009-2013. Initially 4,332 sales met these criteria. Four sales with assessments and/or sales prices below $30,000 and 10 sales having extreme assessment-to-sales ratio of less than 0.55 or greater than 1.70 were removed from consideration, leaving 4,318 sales.

The dependent variable in the analysis was assessment-to-sales ratios in which 2012 values were divided by time-adjusted sales prices. The models that produced 2012 values did not contain variables related to proximity near wind turbines. Thus, the relevant question is to what extent ratios on these properties are too high because of the absence of such adjustments. Independent variables included the following:

- Distance from the nearest wind turbine, including binary variables for being within one kilometer, being within two kilometers, and being within 5 kilometers
- A binary variable for abutting a property with a wind turbine
- View of the nearest wind turbine: full, partial, or none

Preliminary analyses found no meaningful differences in assessment levels among regions or market areas.

Figure 1 shows a graph of assessment ratios with distance to the nearest wind turbine. A trend line has been drawn to the data, along with a horizontal reference line at 1.00. As can be seen, there is no meaningful relationship with the possible exception of properties within approximately 1 km.

Figure 2 contains a box plot of being within 1, 2, or 5 km of a wind turbine. Again, ratios for properties within 1 km appear slightly high, while there is no difference between properties within 2 or 5 km.

Similarly, figure 3 is a box plot for abutting a wind turbine and figure 4 is a box plot of view of the nearest wind turbine (full, partial, or none). Properties with a full view of the nearest wind turbine may have slightly higher ratios. Of course, these will also tend to be those properties closest to a wind turbine. Regression analysis will determine the relevant variables.

Figure 5 shows the initial regression model. The Adjusted R-Square is .006 (meaning that the model explains only 0.6% of the variation in assessment ratios). The only significant variable, with a coefficient of 0.045, is being within 1 km of a wind turbine. The variable is significant at the 99% confidence level.

Since the graphs and initial model revealed little systematic difference in ratios by any of the candidate variables, the ratios were further trimmed at 0.70 and 1.40 and the model rerun to discern relationships more clearly (3.0% of ratios exceeded the trim points). Figure 6 shows the revised results. Distance within 1 km is still the only significant predictor with a coefficient of .037 and relatively strong t-value of 4.7 (again significant at the 99% confidence level).

Finally, sales within 1 kilometer were divided into those with a full view (183 sales), those with a partial view (32 sales), and those with no view of a wind turbine (54 sales). Figure 7 shows the resulting model with the three variables. Ironically, no view enters while partial view does not.

We conclude that presence of a wind turbine (or turbines) has a statistically significant but minor impact on property values in the study area. The most relevant variable is close proximity. Based on the available data, distance within 1 km of a wind turbine tends to lower values approximately 4%.

Figure 1 – Graph of Ratios with Distance to the Nearest Wind Turbine

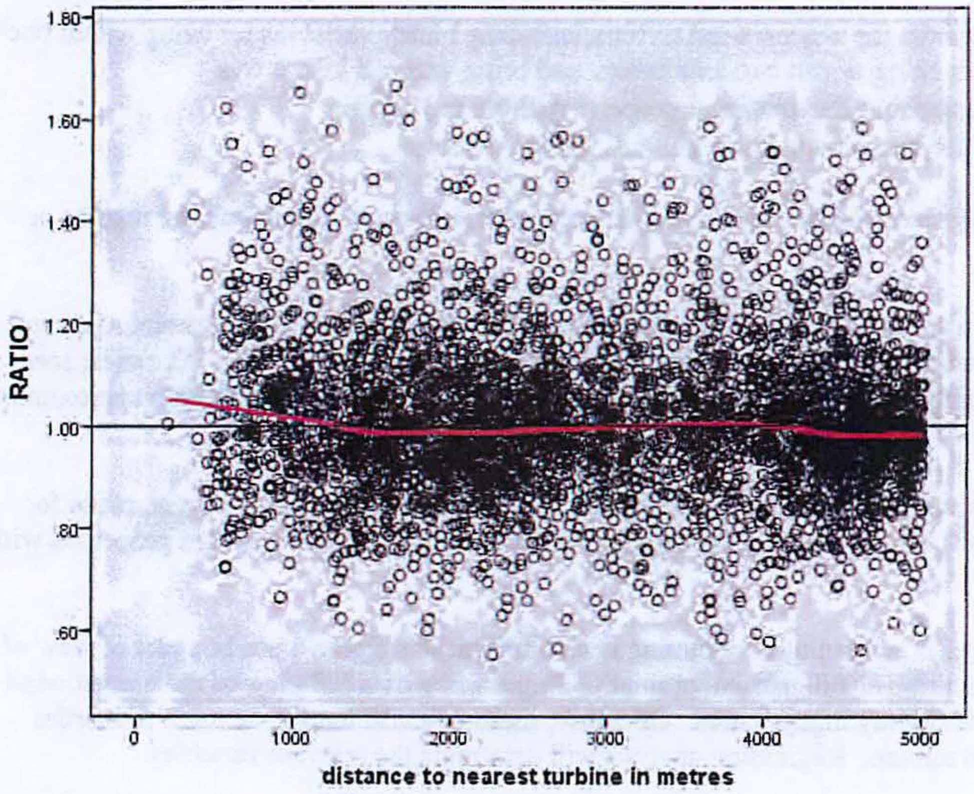


Figure 2 – Graph of Ratios with Kilometers (1, 2, or 5) to the Nearest Wind Turbine

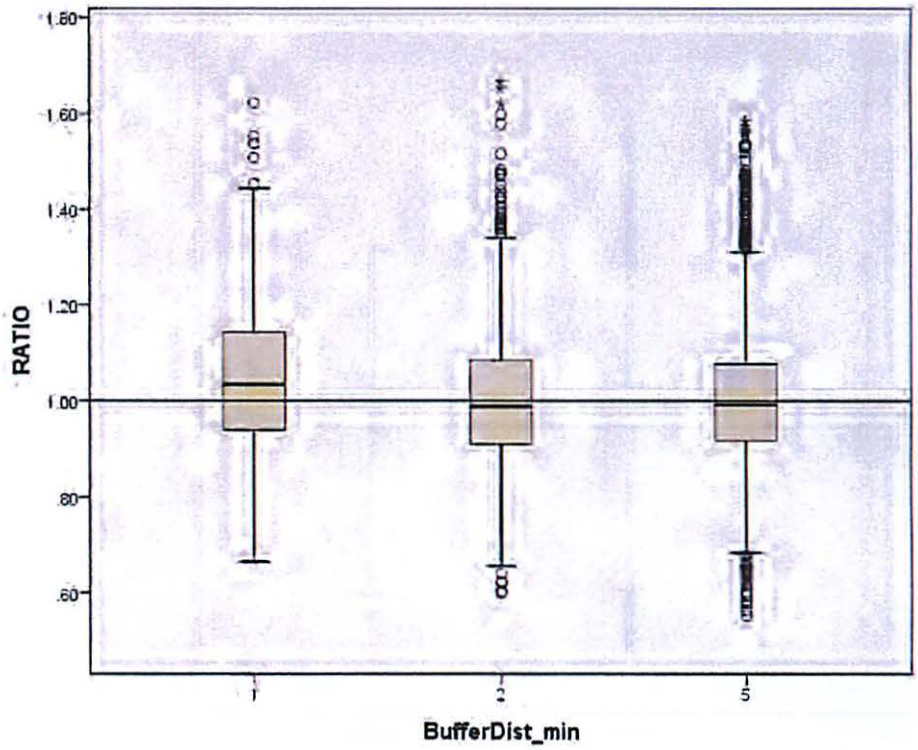


Figure 3 – Graph of Ratios with Abutting a Property with a Wind Turbine (0 = No, 1 = Yes)

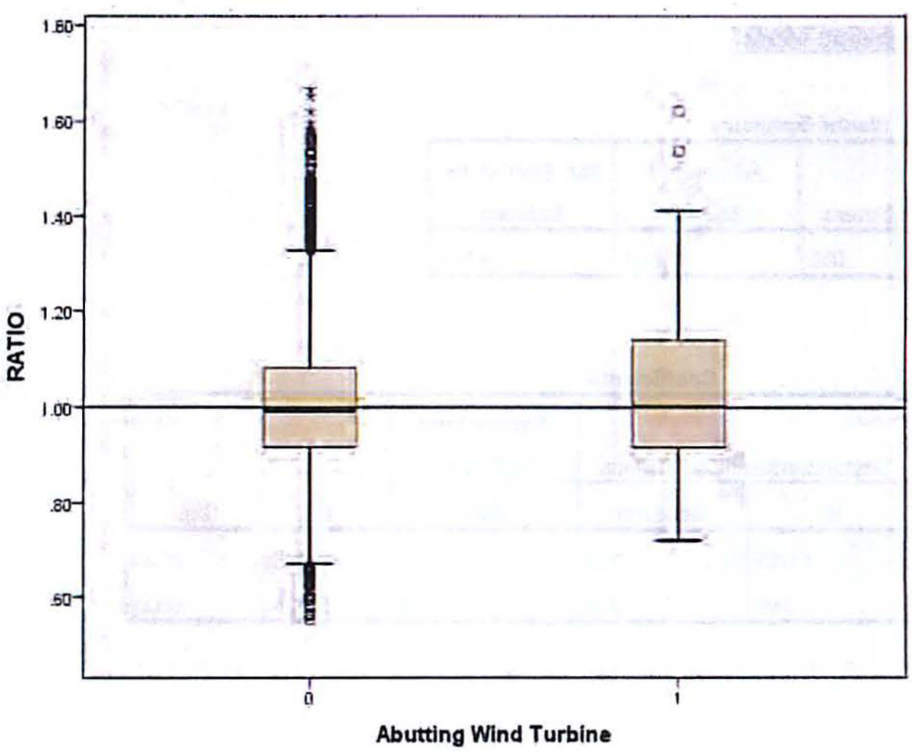


Figure 4 – Graph of Ratios with View of Nearest Wind Turbine

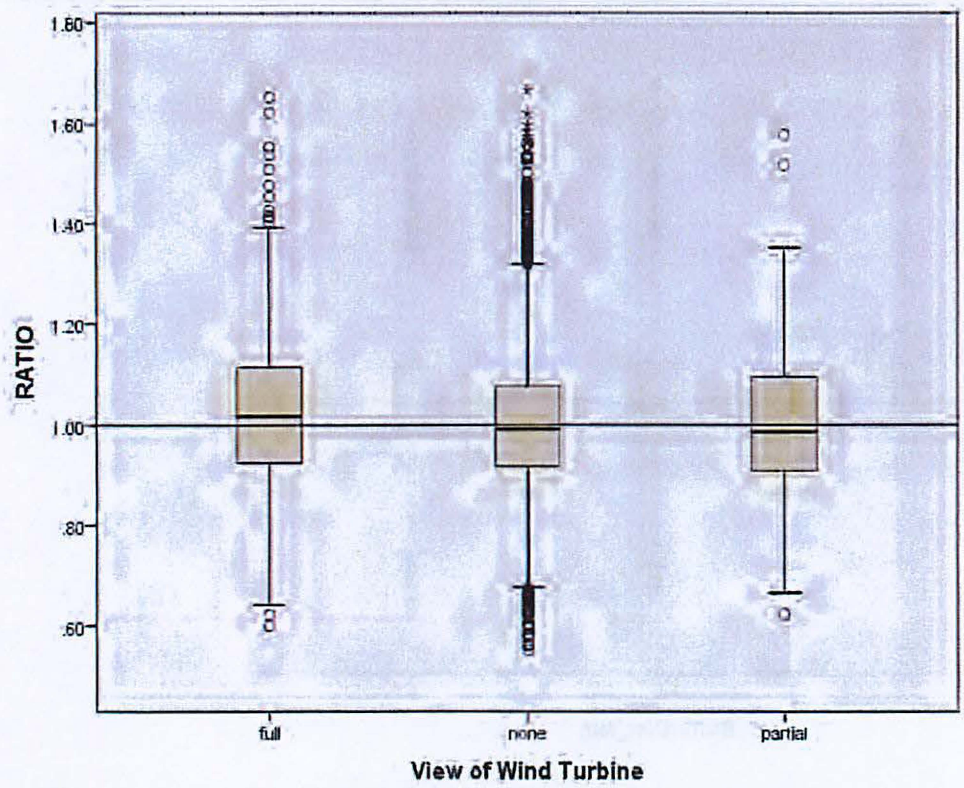


Figure 5 – Initial Regression Model

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.076	.006	.006	.14514

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.003	.002		439.333	.000
	Within 1 km	.045	.009	.076	5.024	.000

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Abutting Wind Turbine	.003	.167	.867	.003	.899
	VIEW_FULL	.021	1.208	.227	.018	.739
	VIEW_PARTIAL	-.017	-1.121	.262	-.017	.983
	Within 2 km	-.006	-.399	.690	-.006	.980
	Distance to nearest turbine	-.010	-.579	.563	-.009	.811

Figure 6 – Revised Model With Outlier Ratios Removed

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.072	.005	.005	.12595

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.000	.002		496.937	.000
	Within 1 km	.037	.008	.072	4.681	.000

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Abutting Wind Turbine	-.024	-1.501	.134	-.023	.906
	VIEW_FULL	.017	.935	.350	.014	.738
	VIEW_PARTIAL	-.016	-1.010	.312	-.016	.983
	Within 2 km	-.008	-.497	.619	-.008	.980
	Distance to nearest turbine	-.006	-.379	.705	-.006	.812

Figure 7 – Model With Sales within 1 Km Categorized by View (Full, Partial, or None)

Model Summary

2

R	R Square	Adjusted R Square	Std. Error of the Estimate
.075	.006	.005	.12594

Coefficients

2

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.000	.002		499.070	.000
Full View	.034	.010	.056	3.609	.000
No View	.057	.017	.051	3.331	.001

Excluded Variables

2

					Collinearity Statistics
	Beta In	t	Sig.	Partial Correlation	Tolerance
Partial View	.012	.796	.426	.012	1.000

Robert J. Gloudemans

Robert J. Gloudemans is a partner in Almy, Gloudemans, Jacobs & Denne. Bob previously worked for IAAO and the Arizona Department of Revenue. He provides consulting services in mass appraisal modeling, computer-assisted appraisal systems, and ratio studies and has served over 100 clients in the U.S., Canada, and internationally. He has served three appointments on the IAAO Standards Committee and has contributed extensively to the mass appraisal literature. He is the author of *Mass Appraisal of Real Property* (IAAO, 1999) and with his partner, Richard Almy, co-author of the new IAAO textbook, *Fundamentals of Mass Appraisal* (IAAO, 2011).

MUNICIPAL PROPERTY ASSESSMENT CORPORATION

Industrial Wind Turbines – Inspection Project

Work Instructions

2013-05-01

Provided by: Assessment Standards & Mass Appraisal

Work Instructions

Objective

MPAC is undertaking a study to determine whether properties within 2km of an industrial wind turbine (IWT) are valued equitably compared to properties further away. That is not to say that that IWTs do not affect value; but rather that any affect on value is accounted for in the 2012 current value assessments, or that the 2012 current value assessments are within standards.

A preliminary study has already been completed by looking at the centre of properties with IWTs and reviewing the sales on properties whose centre is within 1km, 2km, and 5km.

MPAC is now looking to expand the study by using the exact geographic co-ordinates of the IWTs and the co-ordinates of the surrounding houses.

MPAC has purchased the geographic co-ordinates of most IWTs across the province. However, upon reviewing the data, it has come to light that: (1) there are roll numbers on IPS with IWTs where the data provider did not deliver co-ordinates; and (2) the data provider delivered co-ordinates for IWTs and MPAC has no structure keyed on IPS on those roll numbers.

Before continuing with the study, both of these situations need to be addressed with the assistance of staff in Valuation and Customer Relations.

Once this data is collected and analyzed by Assessment Standards and Mass Appraisal (ASMA), additional data collection will be required for sold properties in proximity to properties with IWTs.

Instructions

Two files are being distributed with these instructions – one file contains roll numbers requiring staff to collect the geographic co-ordinates of the IWT(s) on a property (MPAC already has the IWT assessed); and the other file contains roll numbers requiring staff to assess the IWT(s) on a property (MPAC already has the geographic co-ordinates).

1. Roll Numbers Requiring Staff to Collect the Geographic Co-ordinates of the IWT(s) on a Property

To collect this data will require the use of a GPS device. For this project, we will use the "Garmin GPSMAP 76Cx color map navigator", which will provide the latitude and longitude that is required. These units were used during the Provincial Land Tax (PLT) project in Northern Ontario in 2007. Instructions on using the device are found in Appendix 1.

The inventory file contains a list of roll numbers where MPAC data contains a structure code 567 (Wind Turbine) on IPS. However, the data provider did not supply geographic co-ordinates. Note that there is one line in the inventory per IWT, not per roll number. The inventory contains the IPS structure number of the IWT, it's year of construction, and the generating capacity of the IWT in Megawatts (MW). The final column, "Estimated", indicates whether the generating capacity has been estimated based on the value attributed to the structure. If possible, confirm the capacity while obtaining the co-ordinates – there should be a plate/stamp on the IWT with the generating capacity.

When recording the co-ordinates for the IWTs, take the measurement from as close to the IWT as possible. Hold the device as steady as possible for two minutes or until the co-ordinates stabilize, whichever comes first.

If you are unable to obtain close co-ordinates due to fences or other obstructions, take the measurement from as close as you possibly can; preferably such that there is a straight line between you and IWT, perpendicular to the road, and estimate what you think the distance is between where you take the measurement and where the IWT sits. Make sure that this is all recorded in the Comments. If possible, take a picture as well, and include it when you return the inventory files. Upon returning to the office, use iLOOKABOUT™ in an attempt to obtain more accurate co-ordinates. However, since these properties are generally in rural areas, you may not be able to obtain co-ordinates accurately using digital imagery. In either case, make note in the inventory that you have had to approximate the co-ordinates and the reason.

2. Roll Numbers Requiring Staff to Assess the IWT(s) on a Property

This inventory file contains a list of roll numbers where MPAC does not have an IWT on the Structure tab of IPS, but according to the data source purchased, there is an IWT on the property. **Note that for properties valued outside of IPS, we may in fact have the IWT assessed.** In some situations, it may be that there is an IT portion on the property with the correct value, representing the IWT and corresponding land, but no structure has been keyed

and no industrial land component created and valued. If this is the case, update IPS with the correct data.

For the roll numbers in this inventory, you are required to collect the data on the IWTs, key the structure and appropriate value into IPS, create an industrial land component with an appropriate value in IPS, and issue a supplementary or omitted assessment if required. Note that for properties valued outside of IPS, these steps may be somewhat different; however, regardless of where a property is valued, IPS should contain a structure line for every IWT. Of course, if there are any outstanding permits on DTS for the IWTs, ensure that they are marked as complete.

Some roll numbers in the inventory have (potentially) multiple IWTs to be assessed. If you find more IWTs on a property as compared to the inventory, make a note in the Comments field and include the co-ordinates. If you find less IWTs on a property as compared to the inventory, attempt to ascertain whether the IWTs you do find match anything on the inventory. If in doubt, please add as much detail to the Comments field on the inventory to help us understand the situation.

If the IWT is still in the process of being erected, please make a note in the comments field of the inventory file.

If there is no indication of any IWT on the property, or going to be added to the property in the near future, indicate this in the comments field of the inventory file.

What to do if the Owner isn't Home or Entry is Refused (from the Residential Valuation Theory and Data Collection Manual)

If a property owner or any other adult person with authority does not appear to be present at the time of the visit, or it appears no one is at home at the time of the visit, you will make every reasonable effort to confirm no one is at home and verbal contact is not possible. Immediately upon confirmation that no one is at home, you must attach a proper notice to the main or common entrance door or in the alternative the mailbox, if available, explaining the reason for your visit. The notice will provide the owner/adult with authority with a method to contact MPAC subsequent to the visit to discuss the reason for the visit and/or provide information that may be requested concerning the property. After you place the notice, you will then continue to complete an exterior inspection of the property while respecting areas with restricted access. (But only if it is believed no one is at home.)

Reminder: typical inspection procedures are to be followed; and IPS should be updated as required.

Workload Counts by Region (by Roll Number)

Region	Inventory 1	Inventory 2	Total
05	2	3	5
20	29	0	29
21	0	1	1
22	45	20	65
23	37	0	37
24	22	0	22
25	41	14	55
26	93	94	187
27	20	67	87
31	0	4	4

Questions

If you have any questions, please contact one of the following:

Jamie Stata
Region 25 – Owen Sound
519-371-9432 ext 262
Jamie.Stata@mpac.ca

OR

Scott Bradfield
Region 20 – Brantford
519-758-9591 ext 251
Scott.Bradfield@mpac.ca

OR

Jason Moore
Region 18 – St. Catharines
905-688-1968 ext 275
Jason.Moore@mpac.ca

Appendix 1 – Using the "Garmin GPSMAP 76Cx color map navigator"

Using these devices indoors may cause interference for the satellites which it uses to obtain co-ordinates. If you're "getting to know" the device before taking it in the field to use, you may not get the results/steps below unless you're outside.

For example, you may see that it's "Acquiring Satellites" indefinitely, or for a very long time.

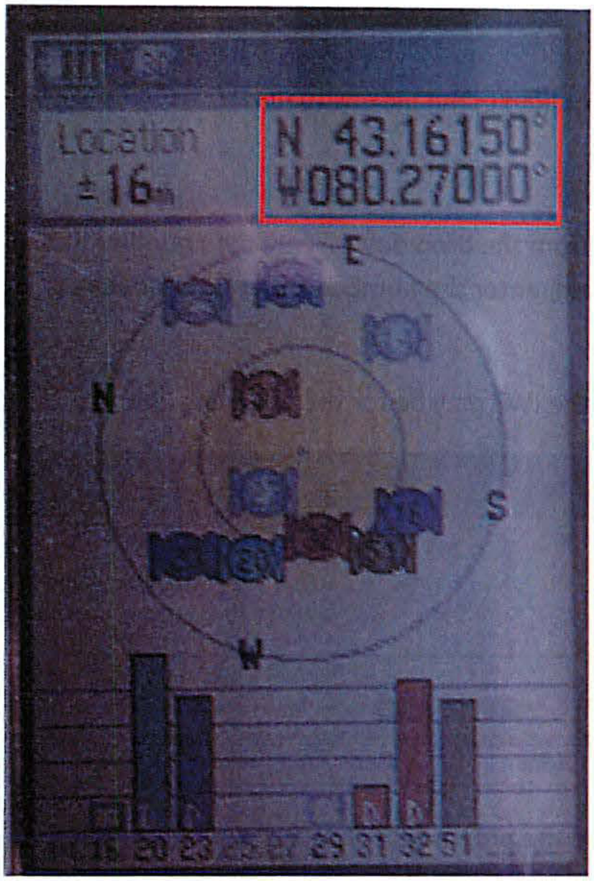
You may get the following message – if you do, chose "New Location".

Insert two AA batteries into the device.

Turn the device on, by pressing and holding the button for a few seconds.

Press the PAGE button until you come to a screen showing satellites orbiting the earth. The screen may say "Acquiring Satellite" at the top until it has locked onto enough satellites.

Once numbers appear in the upper right hand of the screen, you are ready to obtain the geographic co-ordinates.



In the above example, you would record Co-ordinate 1 as 43.16150; and Co-ordinate 2 as 080.27000. Please record all numeric digits, including zeros. Do not include the N (for North) or W (for West) as all of Ontario is North of the Equator; and West of the Prime Meridian

With the exception of putting the batteries in the device, these steps may need to be repeated each time the device is turned off/on. However, there is a car charger that you can plug in which will allow you to keep the device turned on between properties.

Appendix 2 – Using AIM to Find Co-ordinates

AIM has the capability to plot the co-ordinates provided in the inventory file.

Log into AIM.

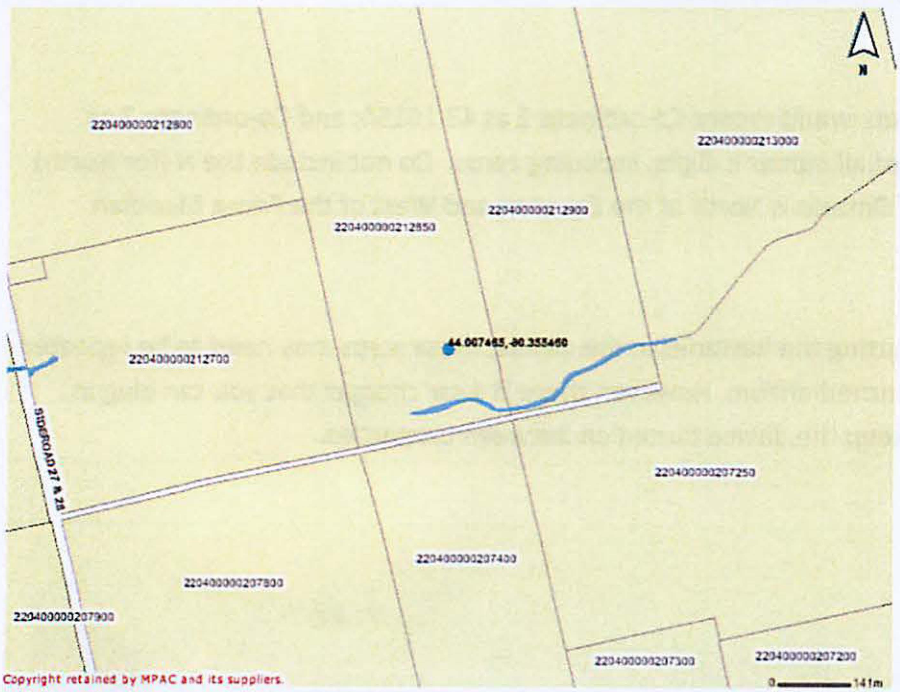
Near the top, beside "Locate", select **ddd.ddddd** from the drop down. Enter the number under Coordinate_1 in the "Lat:" field. In the "Long:" field, enter the number under Coordinate_2, with a negative sign in front of it.

For example, to see exactly where on a property the IWT may be for the following line:

Reg	Roll_Num	Prop code	Hnbhd	Enbhd	Mktarea	CVA2012	Coordinate_1	Coordinate_2	Comments
22	220400000212850	200	A07	0342	RR050	$288,000	N 44.007465	W 80.355460	

Search in AIM as follows:

This will show the location of the expected IWT on the property:



MUNICIPAL PROPERTY ASSESSMENT CORPORATION

Industrial Wind Turbines – Phase 2: Sale Reviews

Work Instructions

2013-07-23

Provided by: Assessment Standards & Mass Appraisal

Work Instructions

Objective

MPAC is undertaking a study to determine whether properties within 2km of an industrial wind turbine (IWT) are valued equitably compared to properties further away. That is not to say that that IWTs do not affect value; but rather that any affect on value is accounted for in the 2012 current value assessments, or that the 2012 current value assessments are within standards.

In the first step of this project, staff from Valuation & Customer Relations visited properties on which IWTs sit, to collect the geographic co-ordinates.

In this phase of the project, properties within 2 km of these IWTs, which have sold, will be inspected and the sale(s) reviewed.

Instructions

One file is being distributed with these instructions – containing a list of sales requiring a field visit and a review of the sale.

Staff are to review each sale to determine its' validity, to verify the data at the time of the sale, and to verify the data as of the date of inspection. Additionally, staff are to collect the co-ordinates of the corner of the house closest to the IWTs, and take a photo(s) from this corner of the house towards the closest IWT (photos labelled as the roll number with "_1", "_2", etc. for multiple photos). If there are multiple IWTs surrounding the property, the closest IWT would be used. Leave "call back" forms if you are unable to talk to the owner. If they do not call back within a reasonable amount of time, do your best to estimate, and note this in the ***Comments*** field of the spreadsheet.

If the sale has already been reviewed (onsite or with a Residential Sales Questionnaire), use the data provided. However, we still require the photo and the co-ordinates.

In the spreadsheet, staff should populate the ***Analysis*** column (Y or N), the ***House Coordinates*** column, the ***Major Value Change*** column (Y or N, if the changes found at time of sale would change the CVA of the property by at least (approximately) ± 5% or ± $10,000), and finally the ***Description of View Towards IWT*** column. There is also a ***Comments*** field to add anything that you feel should be noted. If you are invalidating a sale, use this field to explain why.

As is standard practise while reviewing sales, staff should update the Time of Sale (TOS) snapshot in IPS (manually via the Sales tab until EMS returns the use of the pop-up box), and update the Current Maintenance view with the data on the property at the time of the inspection.

If a property is vacant land, obtain co-ordinates and a photo from as close to the centre of the property (length-wise and width-wise) as possible.

As in the first stage of this project, we will be using the "Garmin GPSMAP 76Cx color map navigator" to collect the co-ordinates. These devices provide co-ordinates as latitude and longitude (also known as decimal degrees). These may look like 42.01425 and -84.00244, or similarly N 42.01425° and W 84.00244°. Other devices, such as the GPS devices in our corporate vehicles, provide co-ordinates in a different format – degrees minutes and seconds. This may look like 42°01'33.024" and -84°13'56.676", or simply 420133.024 and -841356.676. The preference is to use the Garmin devices, but since there are only 6 across the province, the use of the car GPS devices is acceptable – as long as an entire office is done consistently, and we are notified as to which device your office used.

When recording the co-ordinates, take the measurement from as close to the corner of the house as possible. Hold the device as steady as possible for two minutes or until the co-ordinates stabilize, whichever comes first.

If you are unable to obtain close co-ordinates due to fences or other obstructions, take the measurement from as close as you possibly can; preferably such that there is a straight line between you and corner of the house, perpendicular to the road, and estimate what you think the distance is between where you take the measurement and where the corner of the house sits. Make sure that this is all recorded in the Comments. If possible, take a picture as well, and include it when you return the inventory files. Upon returning to the office, use iLOOKABOUT™ or Google Earth™ in an attempt to obtain more accurate co-ordinates. However, since these properties are generally in rural areas, you may not be able to obtain co-ordinates accurately using digital imagery. In either case, make note in the inventory that you have had to approximate the co-ordinates and the reason.

Notes

1. **Typical inspection procedures are to be followed; and IPS should be updated as required.**
2. **Do not use the abuts or proximity to wind turbine variables. If any reduction is warranted due to this study, we will have these fields populated.**

Workload Counts by Region (by Roll Number)

Zone	Region	# of Sales	# of Unique Roll Numbers	Zone Total # of Sales
1	22	174	163	1,070
	23	73	71	
	24	9	9	
	26*	463	448	
	27*	351	334	
2	20	52	51	52
5	25	63	61	63
6	05	32	31	32
7	31	23	21	23

*** Regions 26 and 27 had previously requested a preliminary list of sales. These sales are also included in the current sales files, with a column ("OriginalList") to indicate that they were present in the first list. The numbers above represent the new sales since the first lists and NOT the total including those already given.**

Questions

If you have any questions, please contact one of the following:

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OR

Scott Bradfield
Region 20 – Brantford
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button until you come to a screen showing satellites orbiting the earth. The screen may say "Acquiring Satellite" at the top until it has locked onto enough satellites.

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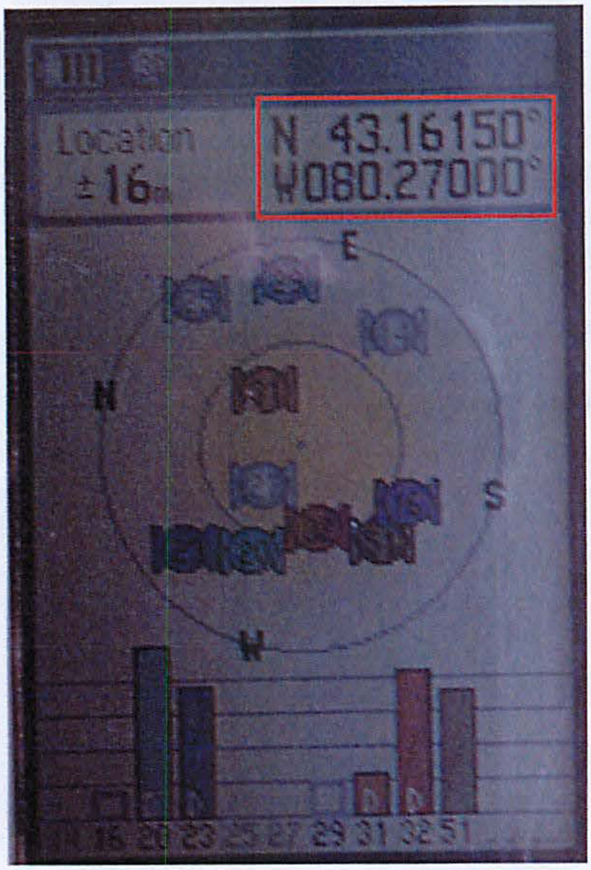

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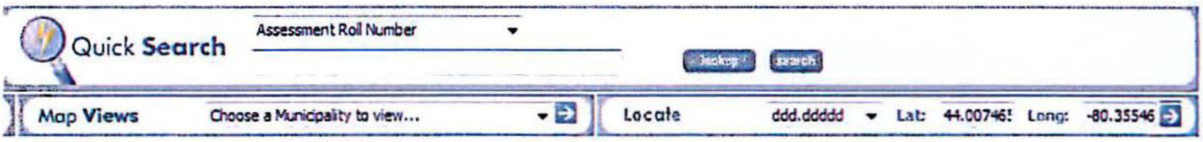
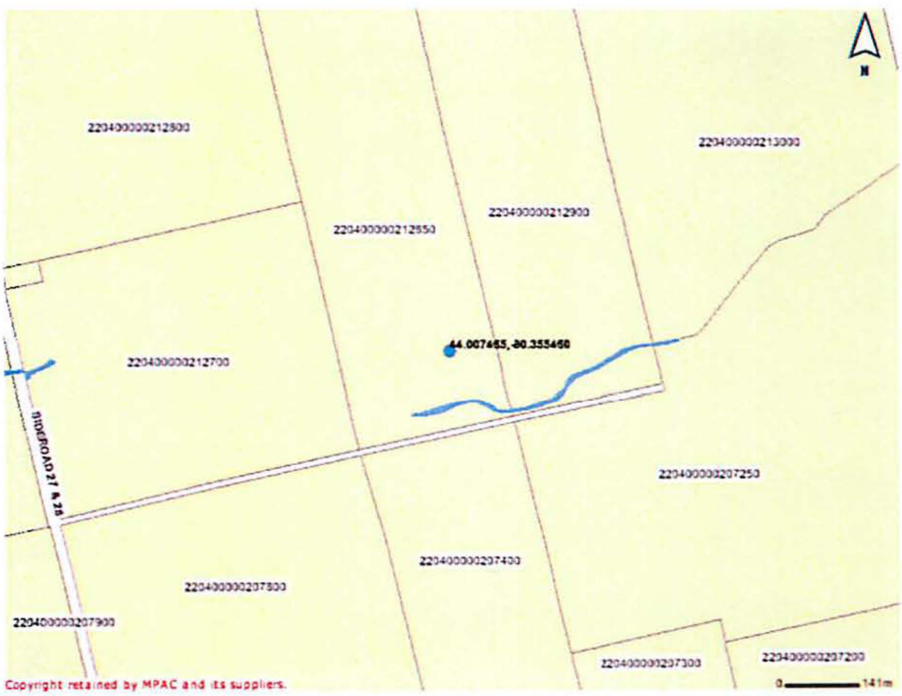


This will show the location of the expected IWT on the property:



Appendix D1 - Abutting a Property with an IWT

Ratio Statistics - Property Abuts a Property with an IWT

Case Processing Summary

	Count
Overall	32
Excluded	0
Total	32

Ratio Statistics for cva2012 / tas_amt

Mean		1.051
95% Confidence Interval for Mean	Lower Bound	.976
	Upper Bound	1.126
Median		1.002
95% Confidence Interval for Median	Lower Bound	.929
	Upper Bound	1.121
	Actual Coverage	98.0%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Sales within 1km of an IWT by Abutting Wind Turbine

Case Processing Summary

		Count	Percent
ABUTTING_WINDTURBINE	0 No	248	88.9%
	1 Yes	31	11.1%
Overall		279	100.0%
Excluded		0	
Total		279	

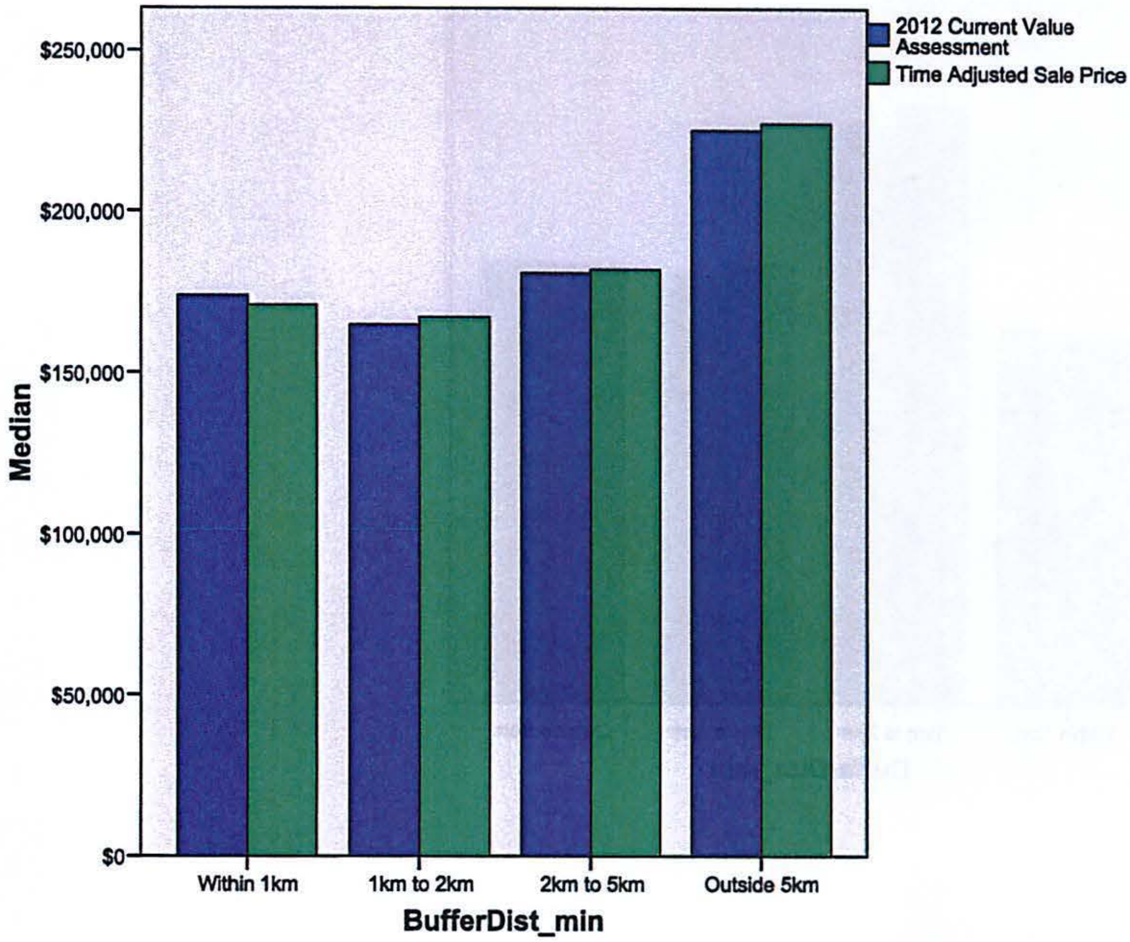
Ratio Statistics for cva2012 / tas_amt

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
0 No	1.051	1.031	1.071	1.040	1.015	1.058	95.1%
1 Yes	1.052	.974	1.130	.989	.929	1.121	97.1%
Overall	1.051	1.032	1.071	1.034	1.011	1.057	95.8%

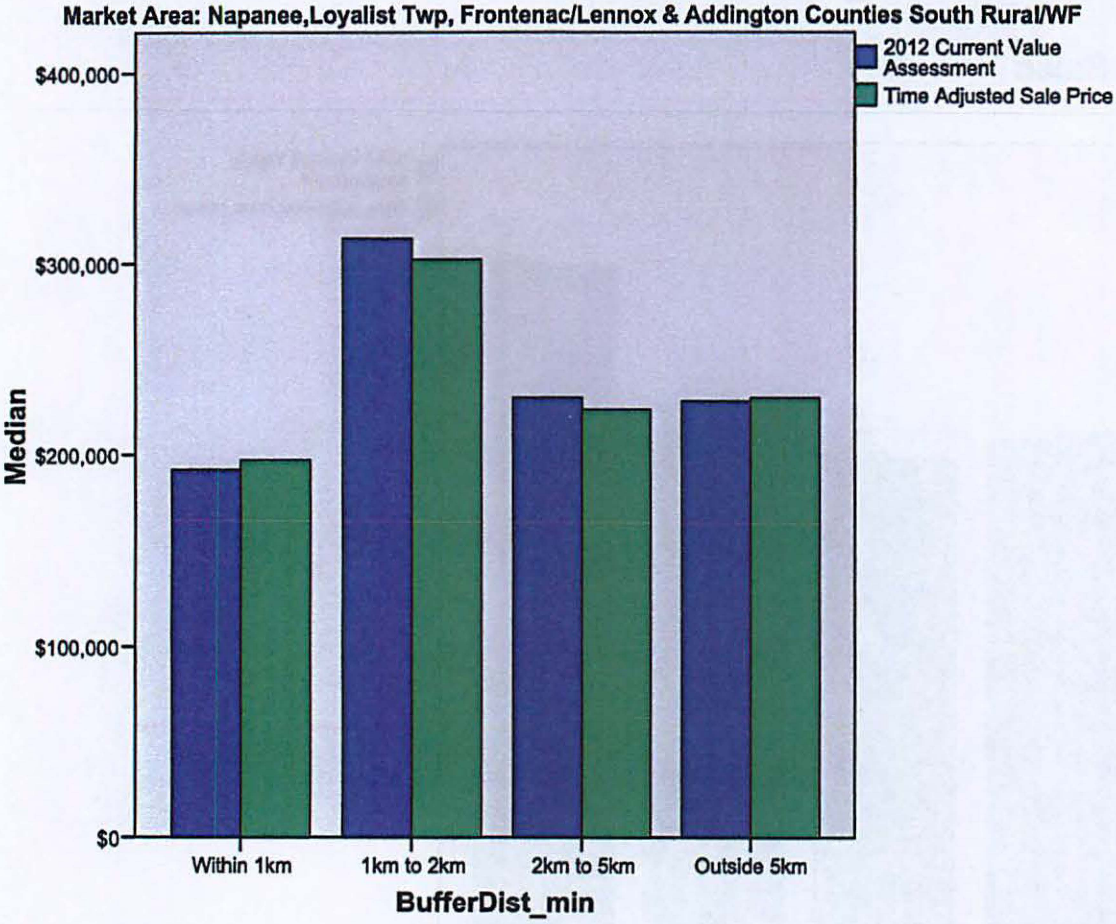
The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

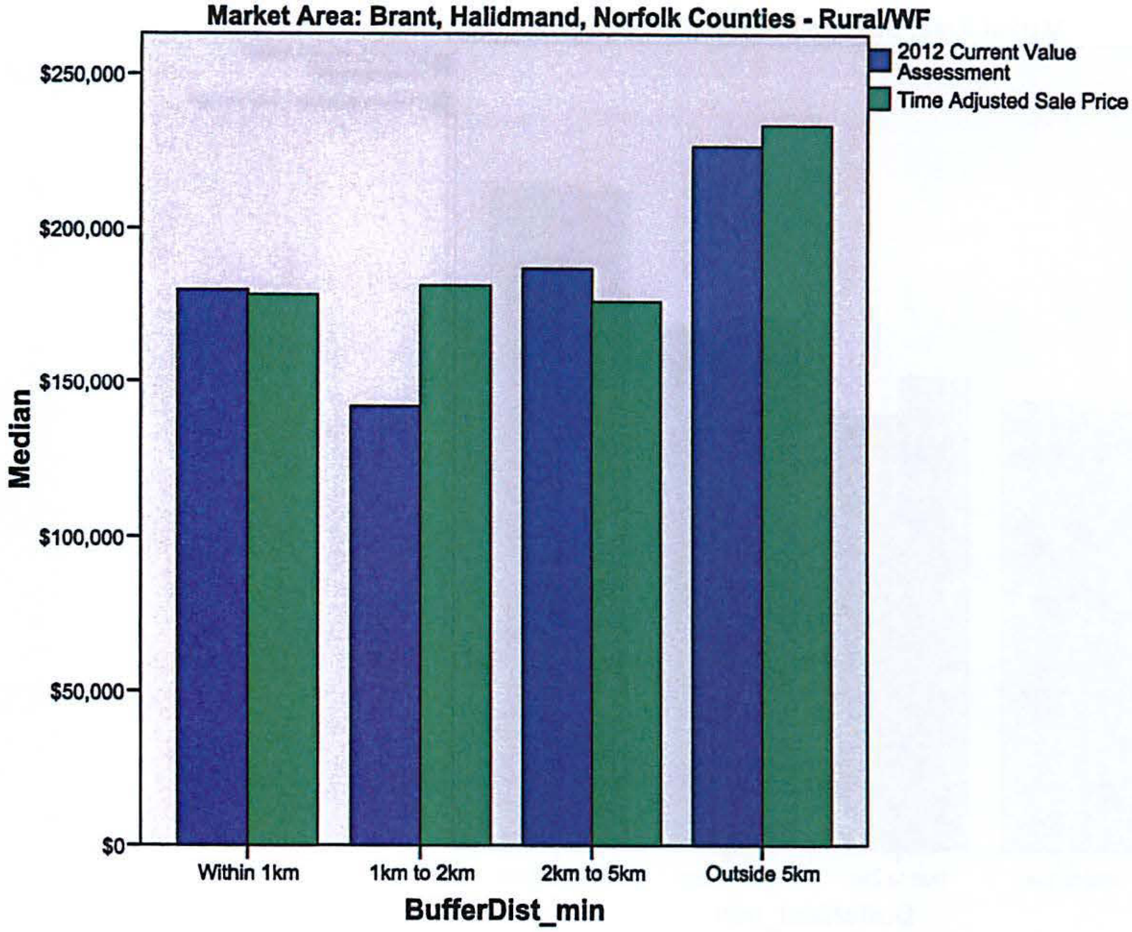
Appendix D2 - CVA and Tas_Amt Bar Charts

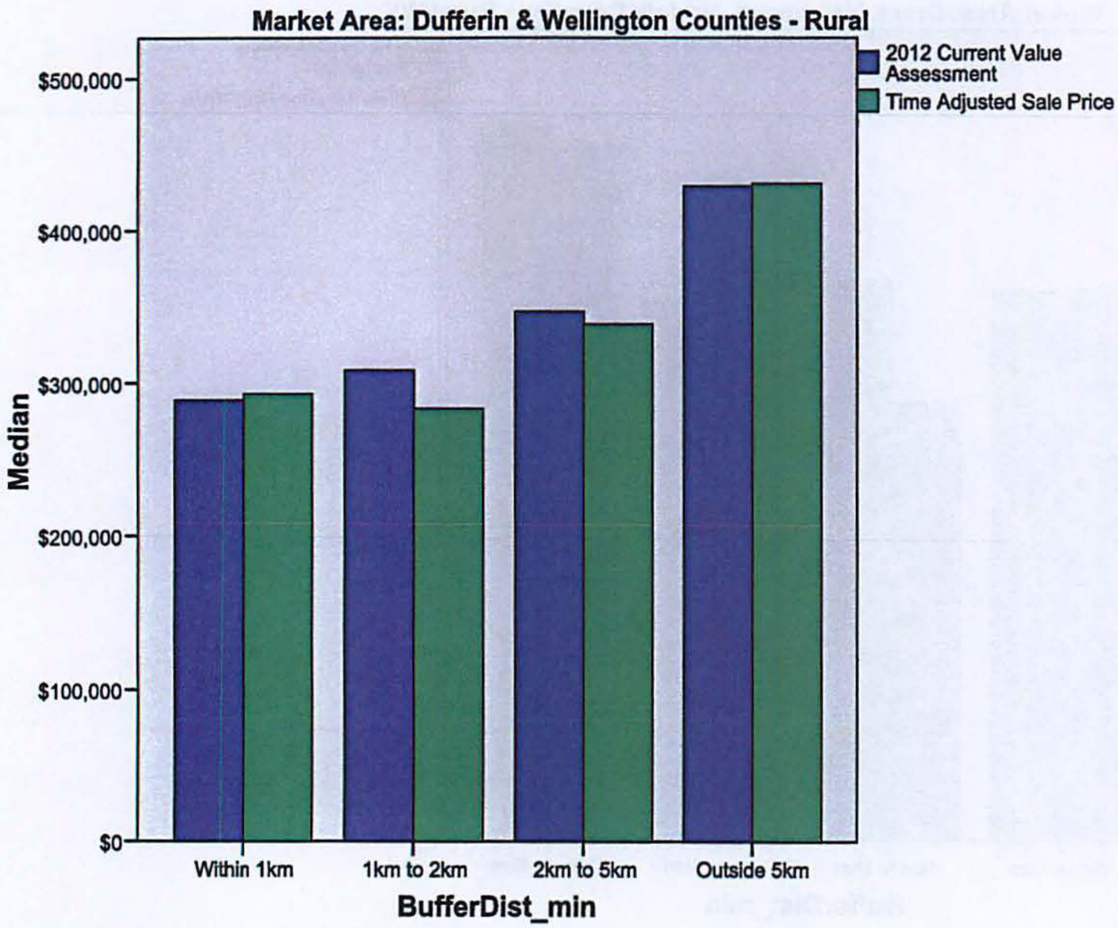
Bar Chart All Sales

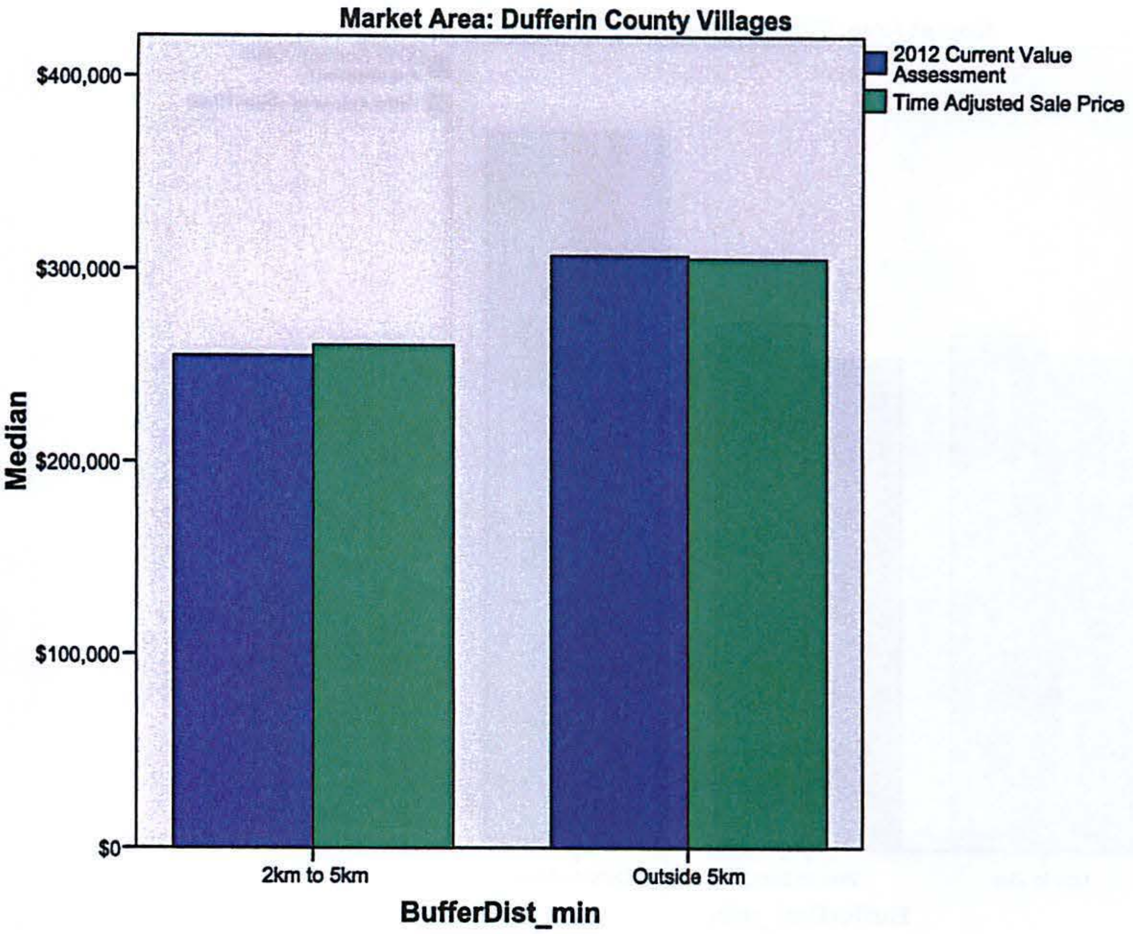


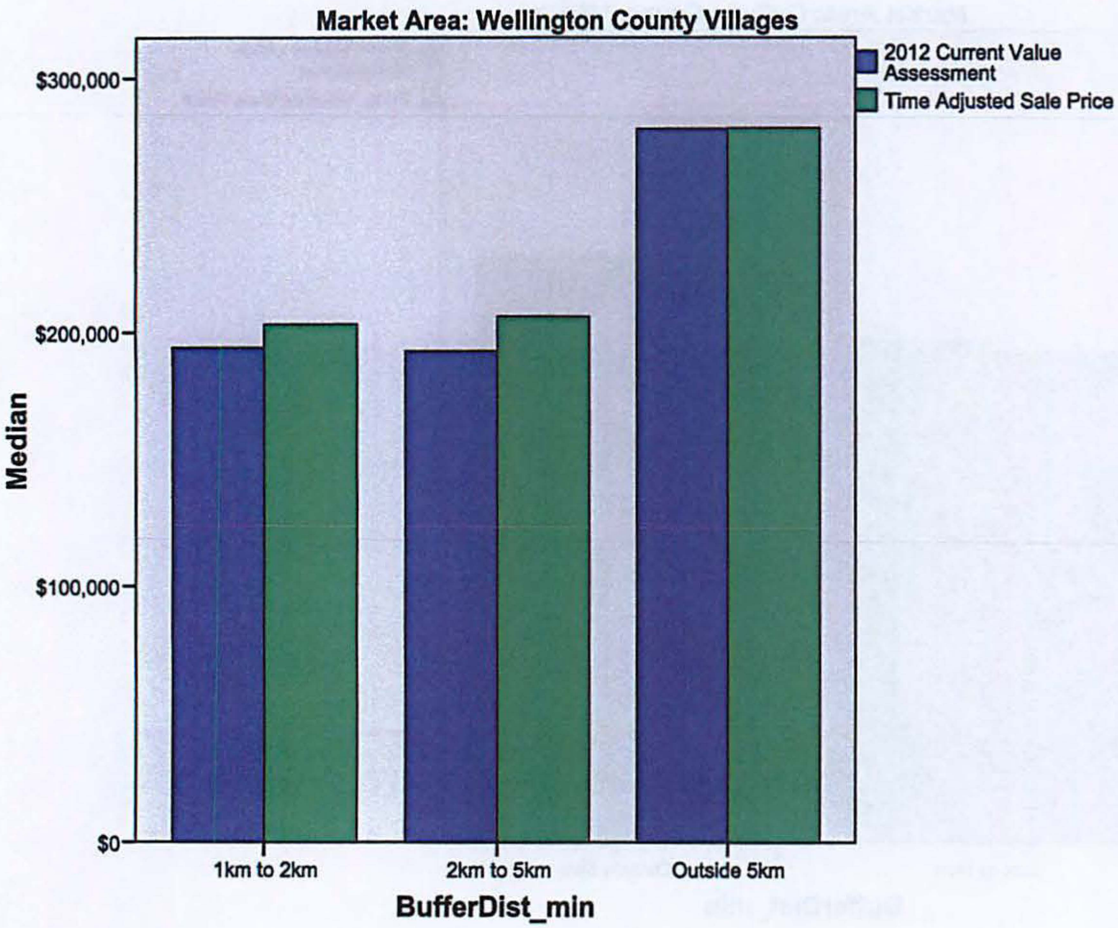
Bar Charts All Sales by Market Area

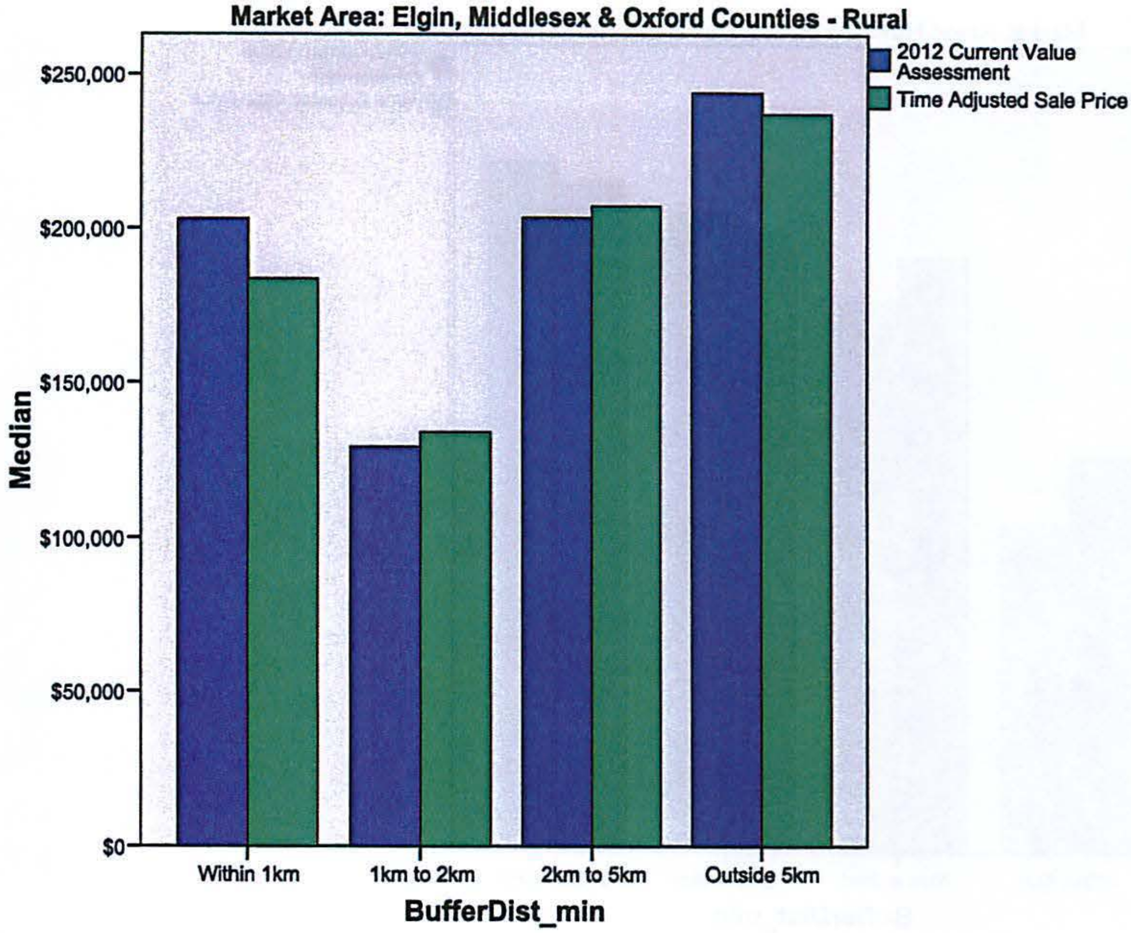

Market Area: Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF
2012 Current Value Assessment
Time Adjusted Sale Price
$400,000
$300,000
$200,000
$100,000
$0
Median
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

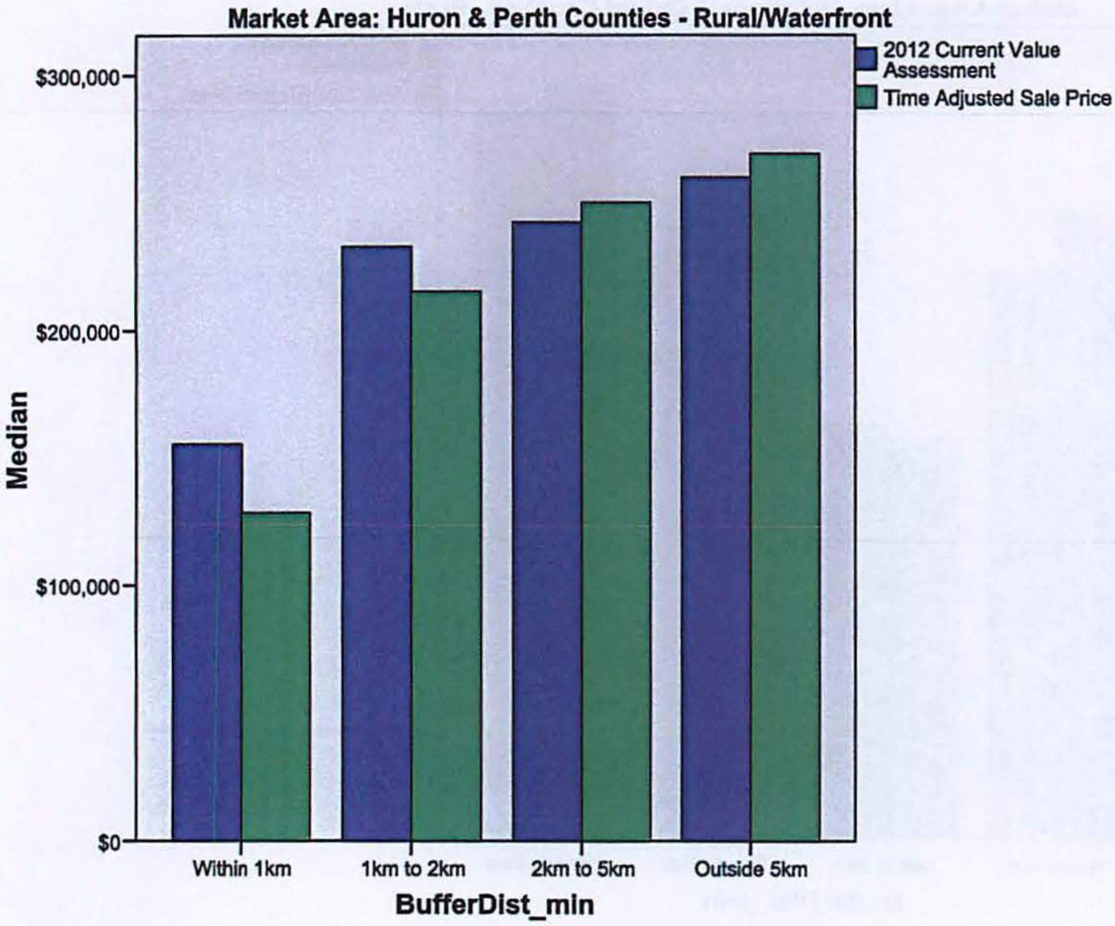

Market Area: Brant, Halidmand, Norfolk Counties - Rural/WF
2012 Current Value Assessment
Time Adjusted Sale Price
$250,000
$200,000
$150,000
$100,000
$50,000
$0
Median
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

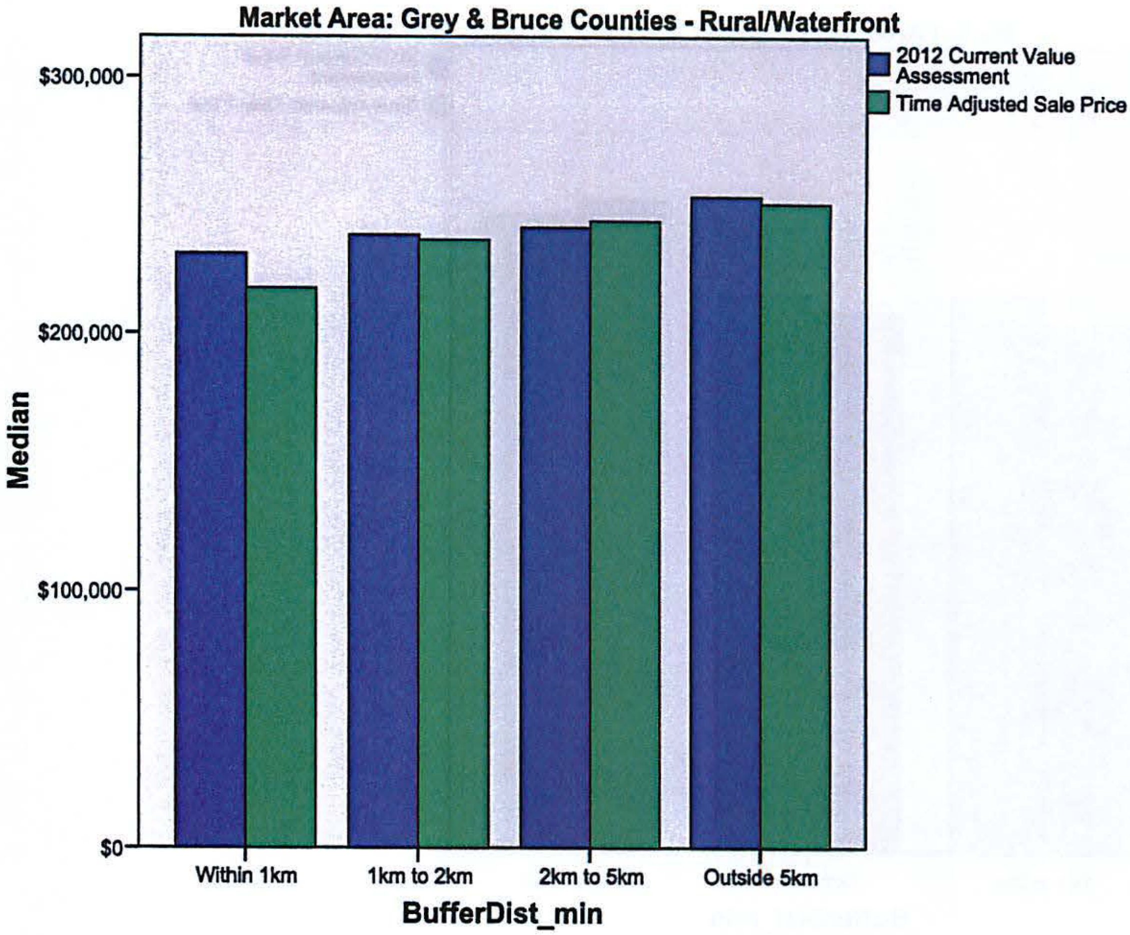

Market Area: Dufferin & Wellington Counties - Rural
2012 Current Value Assessment
Time Adjusted Sale Price
$500,000
$400,000
$300,000
$200,000
$100,000
$0
Median
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

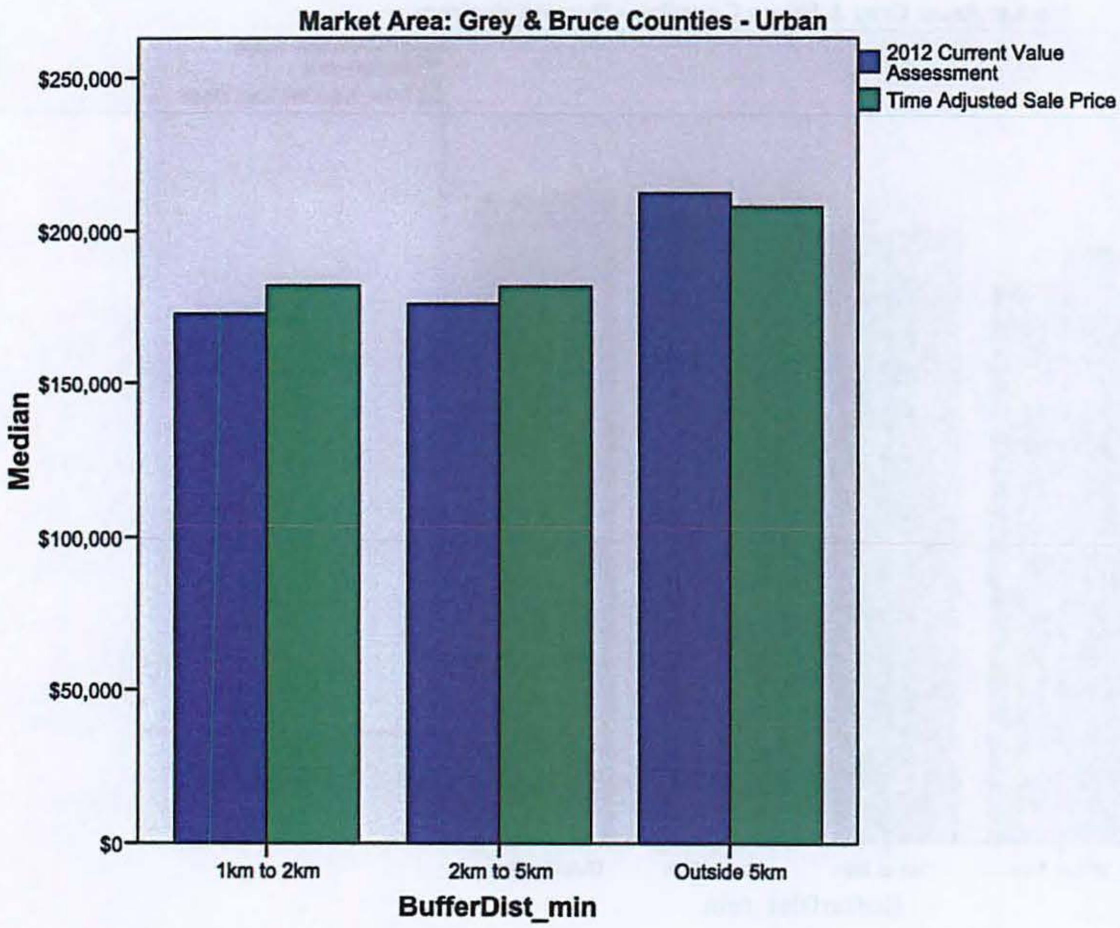

Market Area: Dufferin County Villages
2012 Current Value Assessment
Time Adjusted Sale Price
Median
$400,000
$300,000
$200,000
$100,000
$0
2km to 5km
Outside 5km
BufferDist_min

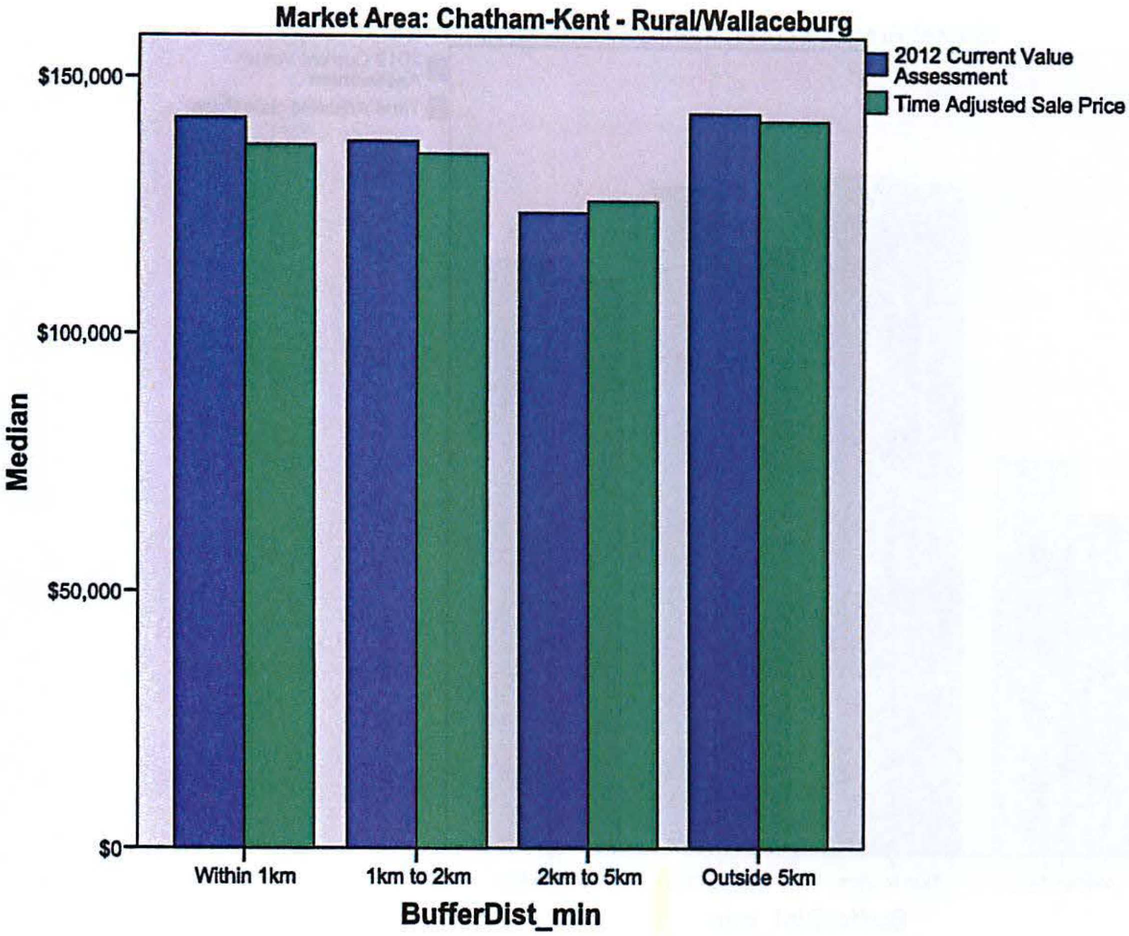

Market Area: Wellington County Villages
2012 Current Value Assessment
Time Adjusted Sale Price
$300,000
$200,000
$100,000
$0
Median
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

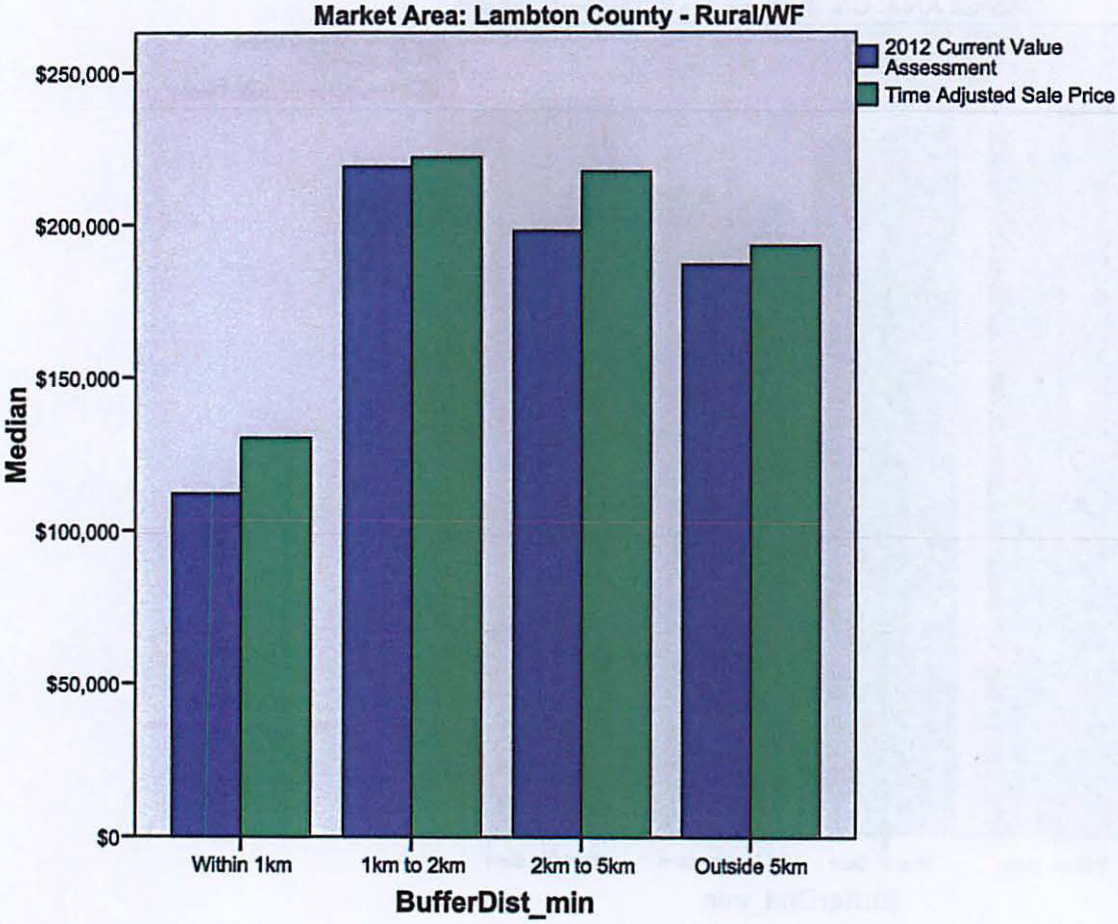

Market Area: Elgin, Middlesex & Oxford Counties - Rural
2012 Current Value Assessment
Time Adjusted Sale Price
Median
$250,000
$200,000
$150,000
$100,000
$50,000
$0
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

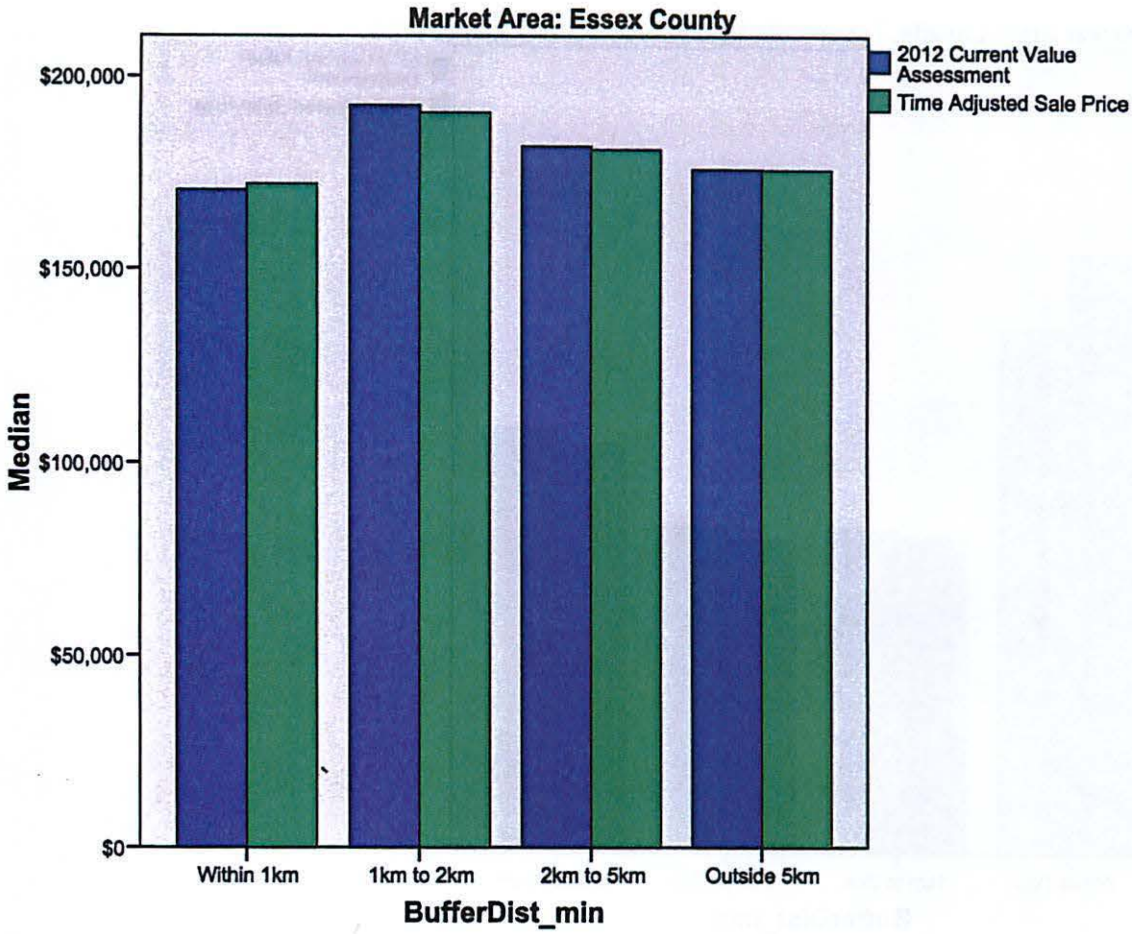

Market Area: Huron & Perth Counties - Rural/Waterfront
2012 Current Value Assessment
Time Adjusted Sale Price
$300,000
$200,000
$100,000
$0
Median
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

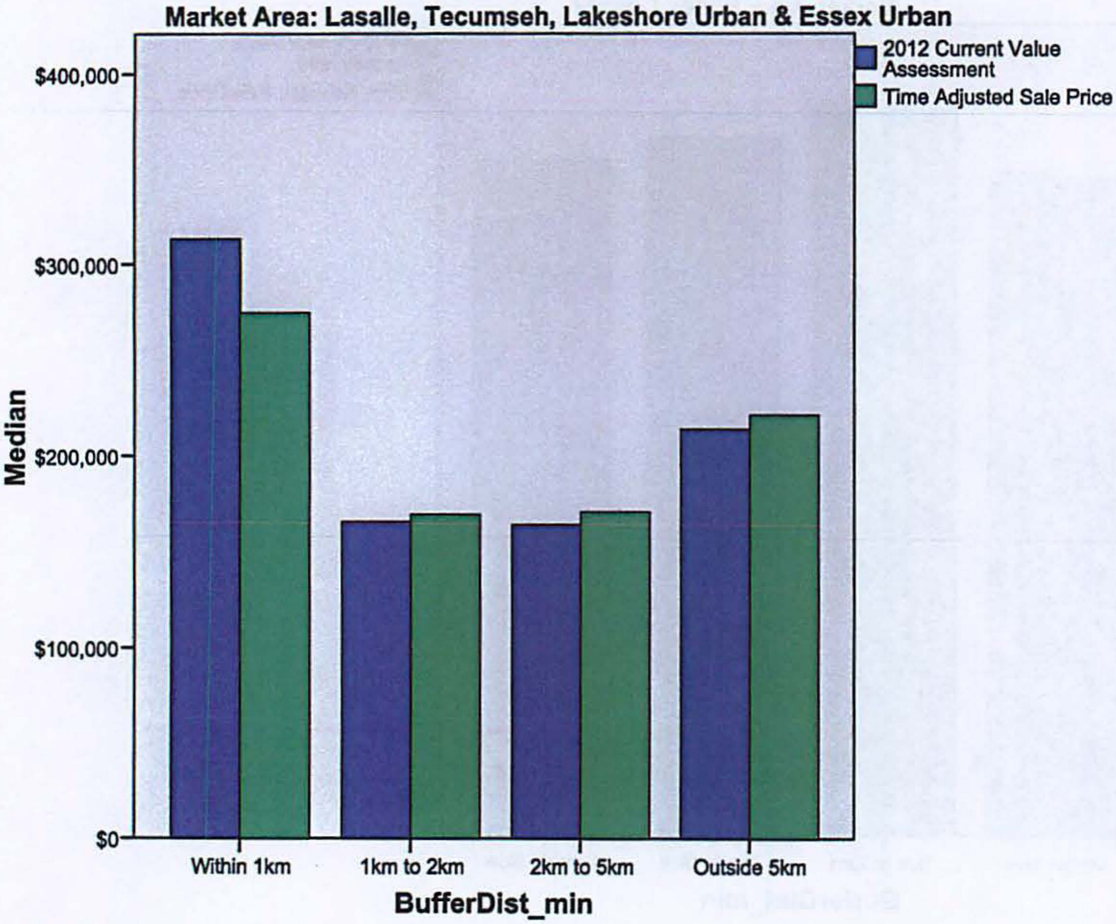

Market Area: Grey & Bruce Counties - Rural/Waterfront
2012 Current Value Assessment
Time Adjusted Sale Price
$300,000
$200,000
$100,000
$0
Median
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

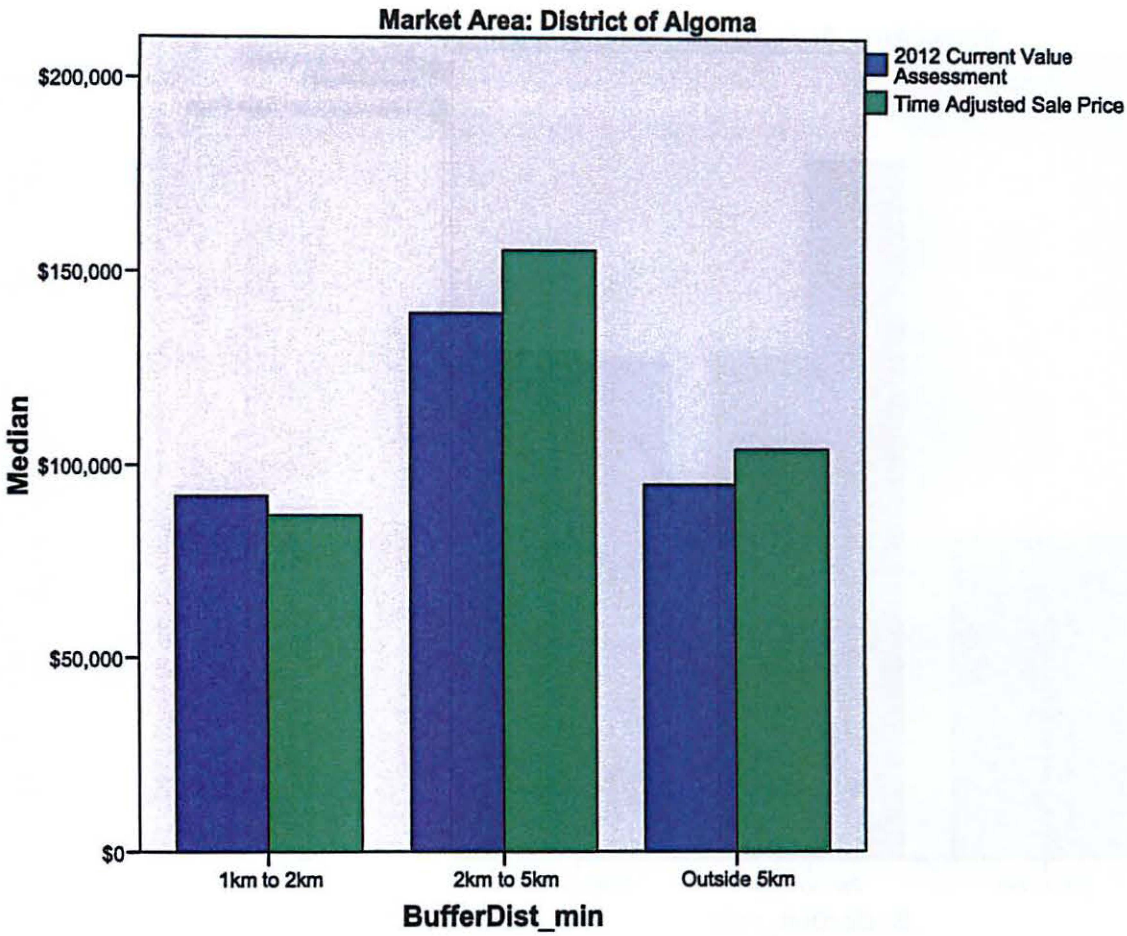

Market Area: Grey & Bruce Counties - Urban
2012 Current Value Assessment
Time Adjusted Sale Price
$250,000
$200,000
$150,000
$100,000
$50,000
$0
Median
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

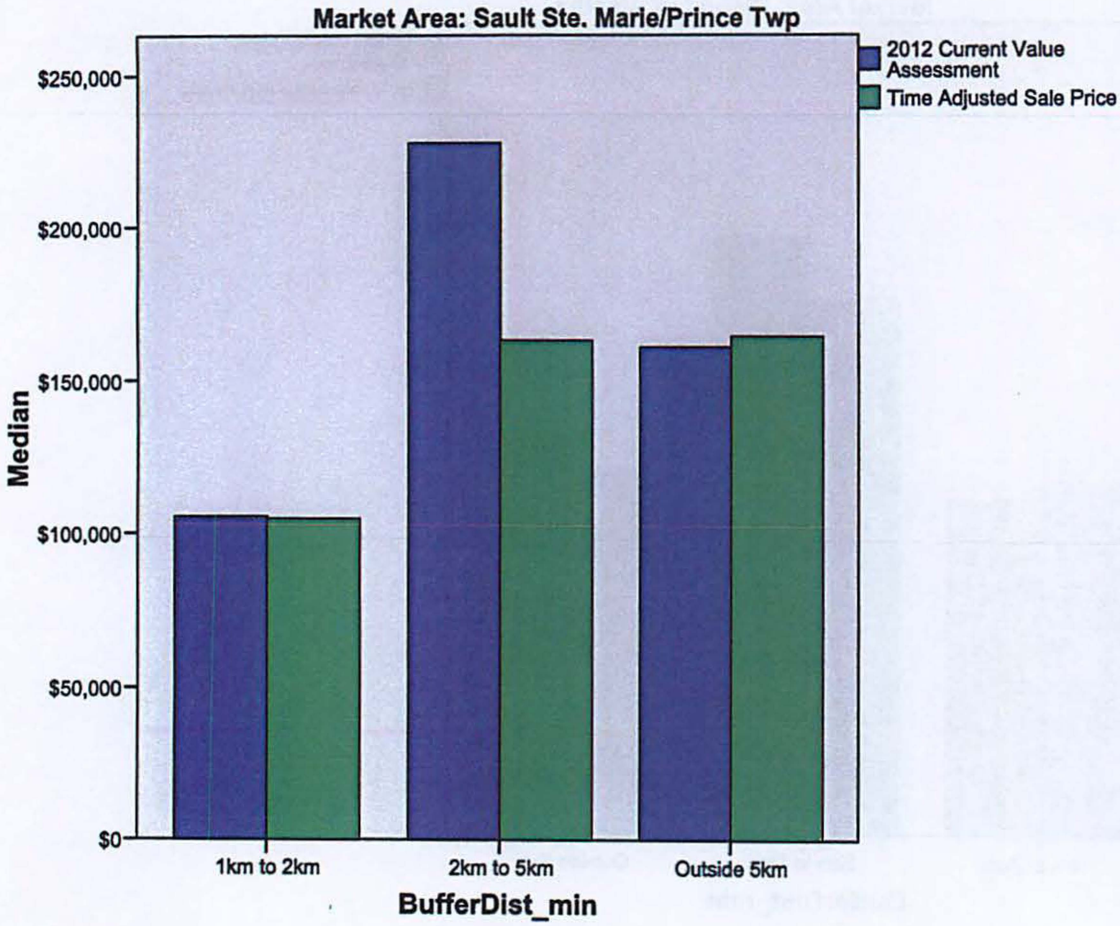

Market Area: Chatham-Kent - Rural/Wallaceburg
$150,000
$100,000
$50,000
$0
Median
2012 Current Value Assessment
Time Adjusted Sale Price
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min


Market Area: Lambton County - Rural/WF
2012 Current Value Assessment
Time Adjusted Sale Price
Median
$250,000
$200,000
$150,000
$100,000
$50,000
$0
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min


Market Area: Essex County
2012 Current Value Assessment
Time Adjusted Sale Price
Median
$200,000
$150,000
$100,000
$50,000
$0
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min


Market Area: Lasalle, Tecumseh, Lakeshore Urban & Essex Urban
2012 Current Value Assessment
Time Adjusted Sale Price
Median
$400,000
$300,000
$200,000
$100,000
$0
Within 1km
1km to 2km
2km to 5km
Outside 5km
BufferDist_min


Market Area: District of Algoma
2012 Current Value Assessment
Time Adjusted Sale Price
Median
$200,000
$150,000
$100,000
$50,000
$0
1km to 2km
2km to 5km
Outside 5km
BufferDist_min


Market Area: Sault Ste. Marie/Prince Twp
2012 Current Value Assessment
Time Adjusted Sale Price
$250,000
$200,000
$150,000
$100,000
$50,000
$0
Median
1km to 2km
2km to 5km
Outside 5km
BufferDist_min

Appendix D3 - Distance by Market Area and Type

Ratio Statistics by Distance All Sales

Case Processing Summary

		Count	Percent
BufferDist_min	1.00 Within 1km	279	.7%
	2.00 1km to 2km	989	2.4%
	5.00 2km to 5km	3063	7.4%
	6.00 Outside 5km	37093	89.5%
Overall		41424	100.0%
Excluded		0	
Total		41424	

Ratio Statistics for cva2012 / tas_amt

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.051	1.032	1.071	1.034
2.00 1km to 2km	1.005	.995	1.015	.989
5.00 2km to 5km	1.003	.998	1.008	.992
6.00 Outside 5km	.999	.997	1.000	.992
Overall	1.000	.998	1.001	.992

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	1.011	1.057	95.8%
2.00 1km to 2km	.979	1.000	95.1%
5.00 2km to 5km	.988	.997	95.3%
6.00 Outside 5km	.991	.993	95.0%
Overall	.991	.994	95.0%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics by Distance by Market Model Area

MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	13	.5%
	2.00 1km to 2km	7	.3%
	5.00 2km to 5km	8	.3%
	6.00 Outside 5km	2606	98.9%
Overall		2634	100.0%
Excluded		0	
Total		2634	

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.015	.893	1.136	.981
2.00 1km to 2km	1.061	.764	1.358	1.105
5.00 2km to 5km	.961	.831	1.090	.949
6.00 Outside 5km	.999	.994	1.004	.986
Overall	.999	.994	1.004	.986

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.813	1.248	97.8%
2.00 1km to 2km	.655	1.578	98.4%
5.00 2km to 5km	.727	1.190	99.2%
6.00 Outside 5km	.981	.993	95.2%
Overall	.981	.993	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	25	.5%
	2.00 1km to 2km	9	.2%
	5.00 2km to 5km	71	1.4%
	6.00 Outside 5km	4868	97.9%
Overall		4973	100.0%
Excluded		0	
Total		4973	

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.038	.977	1.100	1.020
2.00 1km to 2km	.961	.808	1.113	.933
5.00 2km to 5km	1.046	.998	1.093	1.033
6.00 Outside 5km	.986	.983	.990	.980
Overall	.987	.984	.991	.981

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.941	1.118	95.7%
2.00 1km to 2km	.801	1.112	96.1%
5.00 2km to 5km	.997	1.073	96.8%
6.00 Outside 5km	.976	.984	95.0%
Overall	.976	.984	95.3%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

MODEL = 22RR010 Dufferin & Wellington Counties - Rural

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	26	1.5%
	2.00 1km to 2km	25	1.4%
	5.00 2km to 5km	83	4.8%
	6.00 Outside 5km	1597	92.3%
Overall		1731	100.0%
Excluded		0	
Total		1731	

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.042	.975	1.110	1.010
2.00 1km to 2km	1.024	.949	1.099	1.071
5.00 2km to 5km	1.029	1.000	1.059	1.024
6.00 Outside 5km	1.008	1.001	1.014	1.003
Overall	1.009	1.003	1.016	1.004

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.943	1.090	97.1%
2.00 1km to 2km	.921	1.137	95.7%
5.00 2km to 5km	.994	1.049	95.2%
6.00 Outside 5km	.993	1.011	95.5%
Overall	.996	1.012	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

MODEL = 22UR020 Dufferin County Villages

Case Processing Summary[a]

		Count	Percent
BufferDist_min	5.00 2km to 5km	404	16.7%
	6.00 Outside 5km	2017	83.3%
Overall		2421	100.0%
Excluded		0	
Total		2421	

a. MODEL = 22UR020 Dufferin County Villages

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
5.00 2km to 5km	.982	.973	.992	.976
6.00 Outside 5km	.993	.990	.996	.991
Overall	.991	.988	.994	.988

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
5.00 2km to 5km	.969	.986	95.9%
6.00 Outside 5km	.987	.995	95.5%
Overall	.985	.992	95.4%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 22UR020 Dufferin County Villages

MODEL = 22UR030 Wellington County Villages

Case Processing Summary[a]

		Count	Percent
BufferDist_min	2.00 1km to 2km	92	3.8%
	5.00 2km to 5km	32	1.3%
	6.00 Outside 5km	2300	94.9%
Overall		2424	100.0%
Excluded		0	
Total		2424	

a. MODEL = 22UR030 Wellington County Villages

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
2.00 1km to 2km	.952	.922	.983	.948
5.00 2km to 5km	.981	.924	1.038	.951
6.00 Outside 5km	.989	.985	.993	.988
Overall	.987	.983	.991	.986

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
2.00 1km to 2km	.905	.967	95.3%
5.00 2km to 5km	.902	1.031	98.0%
6.00 Outside 5km	.984	.993	95.2%
Overall	.981	.991	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 22UR030 Wellington County Villages

MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	4	.1%
	2.00 1km to 2km	52	1.2%
	5.00 2km to 5km	72	1.6%
	6.00 Outside 5km	4300	97.1%
Overall		4428	100.0%
Excluded		0	
Total		4428	

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.073	.987	1.160	1.063
2.00 1km to 2km	.994	.936	1.052	.935
5.00 2km to 5km	1.017	.979	1.056	1.009
6.00 Outside 5km	1.040	1.036	1.043	1.030
Overall	1.039	1.035	1.043	1.029

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	1.025	1.142	100.0%
2.00 1km to 2km	.899	1.023	96.4%
5.00 2km to 5km	.974	1.042	95.6%
6.00 Outside 5km	1.026	1.034	95.1%
Overall	1.025	1.033	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	2	.2%
	2.00 1km to 2km	3	.3%
	5.00 2km to 5km	98	11.0%
	6.00 Outside 5km	786	88.4%
Overall		889	100.0%
Excluded		0	
Total		889	

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.219	.478	1.960	1.219
2.00 1km to 2km	1.153	.879	1.427	1.170
5.00 2km to 5km	1.027	.994	1.059	1.021
6.00 Outside 5km	1.012	1.001	1.024	1.001
Overall	1.015	1.004	1.026	1.006

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	1.161	1.277	100.0%
2.00 1km to 2km	1.036	1.254	100.0%
5.00 2km to 5km	.998	1.073	96.7%
6.00 Outside 5km	.990	1.012	95.0%
Overall	.994	1.018	95.6%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	12	.4%
	2.00 1km to 2km	19	.6%
	5.00 2km to 5km	265	8.9%
	6.00 Outside 5km	2692	90.1%
Overall		2988	100.0%
Excluded		0	
Total		2988	

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.131	.944	1.318	1.045
2.00 1km to 2km	1.038	.969	1.107	1.029
5.00 2km to 5km	1.016	.995	1.037	1.005
6.00 Outside 5km	1.027	1.021	1.034	1.015
Overall	1.027	1.020	1.033	1.013

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.917	1.271	96.1%
2.00 1km to 2km	.941	1.092	98.1%
5.00 2km to 5km	.986	1.022	95.1%
6.00 Outside 5km	1.006	1.022	95.3%
Overall	1.006	1.021	95.4%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

MODEL = 25UR010 Grey & Bruce Counties - Urban

Case Processing Summary[a]

		Count	Percent
BufferDist_min	2.00 1km to 2km	16	.4%
	5.00 2km to 5km	161	3.7%
	6.00 Outside 5km	4180	95.9%
Overall		4357	100.0%
Excluded		0	
Total		4357	

a. MODEL = 25UR010 Grey & Bruce Counties - Urban

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
2.00 1km to 2km	1.007	.940	1.075	1.026
5.00 2km to 5km	1.005	.982	1.028	.978
6.00 Outside 5km	1.019	1.015	1.023	1.011
Overall	1.018	1.014	1.022	1.010

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
2.00 1km to 2km	.899	1.134	97.9%
5.00 2km to 5km	.962	.998	96.0%
6.00 Outside 5km	1.006	1.016	95.1%
Overall	1.005	1.015	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 25UR010 Grey & Bruce Counties - Urban

MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	83	4.4%
	2.00 1km to 2km	300	15.9%
	5.00 2km to 5km	836	44.4%
	6.00 Outside 5km	663	35.2%
Overall		1882	100.0%
Excluded		0	
Total		1882	

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.085	1.048	1.122	1.055
2.00 1km to 2km	1.027	1.007	1.047	1.006
5.00 2km to 5km	1.009	.998	1.020	.993
6.00 Outside 5km	1.012	1.001	1.022	1.006
Overall	1.016	1.009	1.023	1.002

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	1.036	1.087	95.2%
2.00 1km to 2km	.983	1.027	95.7%
5.00 2km to 5km	.982	1.000	95.1%
6.00 Outside 5km	.997	1.017	95.7%
Overall	.997	1.009	95.5%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

MODEL = 26RR030 Lambton County - Rural/WF

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	1	.0%
	2.00 1km to 2km	23	1.1%
	5.00 2km to 5km	76	3.7%
	6.00 Outside 5km	1942	95.1%
Overall		2042	100.0%
Excluded		0	
Total		2042	

a. MODEL = 26RR030 Lambton County - Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	.862	.	.	.862
2.00 1km to 2km	.993	.957	1.030	.993
5.00 2km to 5km	.952	.921	.983	.963
6.00 Outside 5km	.986	.981	.991	.980
Overall	.985	.980	.990	.980

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.	.	.
2.00 1km to 2km	.943	1.030	96.5%
5.00 2km to 5km	.931	.989	97.1%
6.00 Outside 5km	.972	.986	95.2%
Overall	.972	.985	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 26RR030 Lambton County - Rural/WF

MODEL = 27RR120 Essex County

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	112	3.3%
	2.00 1km to 2km	272	8.1%
	5.00 2km to 5km	768	22.9%
	6.00 Outside 5km	2198	65.6%
Overall		3350	100.0%
Excluded		0	
Total		3350	

a. MODEL = 27RR120 Essex County

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.024	.997	1.052	1.005
2.00 1km to 2km	.993	.978	1.008	.984
5.00 2km to 5km	1.003	.994	1.012	1.001
6.00 Outside 5km	.990	.986	.995	.987
Overall	.995	.991	.998	.991

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.981	1.051	95.3%
2.00 1km to 2km	.969	1.000	95.5%
5.00 2km to 5km	.991	1.010	95.3%
6.00 Outside 5km	.983	.992	95.3%
Overall	.986	.995	95.3%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 27RR120 Essex County

MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	1	.0%
	2.00 1km to 2km	154	5.1%
	5.00 2km to 5km	179	6.0%
	6.00 Outside 5km	2660	88.8%
Overall		2994	100.0%
Excluded		0	
Total		2994	

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.138	.	.	1.138
2.00 1km to 2km	1.012	.992	1.033	.992
5.00 2km to 5km	.988	.971	1.005	.972
6.00 Outside 5km	.979	.976	.983	.977
Overall	.982	.978	.985	.977

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.	.	.
2.00 1km to 2km	.971	1.020	95.6%
5.00 2km to 5km	.957	.997	96.4%
6.00 Outside 5km	.972	.980	95.4%
Overall	.973	.981	95.4%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

MODEL = 31RR010 District of Algoma

Case Processing Summary[a]

		Count	Percent
BufferDist_min	2.00 1km to 2km	5	.3%
	5.00 2km to 5km	7	.5%
	6.00 Outside 5km	1483	99.2%
Overall		1495	100.0%
Excluded		0	
Total		1495	

a. MODEL = 31RR010 District of Algoma

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
2.00 1km to 2km	1.036	.763	1.310	1.058
5.00 2km to 5km	.862	.686	1.037	.888
6.00 Outside 5km	.932	.921	.943	.909
Overall	.932	.921	.943	.908

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
2.00 1km to 2km	.800	1.351	100.0%
5.00 2km to 5km	.684	1.189	98.4%
6.00 Outside 5km	.897	.926	95.2%
Overall	.897	.925	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 31RR010 District of Algoma

MODEL = 31UR010 Sault Ste. Marie/Prince Twp

Case Processing Summary[a]

		Count	Percent
BufferDist_min	2.00 1km to 2km	12	.4%
	5.00 2km to 5km	3	.1%
	6.00 Outside 5km	2801	99.5%
Overall		2816	100.0%
Excluded		0	
Total		2816	

a. MODEL = 31UR010 Sault Ste. Marie/Prince Twp

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
2.00 1km to 2km	.960	.818	1.102	.948
5.00 2km to 5km	1.226	.630	1.823	1.217
6.00 Outside 5km	.972	.966	.977	.963
Overall	.972	.966	.977	.963

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
2.00 1km to 2km	.739	1.062	96.1%
5.00 2km to 5km	.991	1.471	100.0%
6.00 Outside 5km	.957	.968	95.1%
Overall	.957	.968	95.2%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 31UR010 Sault Ste. Marie/Prince Twp

Ratio Statistics by Distance by Market Type

Rural Market Areas

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	278	1.1%
	2.00 1km to 2km	715	2.7%
	5.00 2km to 5km	2284	8.6%
	6.00 Outside 5km	23135	87.6%
Overall		26412	100.0%
Excluded		0	
Total		26412	

a. MRKTTYPE = RR

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.051	1.031	1.071	1.034
2.00 1km to 2km	1.011	.999	1.023	.996
5.00 2km to 5km	1.008	1.002	1.014	.999
6.00 Outside 5km	1.002	1.001	1.004	.995
Overall	1.004	1.002	1.005	.996

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	1.011	1.055	95.2%
2.00 1km to 2km	.982	1.008	95.7%
5.00 2km to 5km	.993	1.005	95.3%
6.00 Outside 5km	.993	.997	95.1%
Overall	.994	.997	95.0%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MRKTTYPE = RR

Urban Market Areas

Case Processing Summary[a]

		Count	Percent
BufferDist_min	1.00 Within 1km	1	.0%
	2.00 1km to 2km	274	1.8%
	5.00 2km to 5km	779	5.2%
	6.00 Outside 5km	13958	93.0%
Overall		15012	100.0%
Excluded		0	
Total		15012	

a. MRKTTYPE = UR

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median
		Lower Bound	Upper Bound	
1.00 Within 1km	1.138	.	.	1.138
2.00 1km to 2km	.990	.973	1.007	.975
5.00 2km to 5km	.989	.981	.997	.976
6.00 Outside 5km	.993	.991	.995	.988
Overall	.993	.991	.995	.987

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics for cva2012 / tas_amt[a]

Group	95% Confidence Interval for Median		
	Lower Bound	Upper Bound	Actual Coverage
1.00 Within 1km	.	.	.
2.00 1km to 2km	.955	.992	95.4%
5.00 2km to 5km	.969	.984	95.5%
6.00 Outside 5km	.986	.990	95.1%
Overall	.985	.989	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MRKTTYPE = UR

Appendix D4 - View All Sales and by Market Area

Ratio Statistics All Sales Less than 1km to an IWT by View

Case Processing Summary

		Count	Percent
view	full	190	68.1%
	none	56	20.1%
	partial	33	11.8%
Overall		279	100.0%
Excluded		0	
Total		279	

Ratio Statistics for cva2012 / tas_amt

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.054	1.029	1.078	1.032	1.001	1.060	95.0%
none	1.070	1.031	1.110	1.064	.998	1.092	95.6%
partial	1.007	.953	1.060	1.005	.952	1.057	96.5%
Overall	1.051	1.032	1.071	1.034	1.011	1.057	95.8%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics All Sales 1km to 2km to an IWT by View

Case Processing Summary

		Count	Percent
view	full	239	24.2%
	none	647	65.4%
	partial	103	10.4%
Overall		989	100.0%
Excluded		0	
Total		989	

Ratio Statistics for cva2012 / tas_amt

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.021	1.000	1.042	1.001	.981	1.026	96.2%
none	1.000	.988	1.012	.984	.972	.997	95.1%
partial	.999	.968	1.029	.980	.939	1.018	95.2%
Overall	1.005	.995	1.015	.989	.979	1.000	95.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

Ratio Statistics Sales less than 1km to an IWT by View by Market Area

MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

Case Processing Summary[a]

		Count	Percent
view	full	8	61.5%
	none	2	15.4%
	partial	3	23.1%
Overall		13	100.0%
Excluded		0	
Total		13	

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.066	.900	1.232	1.083	.804	1.295	99.2%
none	1.068	-1.220	3.355	1.068	.888	1.248	100.0%
partial	.842	.538	1.146	.823	.731	.973	100.0%
Overall	1.015	.893	1.136	.981	.813	1.248	97.8%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

Case Processing Summary[a]

		Count	Percent
view	full	12	48.0%
	none	12	48.0%
	partial	1	4.0%
Overall		25	100.0%
Excluded		0	
Total		25	

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.059	.951	1.166	1.025	.920	1.172	96.1%
none	1.004	.926	1.082	.998	.875	1.118	96.1%
partial	1.212	.	.	1.212	.	.	.
Overall	1.038	.977	1.100	1.020	.941	1.118	95.7%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

MODEL = 22RR010 Dufferin & Wellington Counties - Rural

Case Processing Summary[a]

		Count	Percent
view	full	20	76.9%
	none	3	11.5%
	partial	3	11.5%
Overall		26	100.0%
Excluded		0	
Total		26	

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.051	.965	1.136	1.036	.927	1.121	95.9%
none	1.030	.624	1.436	.943	.929	1.219	100.0%
partial	.998	.979	1.017	1.000	.990	1.005	100.0%
Overall	1.042	.975	1.110	1.010	.943	1.090	97.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

Case Processing Summary[a]

		Count	Percent
view	full	2	50.0%
	partial	2	50.0%
Overall		4	100.0%
Excluded		0	
Total		4	

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.059	.635	1.482	1.059	1.025	1.092	100.0%
partial	1.088	.406	1.770	1.088	1.034	1.142	100.0%
Overall	1.073	.987	1.160	1.063	1.025	1.142	100.0%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

Case Processing Summary[a]

		Count	Percent
view	full	2	100.0%
Overall		2	100.0%
Excluded		0	
Total		2	

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	1.219	.478	1.960	1.219	1.161	1.277	100.0%
Overall	1.219	.478	1.960	1.219	1.161	1.277	100.0%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

Case Processing Summary[a]

		Count	Percent
view	full	10	83.3%
	none	1	8.3%
	partial	1	8.3%
Overall		12	100.0%
Excluded		0	
Total		12	

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	1.126	.914	1.338	1.045	.917	1.271	97.9%
none	1.444	.	.	1.444	.	.	.
partial	.875	.	.	.875	.	.	.
Overall	1.131	.944	1.318	1.045	.917	1.271	96.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

Case Processing Summary[a]

		Count	Percent
view	full	61	73.5%
	none	16	19.3%
	partial	6	7.2%
Overall		83	100.0%
Excluded		0	
Total		83	

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	1.088	1.043	1.133	1.048	1.024	1.097	96.0%
none	1.094	1.008	1.180	1.075	.998	1.260	97.9%
partial	1.032	.948	1.115	1.049	.926	1.129	96.9%
Overall	1.085	1.048	1.122	1.055	1.036	1.087	95.2%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

MODEL = 26RR030 Lambton County - Rural/WF

Case Processing Summary[a]

		Count	Percent
view	partial	1	100.0%
Overall		1	100.0%
Excluded		0	
Total		1	

a. MODEL = 26RR030 Lambton County - Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
partial	.862	.	.	.862	.	.	.
Overall	.862	.	.	.862	.	.	.

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 26RR030 Lambton County - Rural/WF

MODEL = 27RR120 Essex County

Case Processing Summary[a]

		Count	Percent
view	full	74	66.1%
	none	22	19.6%
	partial	16	14.3%
Overall		112	100.0%
Excluded		0	
Total		112	

a. MODEL = 27RR120 Essex County

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	1.009	.976	1.041	.993	.964	1.048	95.3%
none	1.078	1.024	1.132	1.058	.985	1.162	98.3%
partial	1.024	.928	1.120	1.035	.885	1.214	97.9%
Overall	1.024	.997	1.052	1.005	.981	1.051	95.3%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 27RR120 Essex County

MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

Case Processing Summary[a]

		Count	Percent
view	full	1	100.0%
Overall		1	100.0%
Excluded		0	
Total		1	

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	1.138	.	.	1.138	.	.	.
Overall	1.138	.	.	1.138	.	.	.

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

Ratio Statistics Sales 1km to 2km to an IWT by View by Market Area

MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

Case Processing Summary[a]

		Count	Percent
view	none	5	71.4%
	partial	2	28.6%
Overall		7	100.0%
Excluded		0	
Total		7	

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
none	.944	.616	1.272	1.103	.655	1.197	100.0%
partial	1.354	-1.482	4.191	1.354	1.131	1.578	100.0%
Overall	1.061	.764	1.358	1.105	.655	1.578	98.4%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

Case Processing Summary[a]

		Count	Percent
view	full	2	22.2%
	none	7	77.8%
Overall		9	100.0%
Excluded		0	
Total		9	

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.109	-2.798	5.016	1.109	.801	1.417	100.0%
none	.919	.819	1.018	.933	.783	1.112	98.4%
Overall	.961	.808	1.113	.933	.801	1.112	96.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

MODEL = 22RR010 Dufferin & Wellington Counties - Rural

Case Processing Summary[a]

		Count	Percent
view	full	10	40.0%
	none	7	28.0%
	partial	8	32.0%
Overall		25	100.0%
Excluded		0	
Total		25	

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	1.016	.900	1.132	1.032	.852	1.158	97.9%
none	1.074	.924	1.225	1.086	.853	1.341	98.4%
partial	.990	.799	1.182	1.120	.623	1.189	99.2%
Overall	1.024	.949	1.099	1.071	.921	1.137	95.7%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

MODEL = 22UR030 Wellington County Villages

Case Processing Summary[a]

		Count	Percent
view	full	6	6.5%
	none	81	88.0%
	partial	5	5.4%
Overall		92	100.0%
Excluded		0	
Total		92	

a. MODEL = 22UR030 Wellington County Villages

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	.879	.837	.922	.887	.831	.929	96.9%
none	.958	.923	.993	.954	.911	.972	95.5%
partial	.950	.864	1.036	.980	.864	1.015	100.0%
Overall	.952	.922	.983	.948	.905	.967	95.3%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 22UR030 Wellington County Villages

MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

Case Processing Summary[a]

		Count	Percent
view	full	2	3.8%
	none	48	92.3%
	partial	2	3.8%
Overall		52	100.0%
Excluded		0	
Total		52	

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	.954	-.151	2.058	.954	.867	1.041	100.0%
none	.987	.929	1.046	.935	.899	1.023	97.1%
partial	1.190	-2.956	5.337	1.190	.864	1.517	100.0%
Overall	.994	.936	1.052	.935	.899	1.023	96.4%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

Case Processing Summary[a]

		Count	Percent
view	full	2	66.7%
	partial	1	33.3%
Overall		3	100.0%
Excluded		0	
Total		3	

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.212	.675	1.749	1.212	1.170	1.254	100.0%
partial	1.036	.	.	1.036	.	.	.
Overall	1.153	.879	1.427	1.170	1.036	1.254	100.0%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

Case Processing Summary[a]

		Count	Percent
view	full	13	68.4%
	none	4	21.1%
	partial	2	10.5%
Overall		19	100.0%
Excluded		0	
Total		19	

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.073	.979	1.167	1.048	.977	1.188	97.8%
none	.966	.824	1.107	.981	.852	1.049	100.0%
partial	.956	.374	1.538	.956	.910	1.002	100.0%
Overall	1.038	.969	1.107	1.029	.941	1.092	98.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

MODEL = 25UR010 Grey & Bruce Counties - Urban

Case Processing Summary[a]

		Count	Percent
view	none	15	93.8%
	partial	1	6.3%
Overall		16	100.0%
Excluded		0	
Total		16	

a. MODEL = 25UR010 Grey & Bruce Counties - Urban

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
none	1.025	.965	1.085	1.026	.928	1.134	96.5%
partial	.746	.	.	.746	.	.	.
Overall	1.007	.940	1.075	1.026	.899	1.134	97.9%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 25UR010 Grey & Bruce Counties - Urban

MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

Case Processing Summary[a]

		Count	Percent
view	full	78	26.0%
	none	196	65.3%
	partial	26	8.7%
Overall		300	100.0%
Excluded		0	
Total		300	

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	1.027	.981	1.073	.999	.958	1.030	96.9%
none	1.031	1.007	1.055	1.012	.991	1.040	96.2%
partial	.989	.936	1.041	.972	.924	1.056	97.1%
Overall	1.027	1.007	1.047	1.006	.983	1.027	95.7%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

MODEL = 26RR030 Lambton County - Rural/WF

Case Processing Summary[a]

		Count	Percent
view	full	1	4.3%
	none	20	87.0%
	partial	2	8.7%
Overall		23	100.0%
Excluded		0	
Total		23	

a. MODEL = 26RR030 Lambton County - Rural/WF

Ratio Statistics for cva2012 / tas_amt[a]

		95% Confidence Interval for Mean			95% Confidence Interval for Median		
Group	Mean	Lower Bound	Upper Bound	Median	Lower Bound	Upper Bound	Actual Coverage
full	.841	.	.	.841	.	.	.
none	1.004	.965	1.042	1.002	.945	1.049	95.9%
partial	.968	.647	1.289	.968	.943	.993	100.0%
Overall	.993	.957	1.030	.993	.943	1.030	96.5%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 26RR030 Lambton County - Rural/WF

MODEL = 27RR120 Essex County

Case Processing Summary[a]

		Count	Percent
view	full	99	36.4%
	none	132	48.5%
	partial	41	15.1%
Overall		272	100.0%
Excluded		0	
Total		272	

a. MODEL = 27RR120 Essex County

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.011	.983	1.039	.999	.977	1.024	95.6%
none	.981	.961	1.001	.983	.961	.997	95.5%
partial	.989	.945	1.033	.948	.920	1.029	97.2%
Overall	.993	.978	1.008	.984	.969	1.000	95.5%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 27RR120 Essex County

MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

Case Processing Summary[a]

		Count	Percent
view	full	25	16.2%
	none	116	75.3%
	partial	13	8.4%
Overall		154	100.0%
Excluded		0	
Total		154	

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	1.052	.997	1.107	1.036	.983	1.125	95.7%
none	1.003	.980	1.027	.980	.948	1.009	96.8%
partial	1.016	.945	1.087	1.014	.934	1.121	97.8%
Overall	1.012	.992	1.033	.992	.971	1.020	95.6%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

MODEL = 31RR010 District of Algoma

Case Processing Summary[a]

		Count	Percent
view	none	5	100.0%
Overall		5	100.0%
Excluded		0	
Total		5	

a. MODEL = 31RR010 District of Algoma

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
none	1.036	.763	1.310	1.058	.800	1.351	100.0%
Overall	1.036	.763	1.310	1.058	.800	1.351	100.0%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 31RR010 District of Algoma

MODEL = 31UR010 Sault Ste. Marie/Prince Twp

Case Processing Summary[a]

		Count	Percent
view	full	1	8.3%
	none	11	91.7%
Overall		12	100.0%
Excluded		0	
Total		12	

a. MODEL = 31UR010 Sault Ste. Marie/Prince Twp

Ratio Statistics for cva2012 / tas_amt[a]

Group	Mean	95% Confidence Interval for Mean		Median	95% Confidence Interval for Median		
		Lower Bound	Upper Bound		Lower Bound	Upper Bound	Actual Coverage
full	.739	.	.	.739	.	.	.
none	.980	.830	1.130	.963	.714	1.267	98.8%
Overall	.960	.818	1.102	.948	.739	1.062	96.1%

The confidence interval for the median is constructed without any distribution assumptions. The actual coverage level may be greater than the specified level. Other confidence intervals are constructed by assuming a Normal distribution for the ratios.

a. MODEL = 31UR010 Sault Ste. Marie/Prince Twp

Appendix D5 - Distance Boxplots

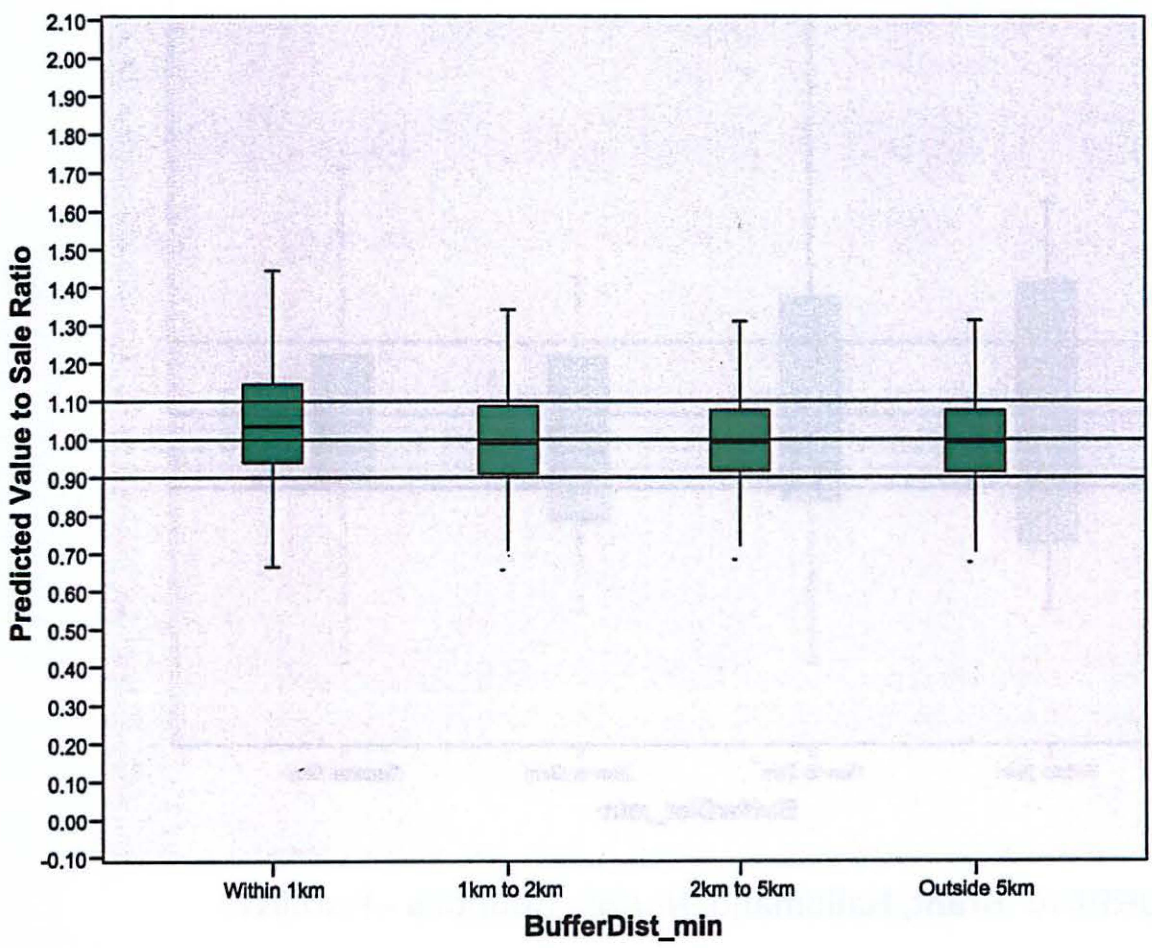
Boxplot ASR by Distance All Sales

BufferDist_min

Case Processing Summary

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	279	100.0%	0	.0%	279	100.0%
	2.00 1km to 2km	989	100.0%	0	.0%	989	100.0%
	5.00 2km to 5km	3063	100.0%	0	.0%	3063	100.0%
	6.00 Outside 5km	37093	100.0%	0	.0%	37093	100.0%

ASRX



Boxplots ASR by Distance by Market Area

MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

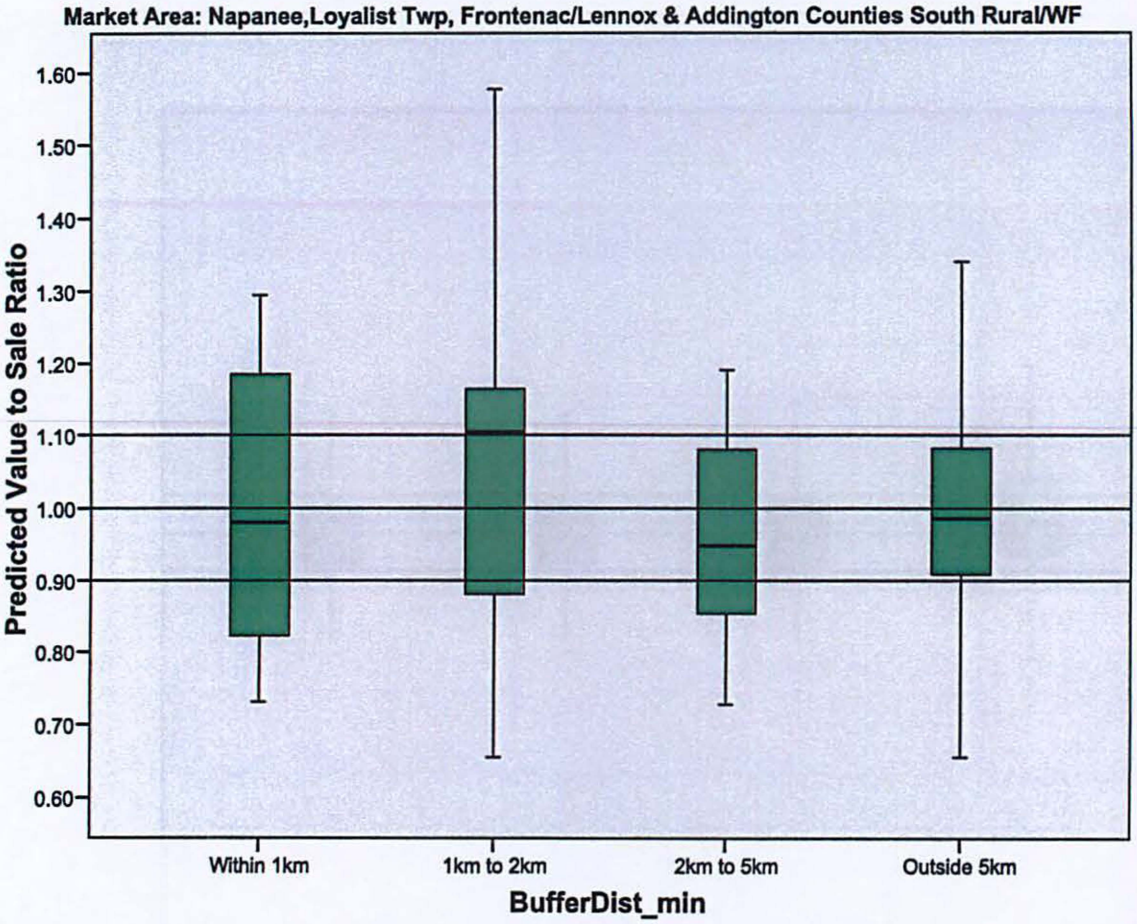
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	13	100.0%	0	.0%	13	100.0%
	2.00 1km to 2km	7	100.0%	0	.0%	7	100.0%
	5.00 2km to 5km	8	100.0%	0	.0%	8	100.0%
	6.00 Outside 5km	2606	100.0%	0	.0%	2606	100.0%

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

ASRX



MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

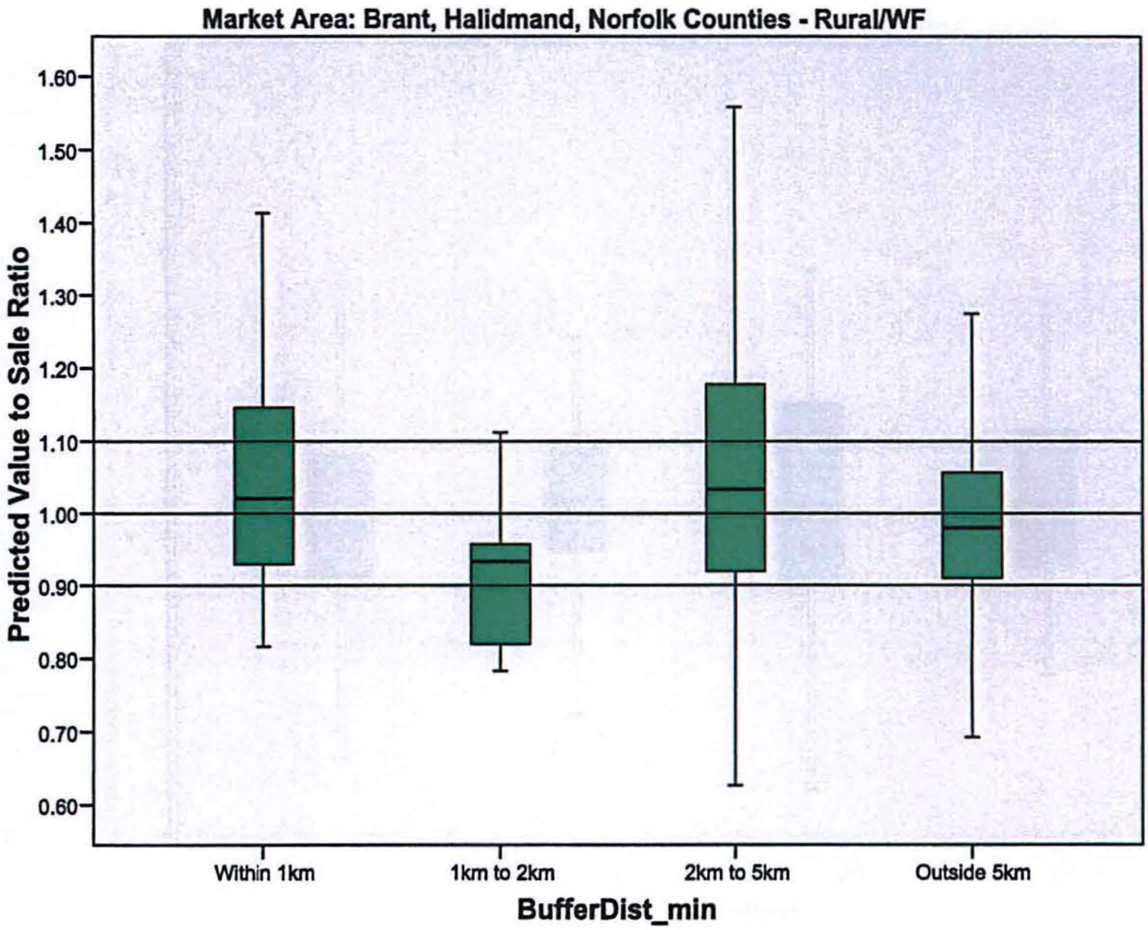
BufferDist_min

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	BufferDist_min	N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	25	100.0%	0	.0%	25	100.0%
	2.00 1km to 2km	9	100.0%	0	.0%	9	100.0%
	5.00 2km to 5km	71	100.0%	0	.0%	71	100.0%
	6.00 Outside 5km	4868	100.0%	0	.0%	4868	100.0%

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

ASRX



MODEL = 22RR010 Dufferin & Wellington Counties - Rural

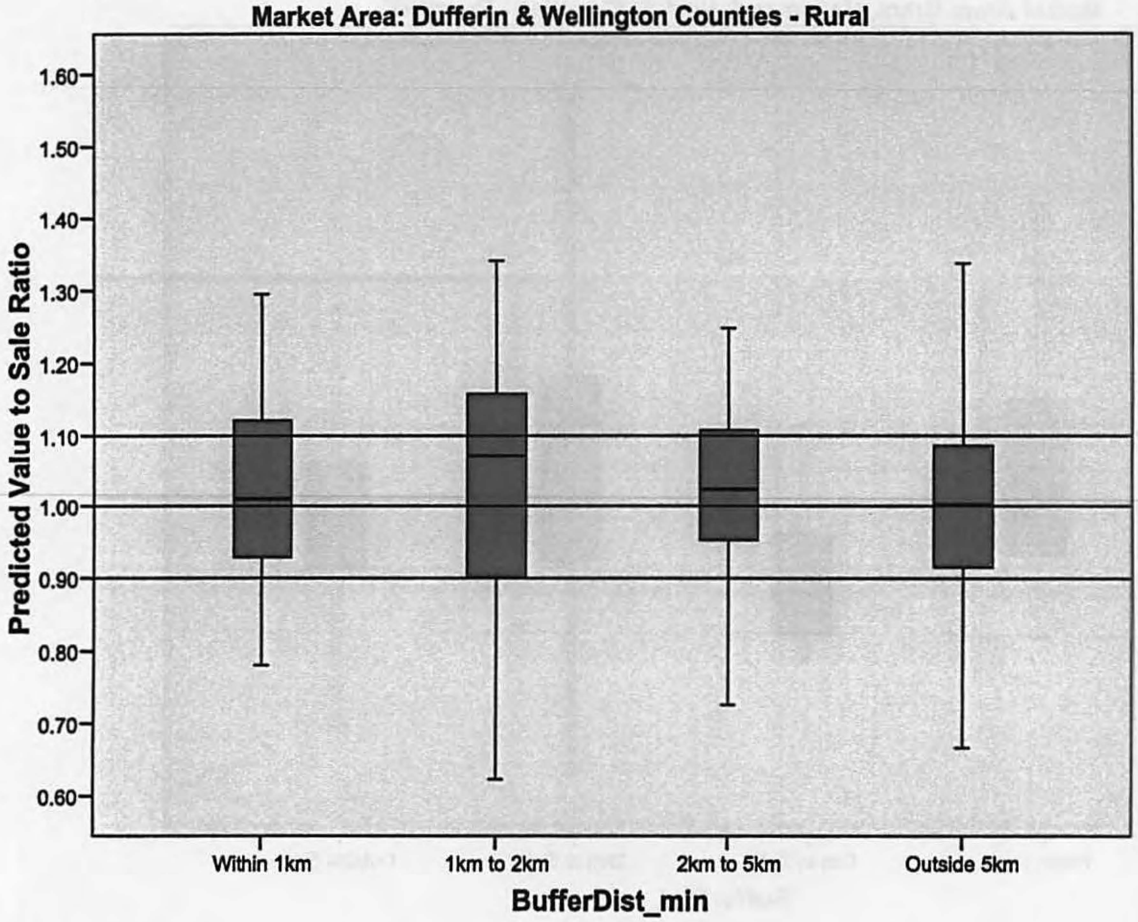
BufferDist_min

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	BufferDist_min	N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	26	100.0%	0	.0%	26	100.0%
	2.00 1km to 2km	25	100.0%	0	.0%	25	100.0%
	5.00 2km to 5km	83	100.0%	0	.0%	83	100.0%
	6.00 Outside 5km	1597	100.0%	0	.0%	1597	100.0%

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

ASRX



MODEL = 22UR020 Dufferin County Villages

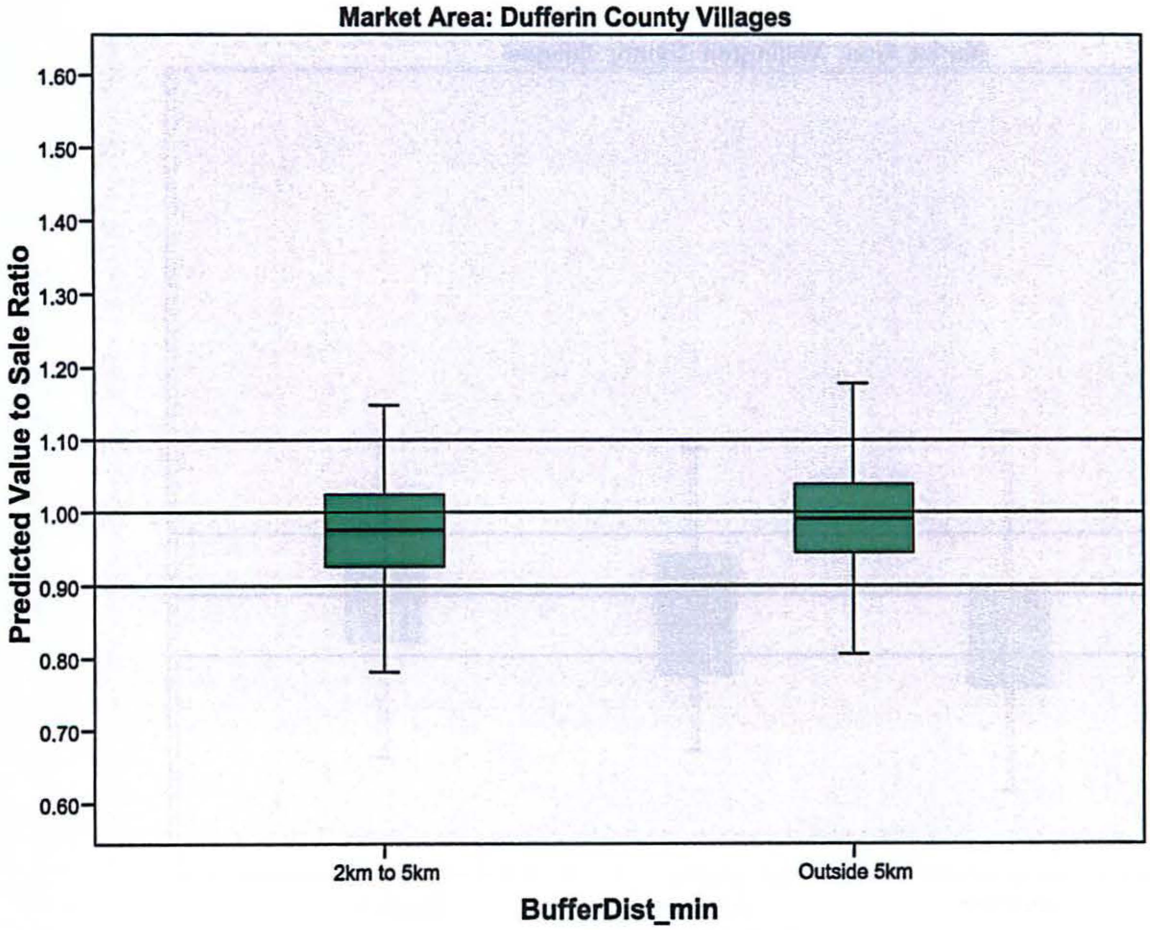
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	5.00 2km to 5km	404	100.0%	0	.0%	404	100.0%
	6.00 Outside 5km	2017	100.0%	0	.0%	2017	100.0%

a. MODEL = 22UR020 Dufferin County Villages

ASRX



MODEL = 22UR030 Wellington County Villages

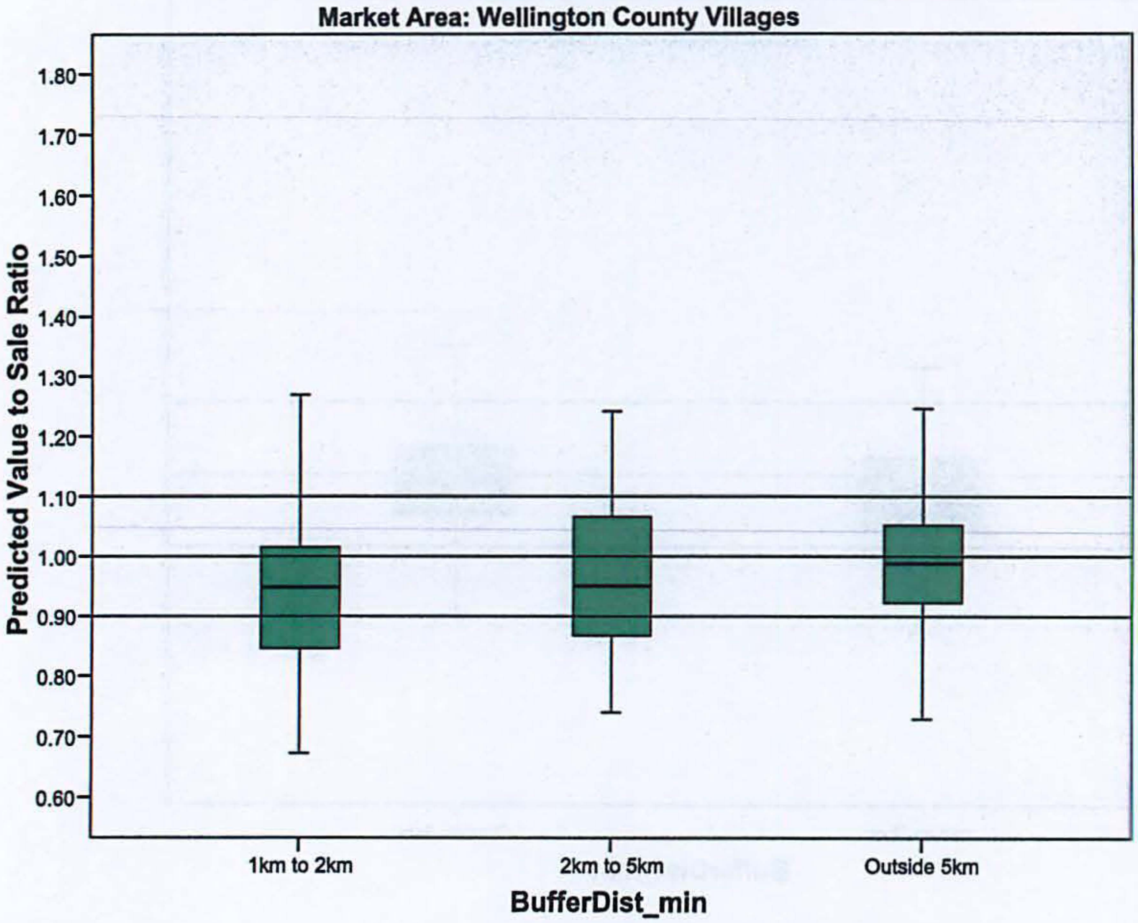
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	2.00 1km to 2km	92	100.0%	0	.0%	92	100.0%
	5.00 2km to 5km	32	100.0%	0	.0%	32	100.0%
	6.00 Outside 5km	2300	100.0%	0	.0%	2300	100.0%

a. MODEL = 22UR030 Wellington County Villages

ASRX



MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

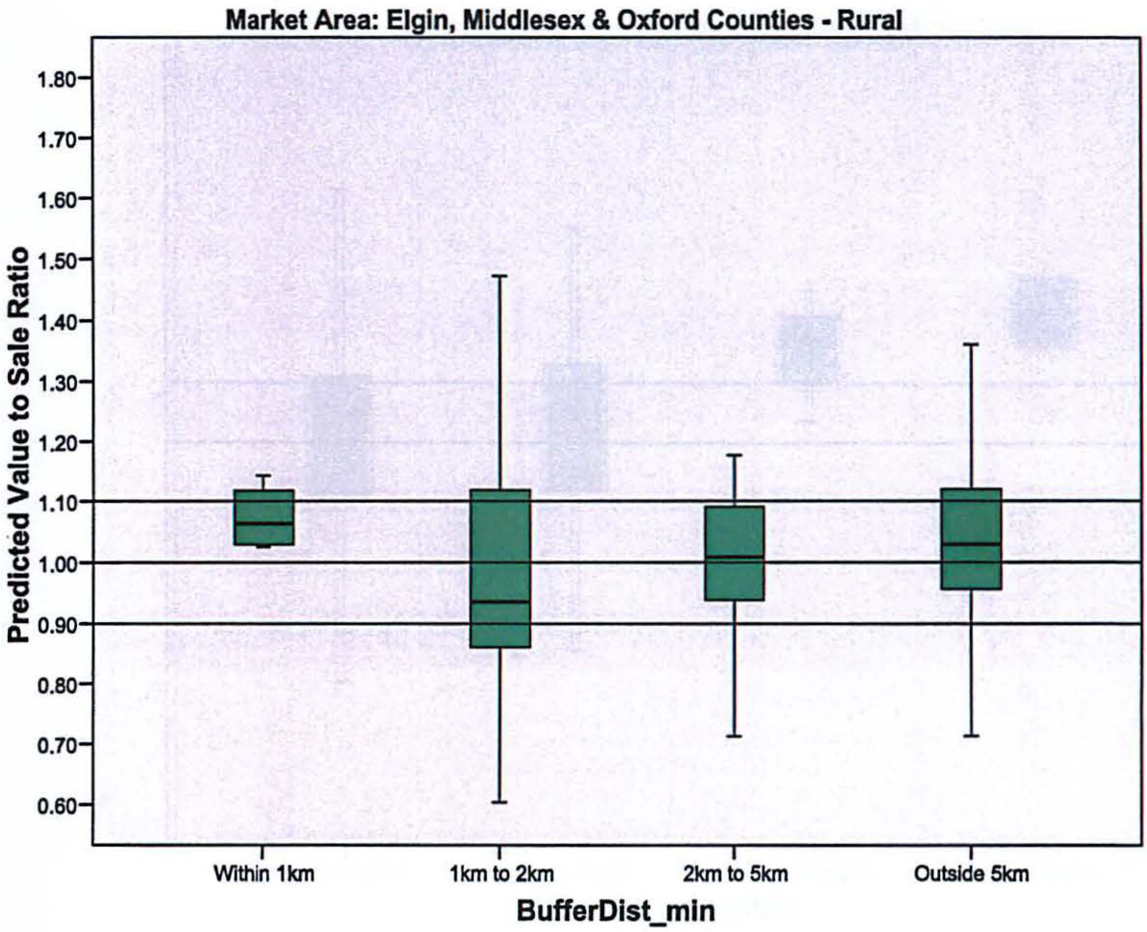
BufferDist_min

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	BufferDist_min	N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	4	100.0%	0	.0%	4	100.0%
	2.00 1km to 2km	52	100.0%	0	.0%	52	100.0%
	5.00 2km to 5km	72	100.0%	0	.0%	72	100.0%
	6.00 Outside 5km	4300	100.0%	0	.0%	4300	100.0%

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

ASRX



MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

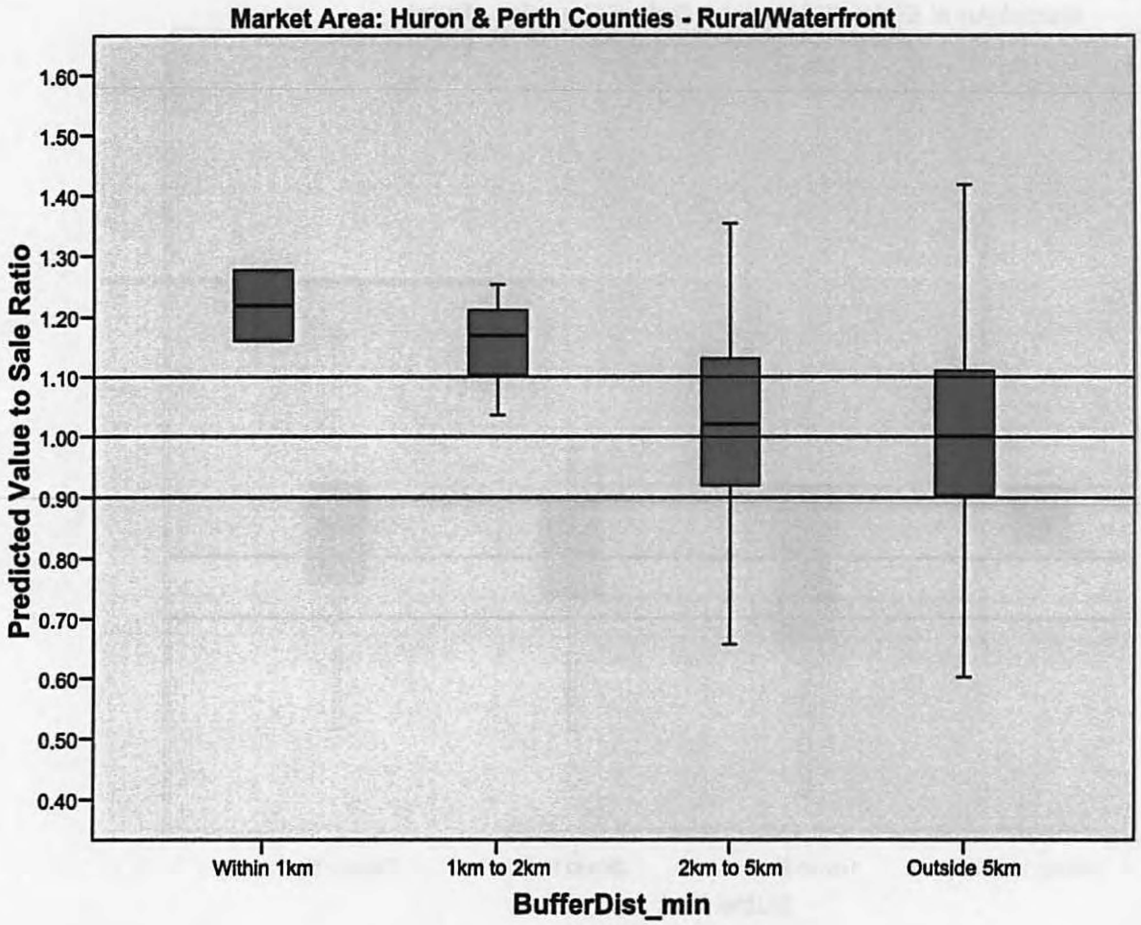
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	2	100.0%	0	.0%	2	100.0%
	2.00 1km to 2km	3	100.0%	0	.0%	3	100.0%
	5.00 2km to 5km	98	100.0%	0	.0%	98	100.0%
	6.00 Outside 5km	786	100.0%	0	.0%	786	100.0%

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

ASRX



MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

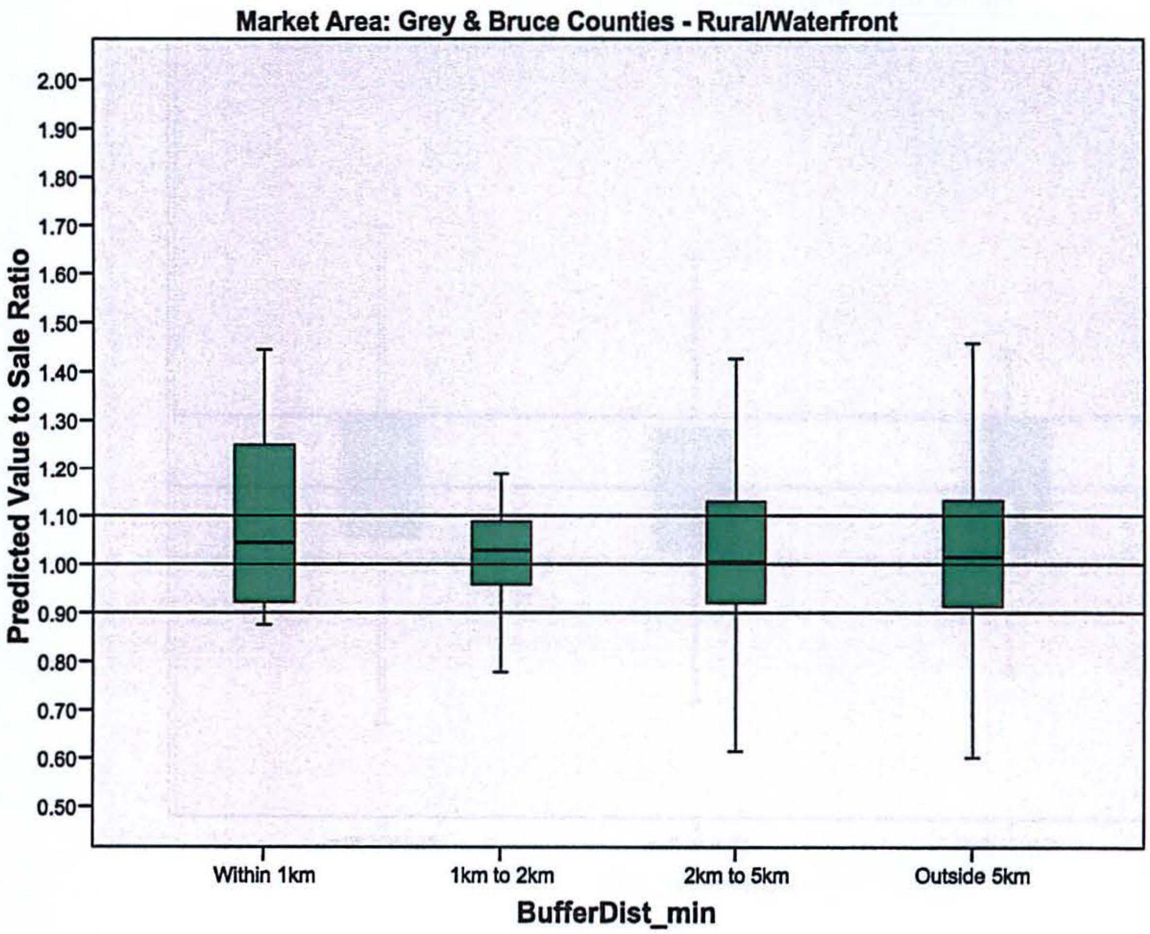
BufferDist_min

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	BufferDist_min	N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	12	100.0%	0	.0%	12	100.0%
	2.00 1km to 2km	19	100.0%	0	.0%	19	100.0%
	5.00 2km to 5km	265	100.0%	0	.0%	265	100.0%
	6.00 Outside 5km	2692	100.0%	0	.0%	2692	100.0%

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

ASRX



MODEL = 25UR010 Grey & Bruce Counties - Urban

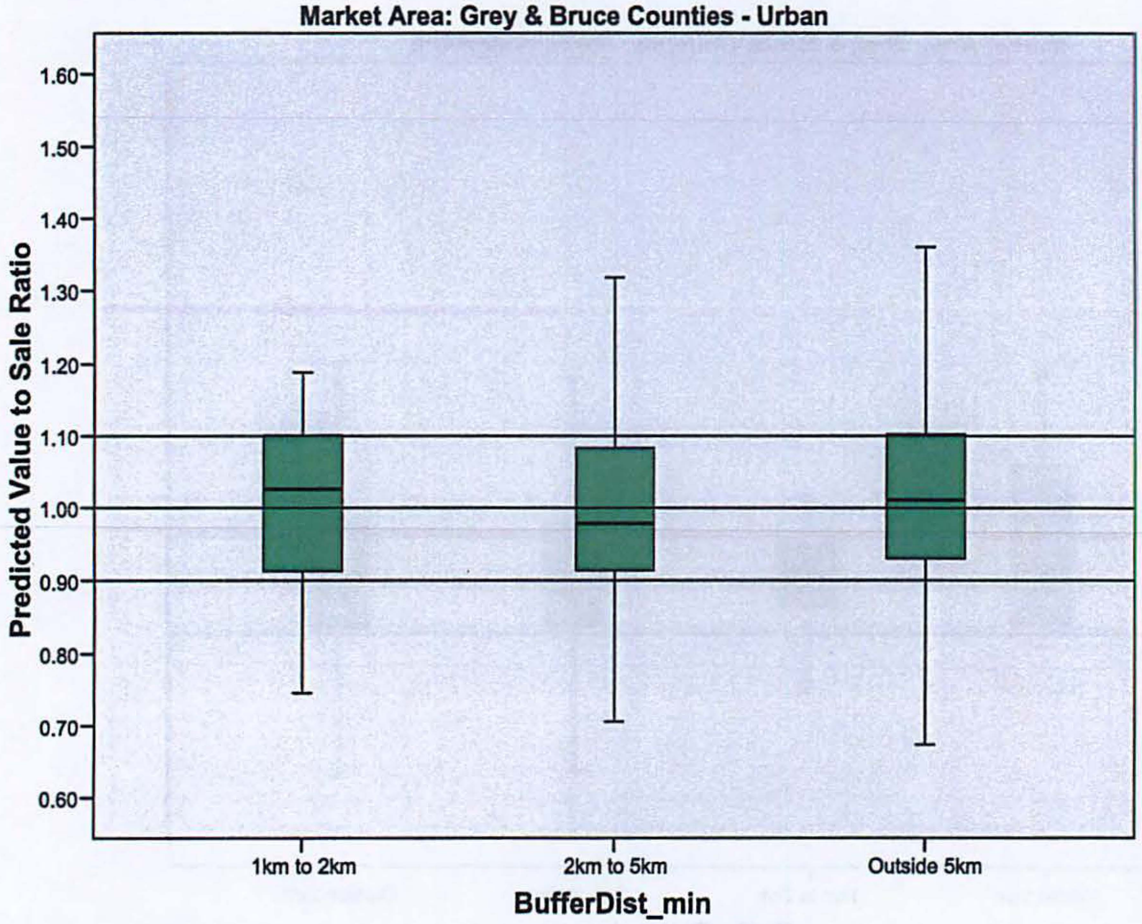
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Valid N	Valid Percent	Missing N	Missing Percent	Total N	Total Percent
ASRX	2.00 1km to 2km	16	100.0%	0	.0%	16	100.0%
	5.00 2km to 5km	161	100.0%	0	.0%	161	100.0%
	6.00 Outside 5km	4180	100.0%	0	.0%	4180	100.0%

a. MODEL = 25UR010 Grey & Bruce Counties - Urban

ASRX



MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

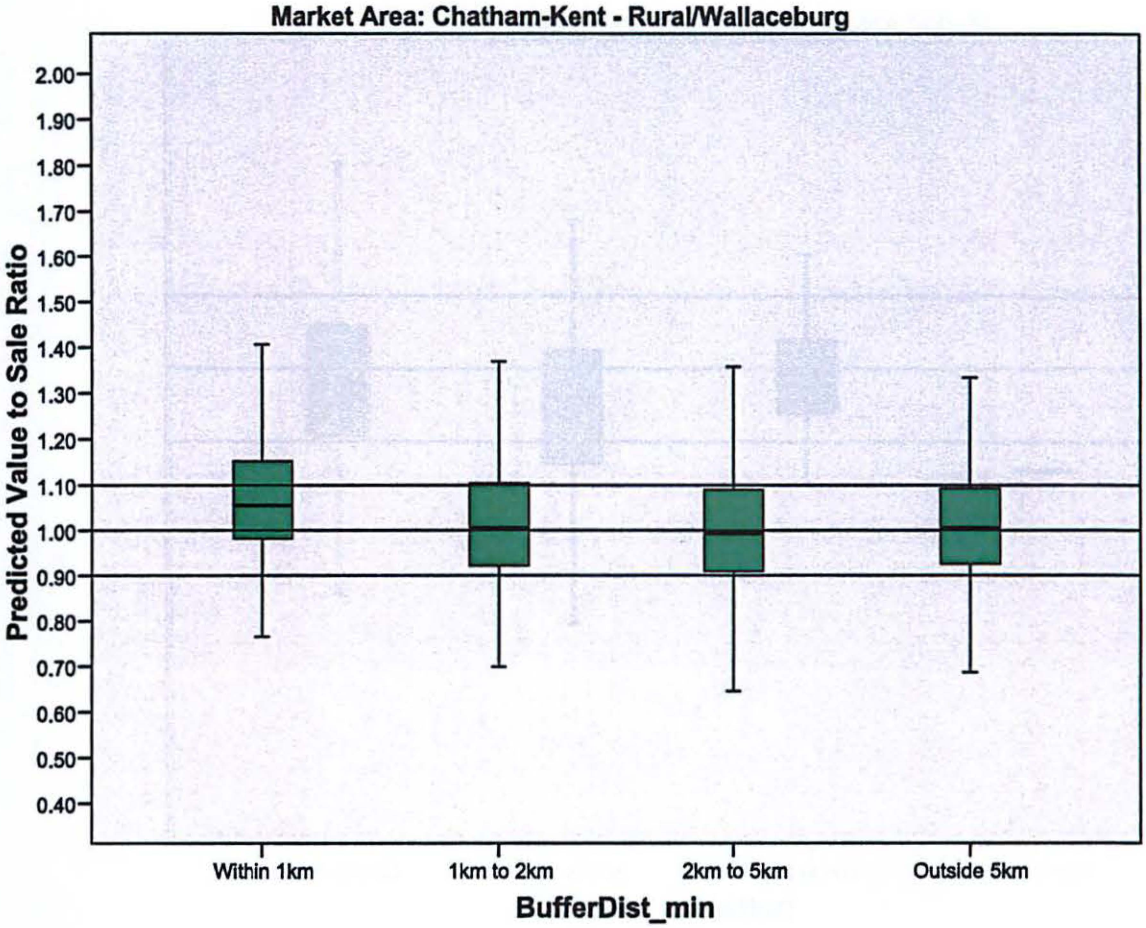
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	83	100.0%	0	.0%	83	100.0%
	2.00 1km to 2km	300	100.0%	0	.0%	300	100.0%
	5.00 2km to 5km	836	100.0%	0	.0%	836	100.0%
	6.00 Outside 5km	663	100.0%	0	.0%	663	100.0%

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

ASRX



MODEL = 26RR030 Lambton County - Rural/WF

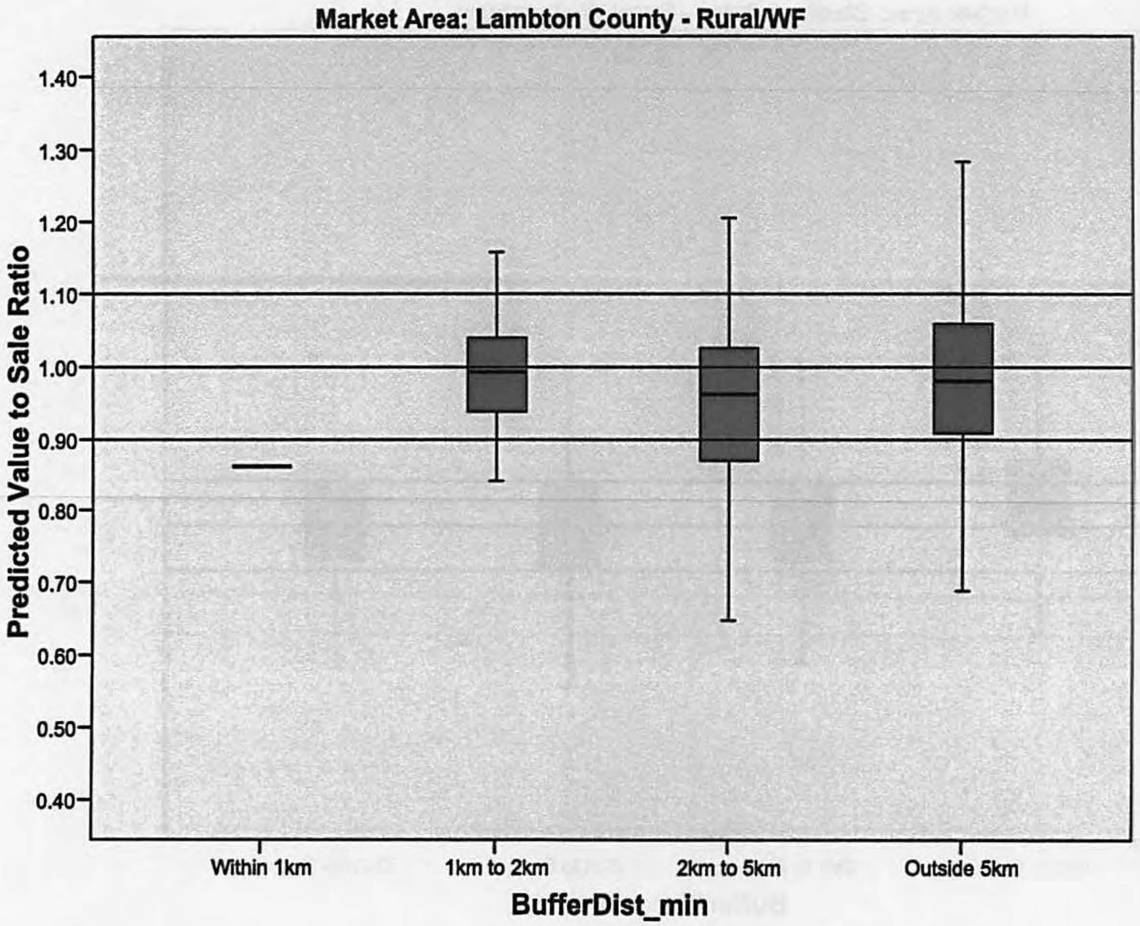
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	1	100.0%	0	.0%	1	100.0%
	2.00 1km to 2km	23	100.0%	0	.0%	23	100.0%
	5.00 2km to 5km	76	100.0%	0	.0%	76	100.0%
	6.00 Outside 5km	1942	100.0%	0	.0%	1942	100.0%

a. MODEL = 26RR030 Lambton County - Rural/WF

ASRX



MODEL = 27RR120 Essex County

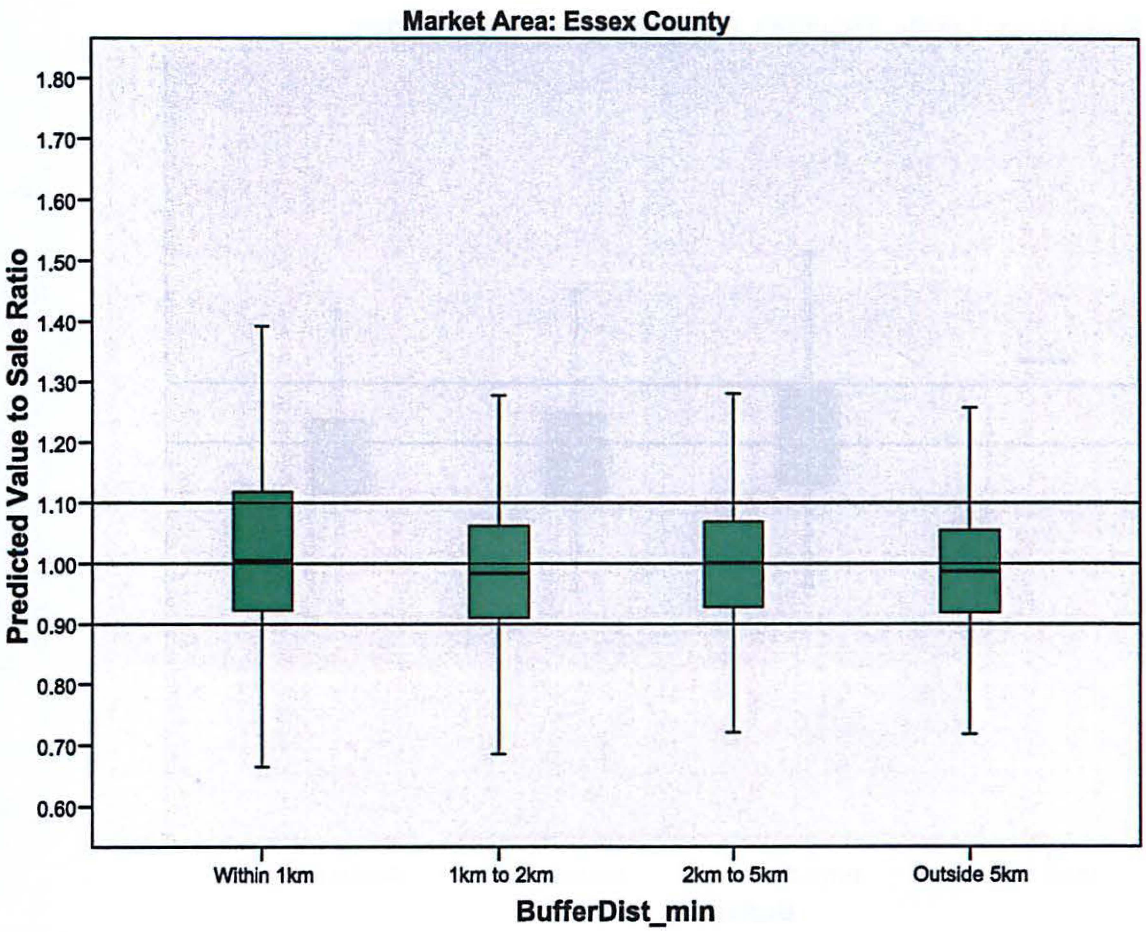
BufferDist_min

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	BufferDist_min	N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	112	100.0%	0	.0%	112	100.0%
	2.00 1km to 2km	272	100.0%	0	.0%	272	100.0%
	5.00 2km to 5km	768	100.0%	0	.0%	768	100.0%
	6.00 Outside 5km	2198	100.0%	0	.0%	2198	100.0%

a. MODEL = 27RR120 Essex County

ASRX



MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

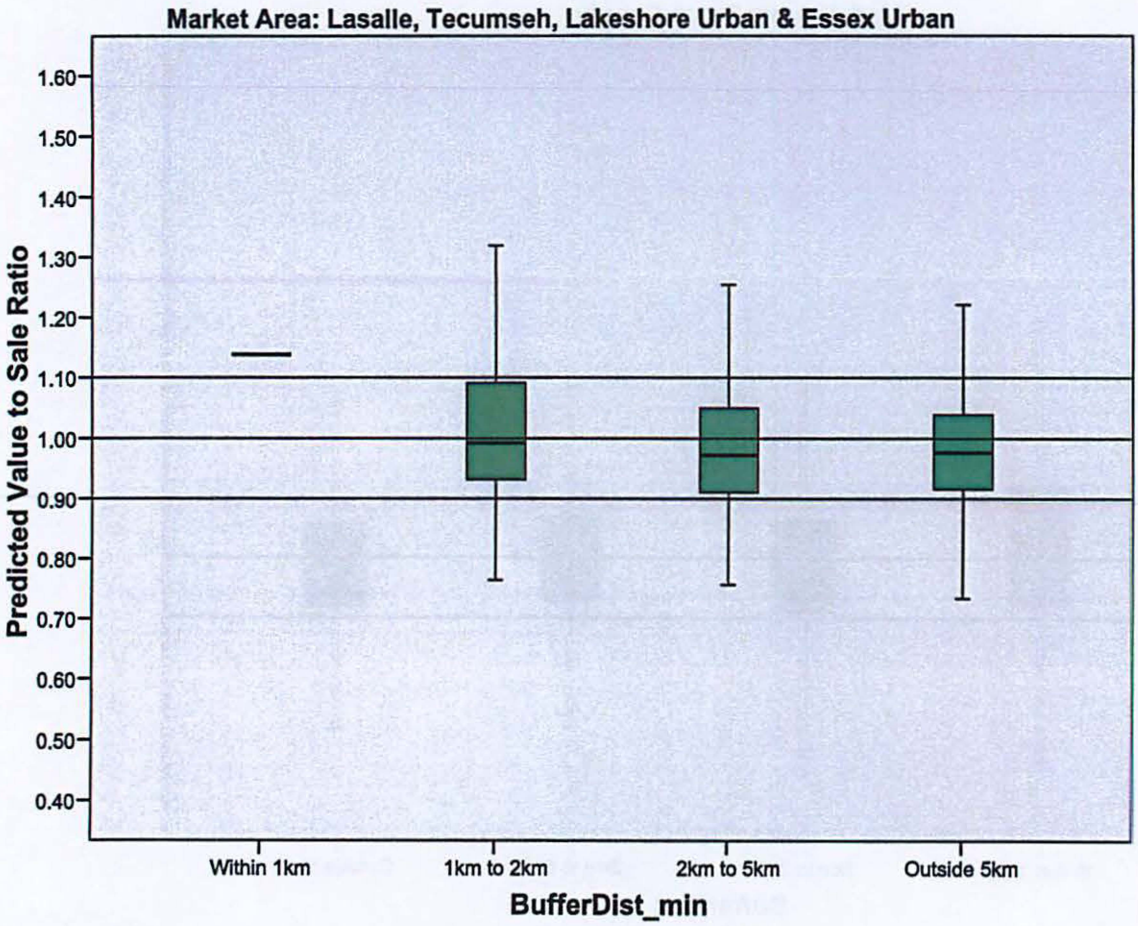
BufferDist_min

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	BufferDist_min	N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	1	100.0%	0	.0%	1	100.0%
	2.00 1km to 2km	154	100.0%	0	.0%	154	100.0%
	5.00 2km to 5km	179	100.0%	0	.0%	179	100.0%
	6.00 Outside 5km	2660	100.0%	0	.0%	2660	100.0%

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

ASRX



MODEL = 31RR010 District of Algoma

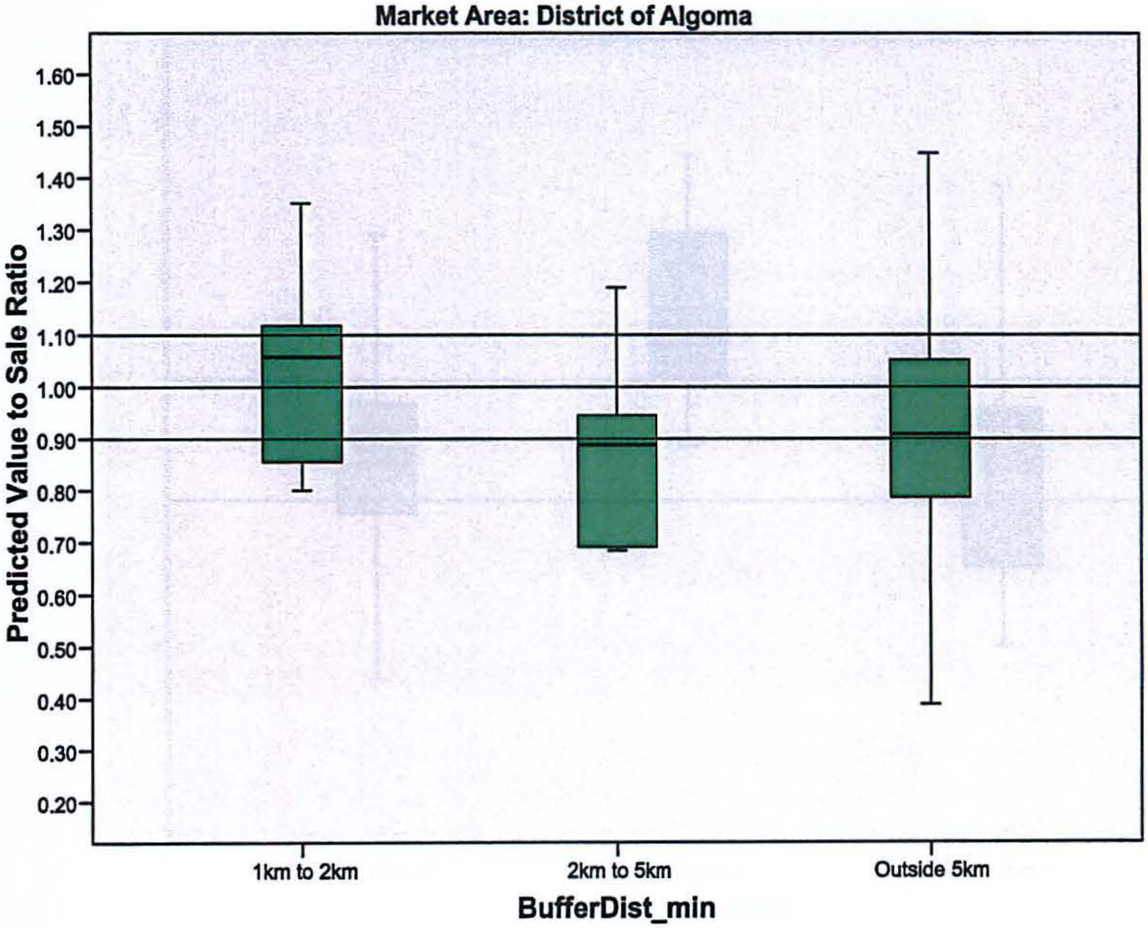
BufferDist_min

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	BufferDist_min	N	Percent	N	Percent	N	Percent
ASRX	2.00 1km to 2km	5	100.0%	0	.0%	5	100.0%
	5.00 2km to 5km	7	100.0%	0	.0%	7	100.0%
	6.00 Outside 5km	1483	100.0%	0	.0%	1483	100.0%

a. MODEL = 31RR010 District of Algoma

ASRX



MODEL = 31UR010 Sault Ste. Marie/Prince Twp

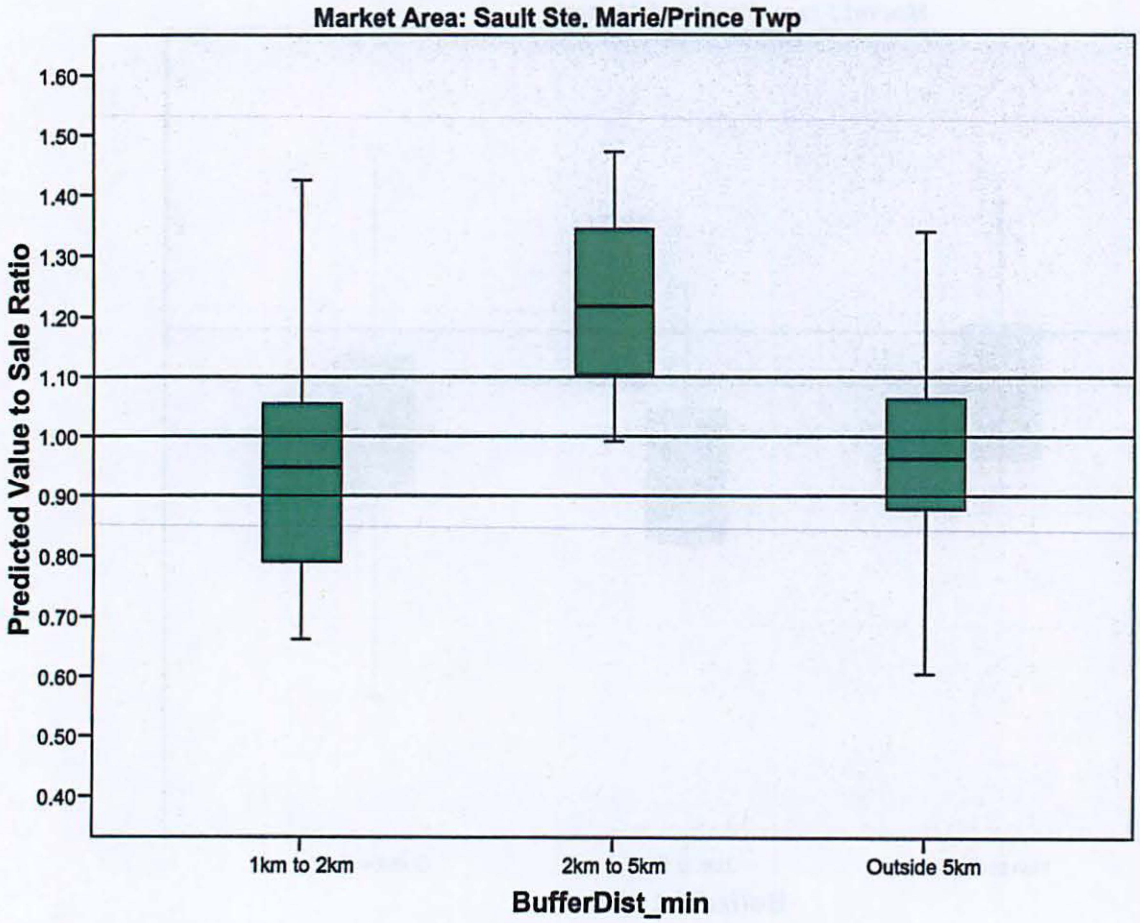
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	2.00 1km to 2km	12	100.0%	0	.0%	12	100.0%
	5.00 2km to 5km	3	100.0%	0	.0%	3	100.0%
	6.00 Outside 5km	2801	100.0%	0	.0%	2801	100.0%

a. MODEL = 31UR010 Sault Ste. Marie/Prince Twp

ASRX



Boxplot ASR by Distance by Market Type

Rural

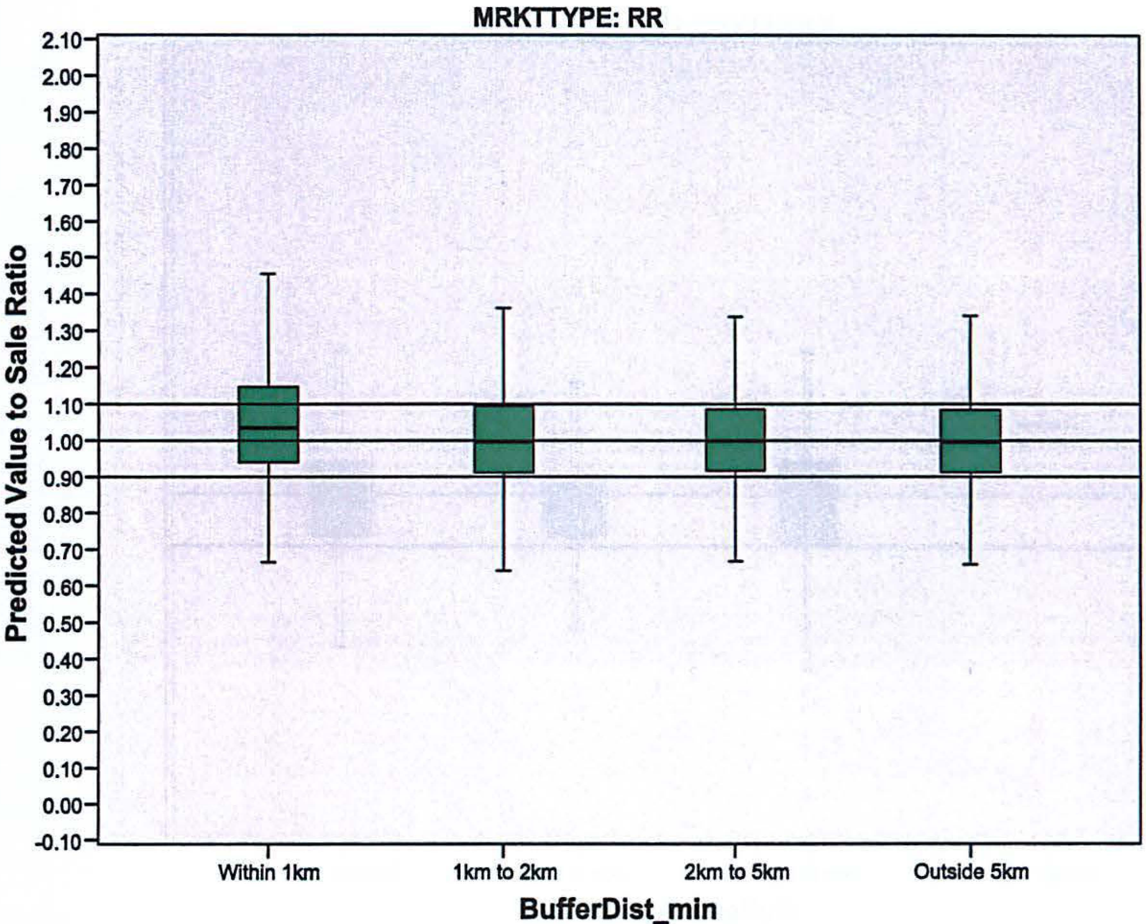
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	278	100.0%	0	.0%	278	100.0%
	2.00 1km to 2km	715	100.0%	0	.0%	715	100.0%
	5.00 2km to 5km	2284	100.0%	0	.0%	2284	100.0%
	6.00 Outside 5km	23135	100.0%	0	.0%	23135	100.0%

a. MRKTTYPE = RR

ASRX



Urban

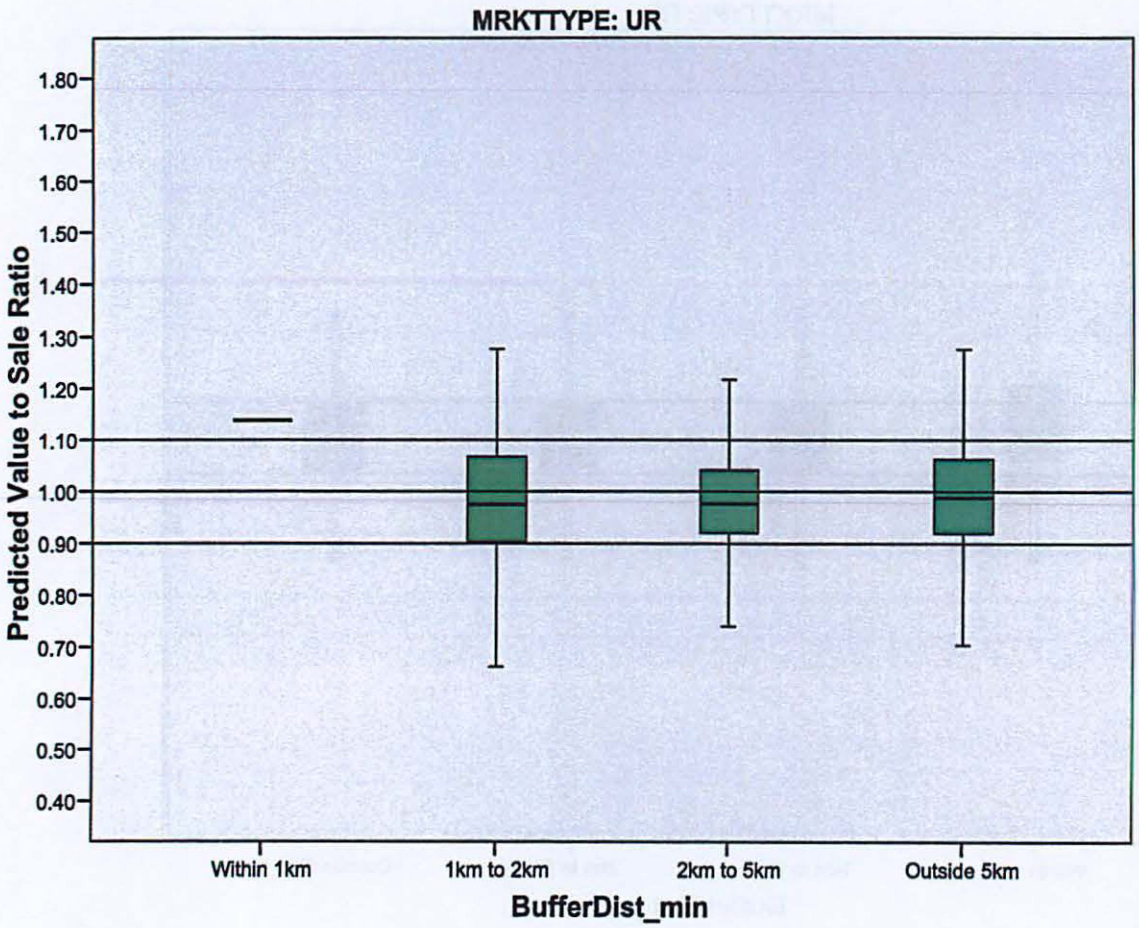
BufferDist_min

Case Processing Summary[a]

	BufferDist_min	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	1.00 Within 1km	1	100.0%	0	.0%	1	100.0%
	2.00 1km to 2km	274	100.0%	0	.0%	274	100.0%
	5.00 2km to 5km	779	100.0%	0	.0%	779	100.0%
	6.00 Outside 5km	13958	100.0%	0	.0%	13958	100.0%

a. MRKTTYPE = UR

ASRX



Appendix D6 - View Boxplots

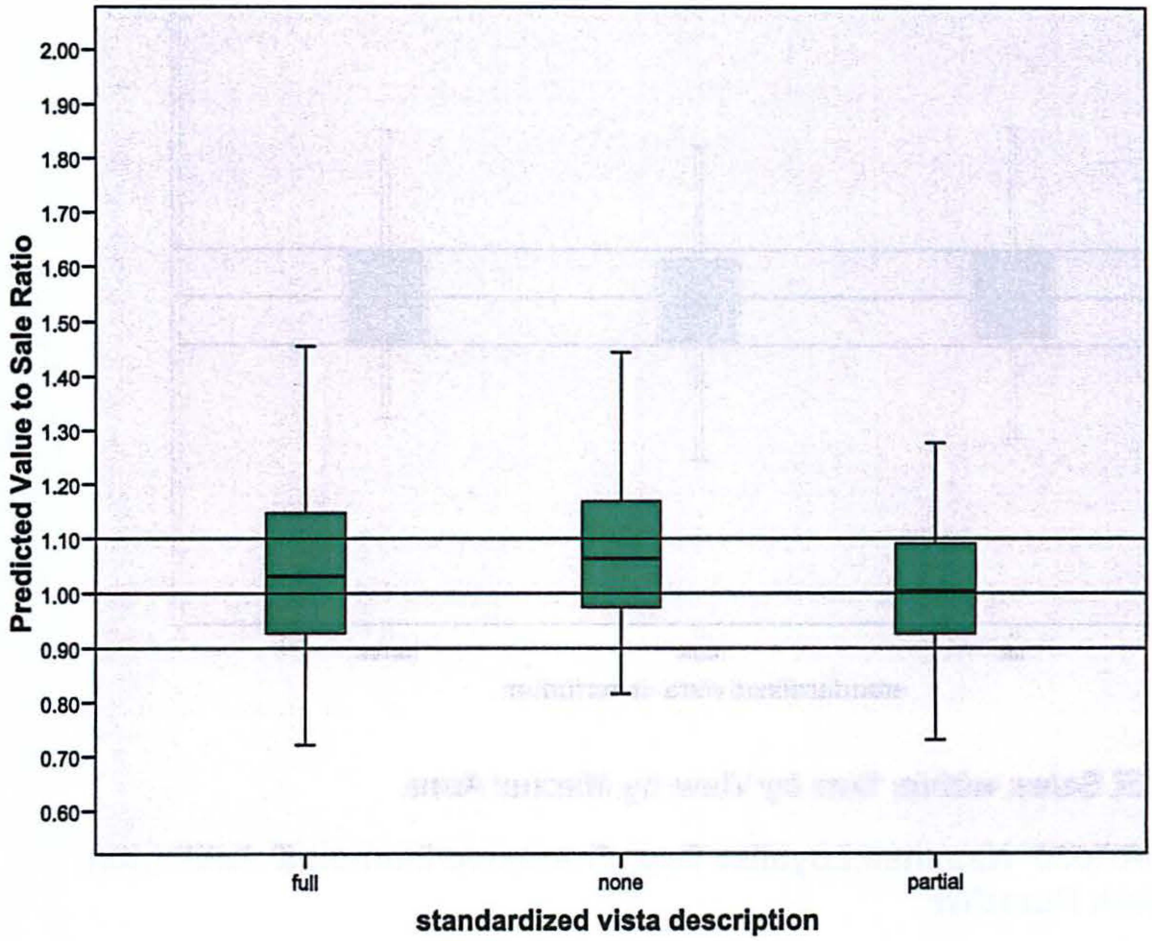
Boxplot ASRs Sales Less Than 1km by View

view

Case Processing Summary

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	190	100.0%	0	.0%	190	100.0%
	none	56	100.0%	0	.0%	56	100.0%
	partial	33	100.0%	0	.0%	33	100.0%

ASRX



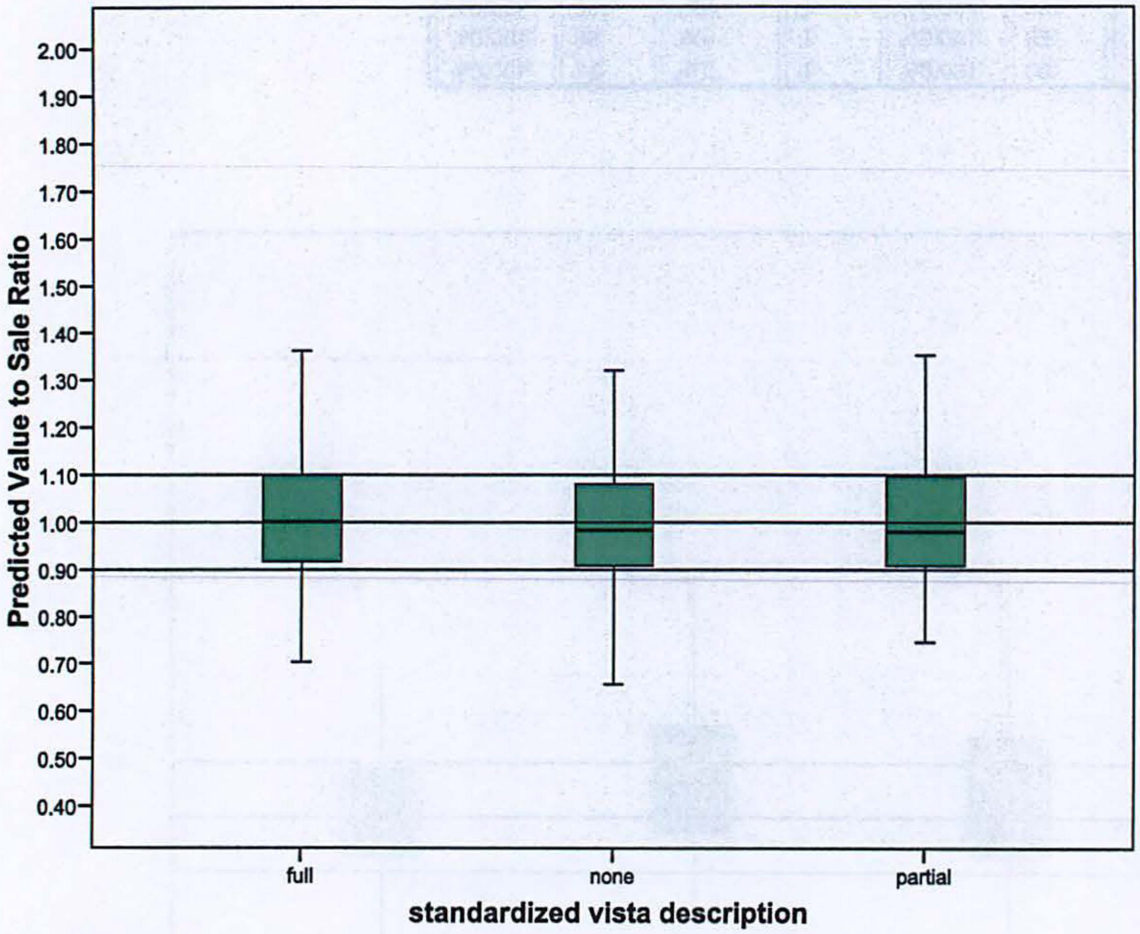
Boxplot ASR Sales 1km to 2km by View

view

Case Processing Summary

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	239	100.0%	0	.0%	239	100.0%
	none	647	100.0%	0	.0%	647	100.0%
	partial	103	100.0%	0	.0%	103	100.0%

ASRX



Boxplots ASR Sales within 1km by View by Market Area

MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

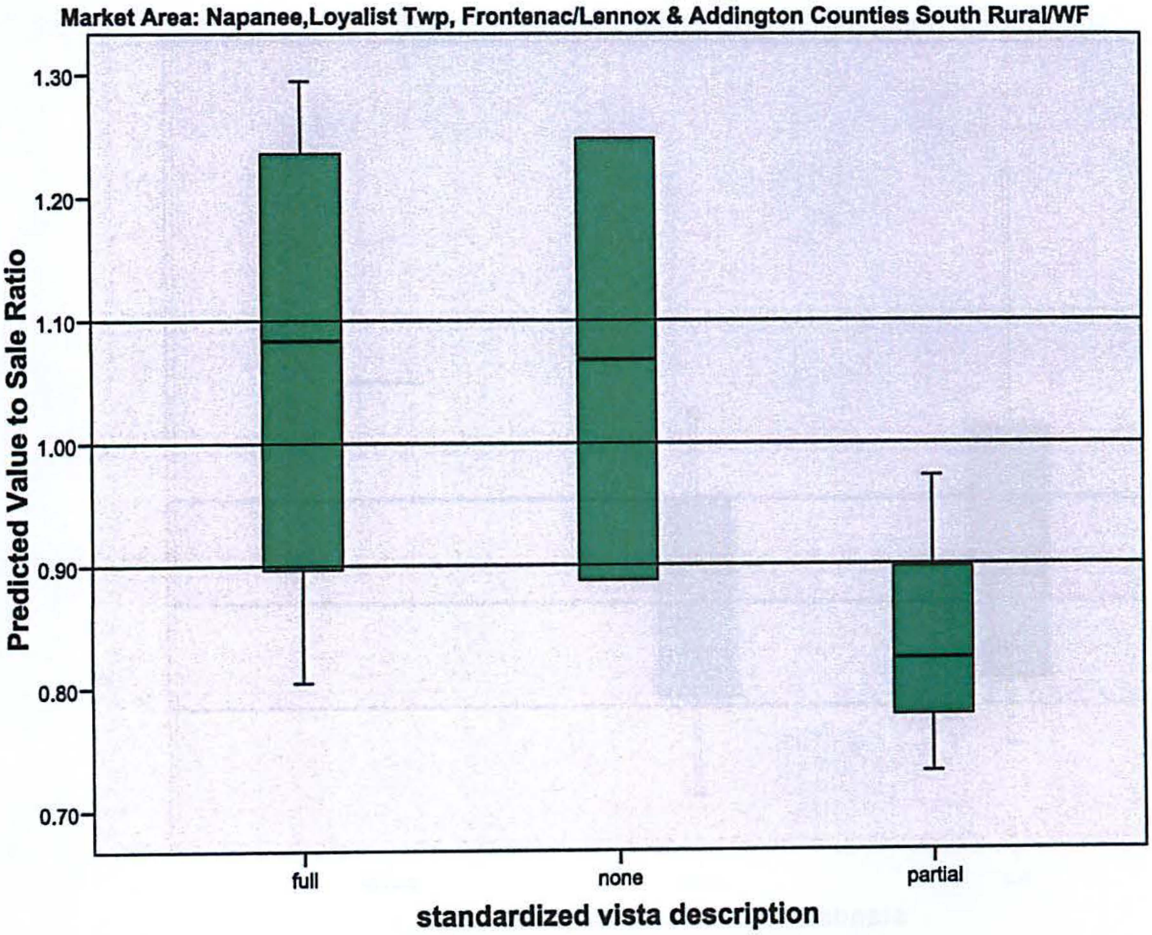
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	8	100.0%	0	.0%	8	100.0%
	none	2	100.0%	0	.0%	2	100.0%
	partial	3	100.0%	0	.0%	3	100.0%

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

ASRX



MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

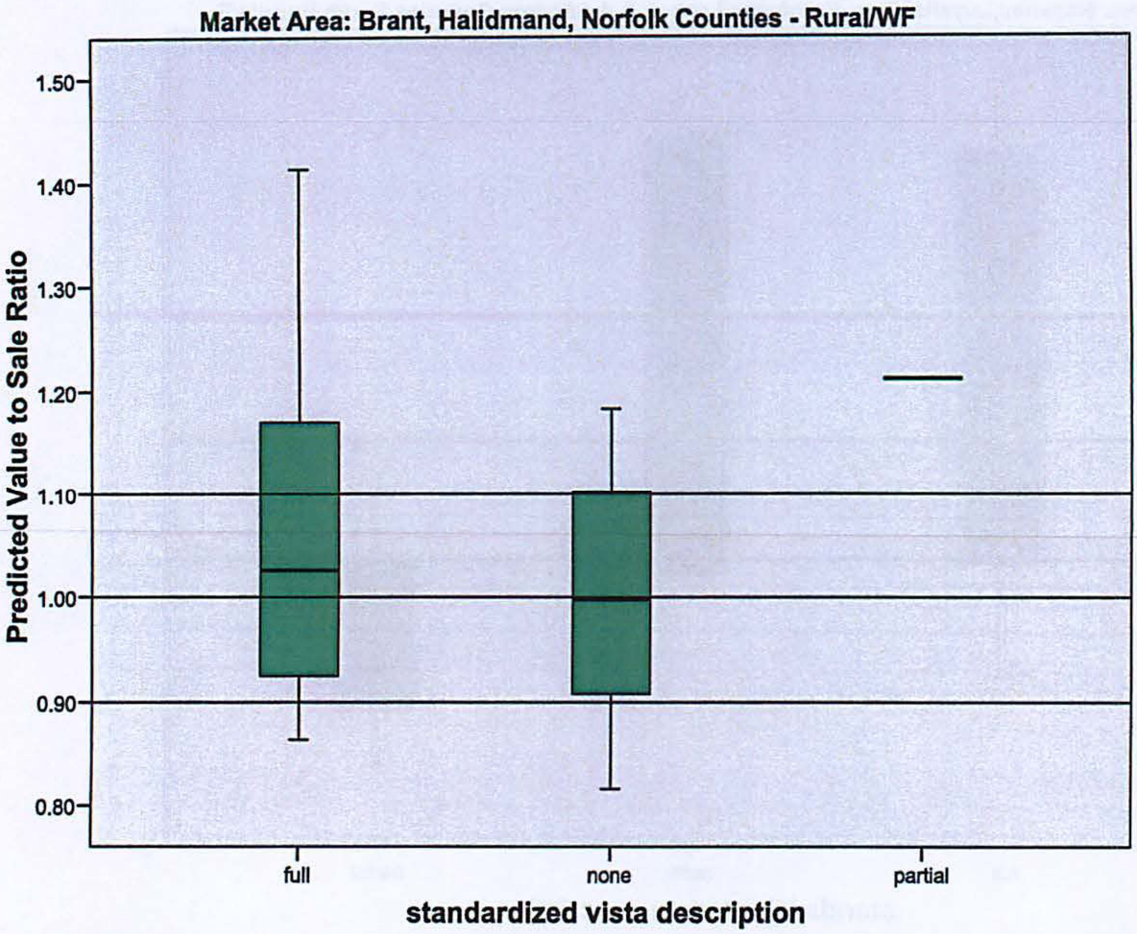
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	12	100.0%	0	.0%	12	100.0%
	none	12	100.0%	0	.0%	12	100.0%
	partial	1	100.0%	0	.0%	1	100.0%

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

ASRX



MODEL = 22RR010 Dufferin & Wellington Counties - Rural

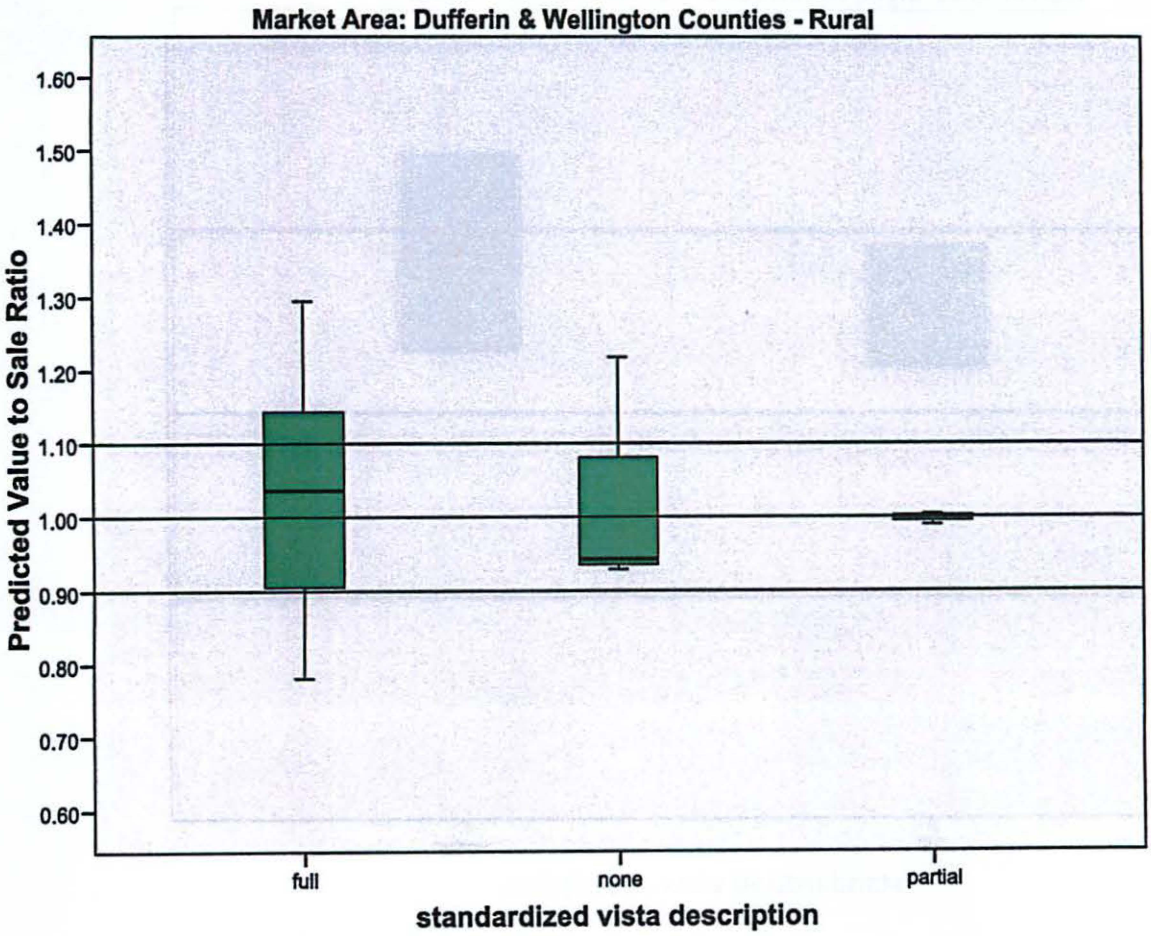
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	20	100.0%	0	.0%	20	100.0%
	none	3	100.0%	0	.0%	3	100.0%
	partial	3	100.0%	0	.0%	3	100.0%

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

ASRX



MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

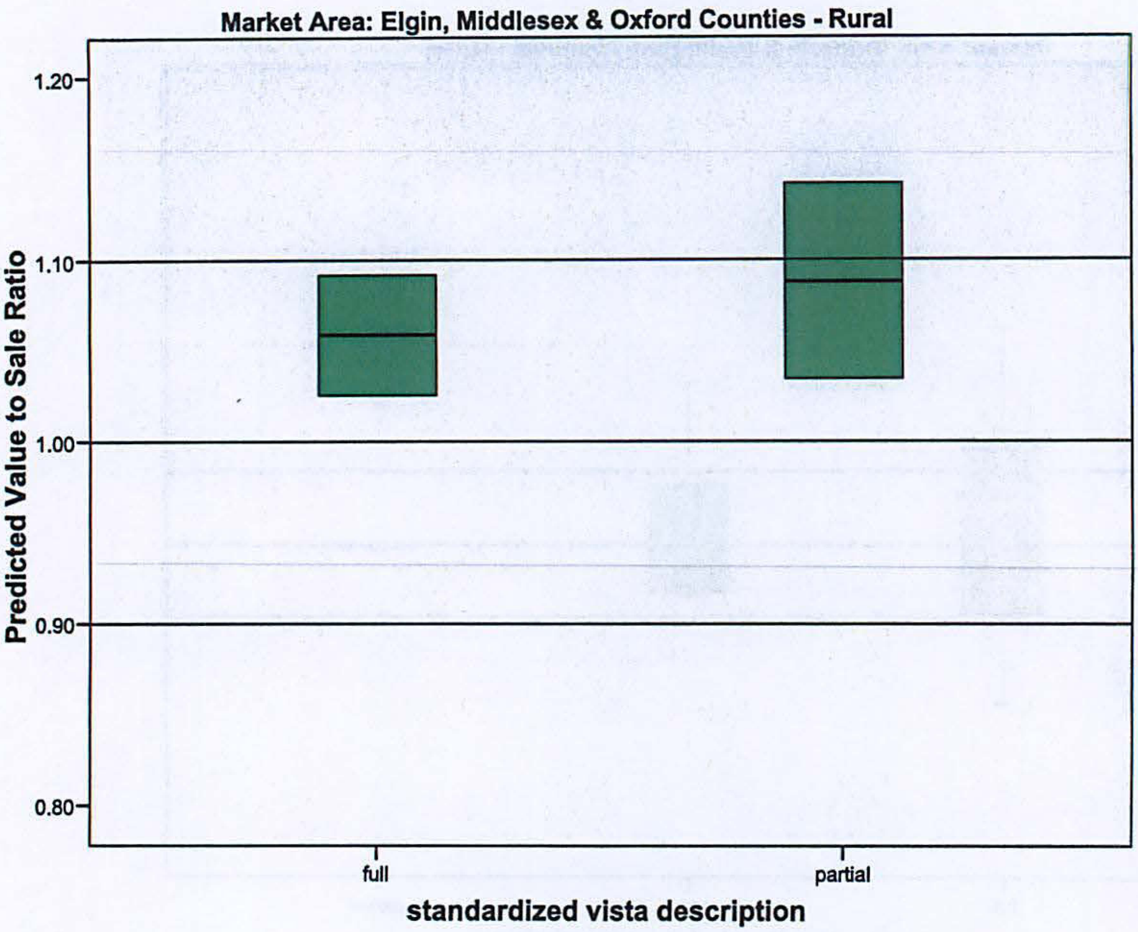
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	2	100.0%	0	.0%	2	100.0%
	partial	2	100.0%	0	.0%	2	100.0%

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

ASRX



MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

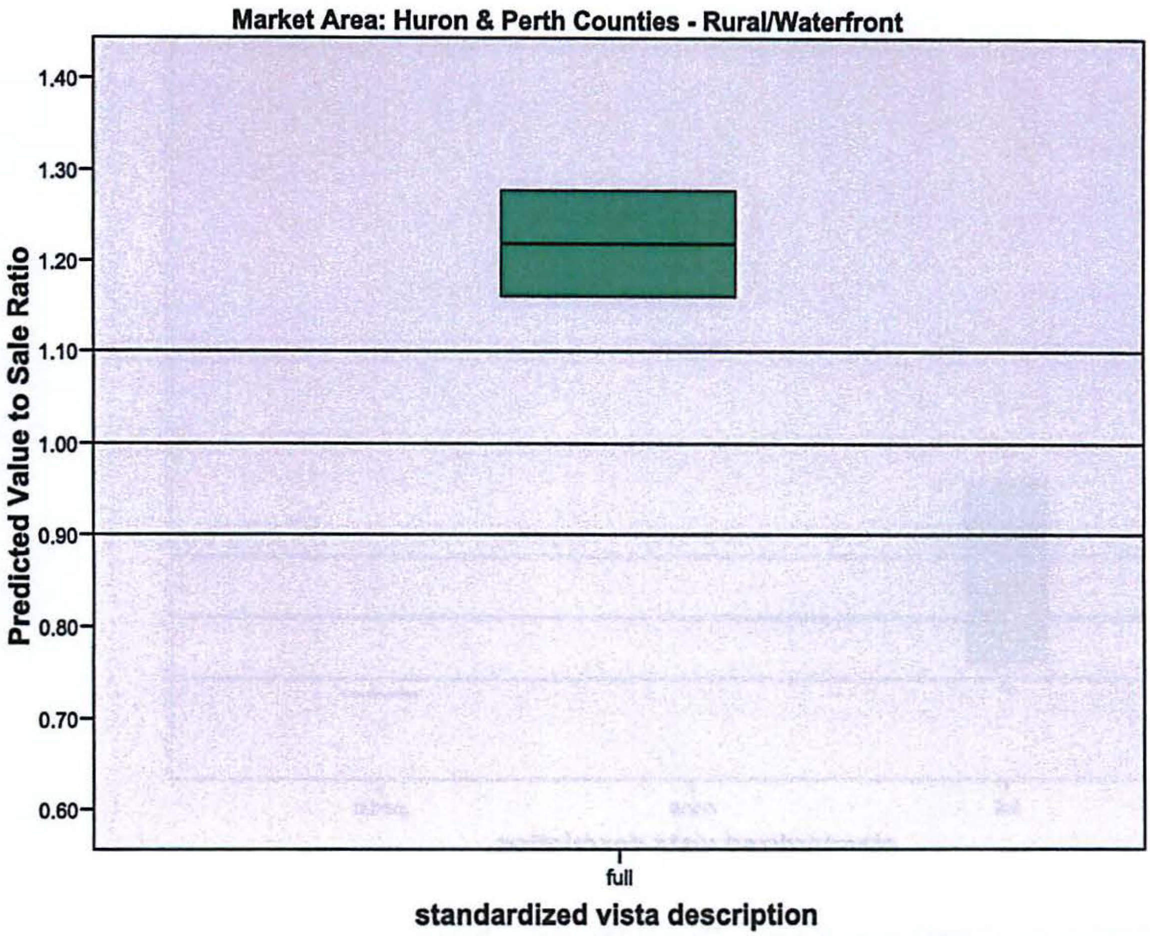
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	2	100.0%	0	.0%	2	100.0%

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

ASRX



MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

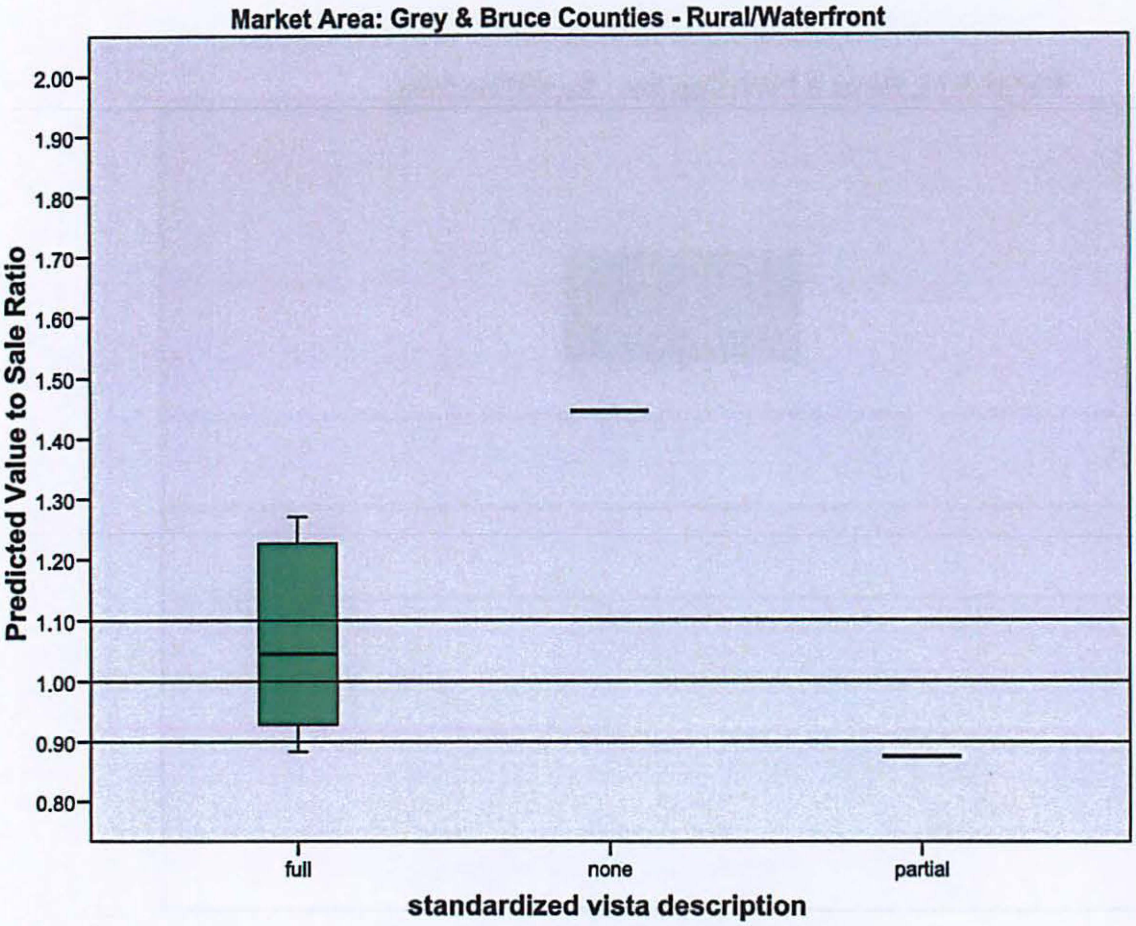
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	10	100.0%	0	.0%	10	100.0%
	none	1	100.0%	0	.0%	1	100.0%
	partial	1	100.0%	0	.0%	1	100.0%

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

ASRX



MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

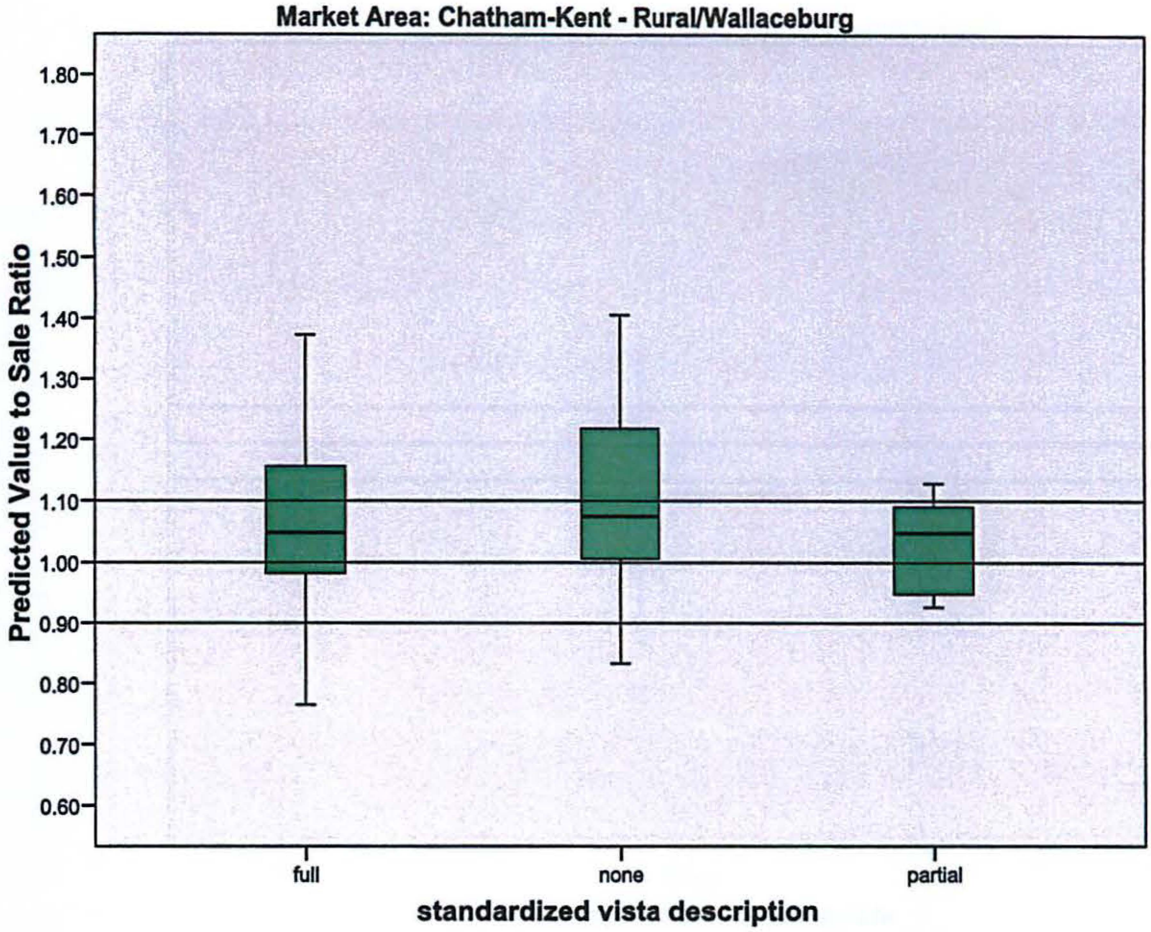
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	61	100.0%	0	.0%	61	100.0%
	none	16	100.0%	0	.0%	16	100.0%
	partial	6	100.0%	0	.0%	6	100.0%

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

ASRX



MODEL = 26RR030 Lambton County - Rural/WF

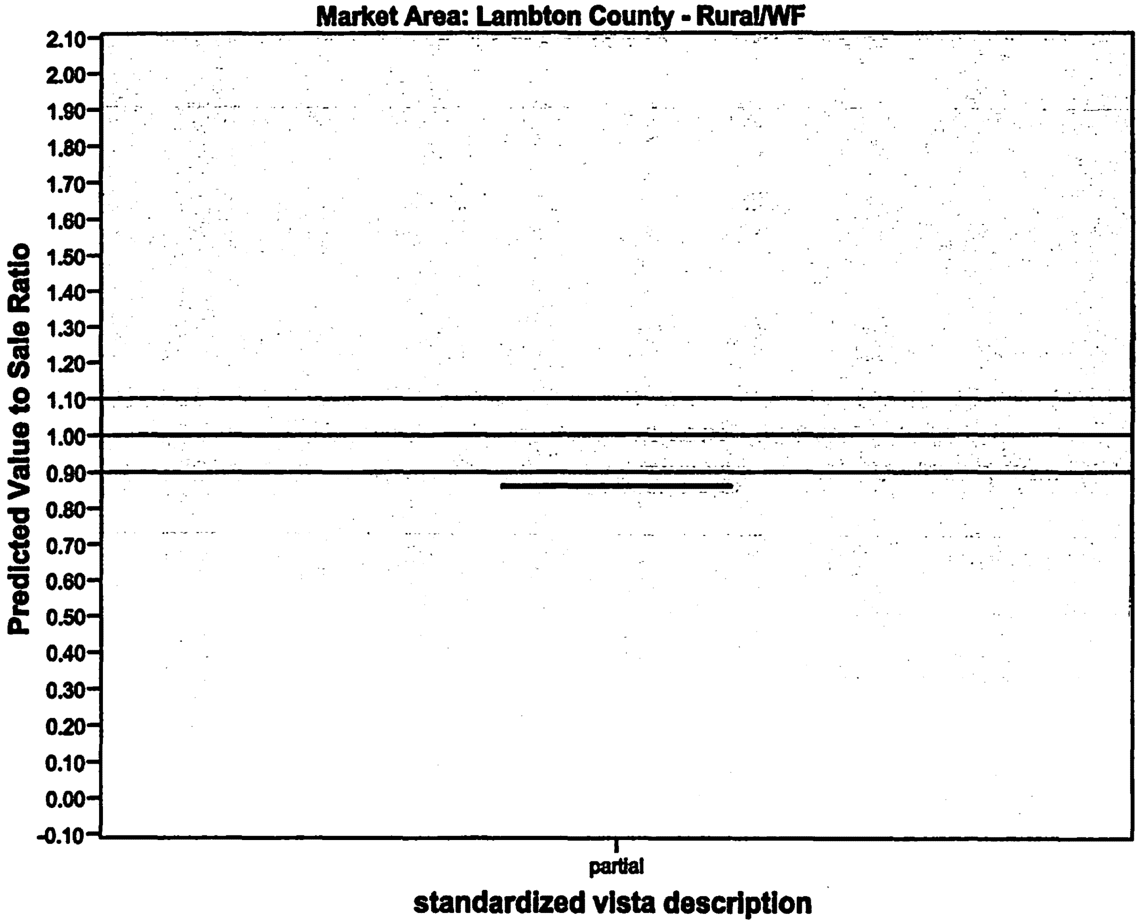
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	partial	1	100.0%	0	.0%	1	100.0%

a. MODEL = 26RR030 Lambton County - Rural/WF

ASRX



MODEL = 27RR120 Essex County

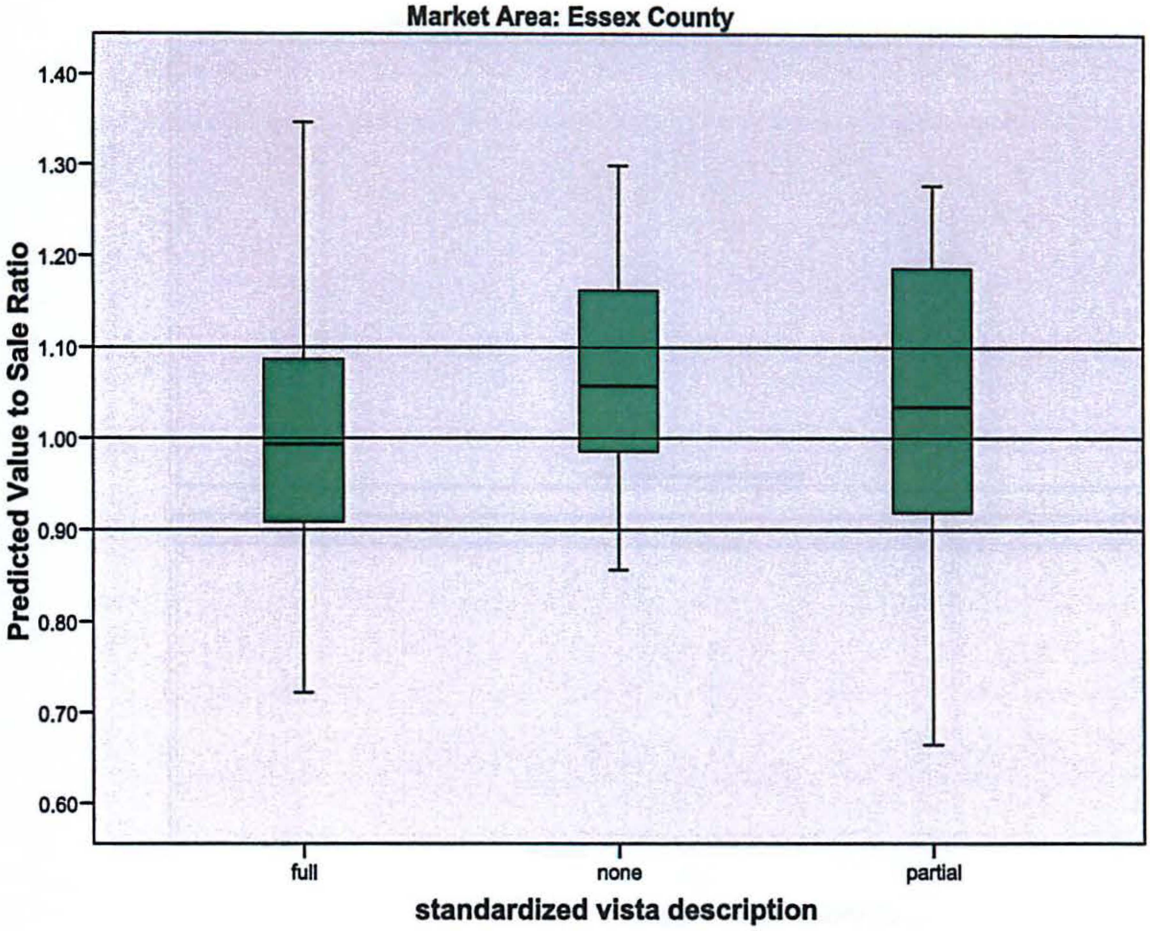
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	74	100.0%	0	.0%	74	100.0%
	none	22	100.0%	0	.0%	22	100.0%
	partial	16	100.0%	0	.0%	16	100.0%

a. MODEL = 27RR120 Essex County

ASRX



MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

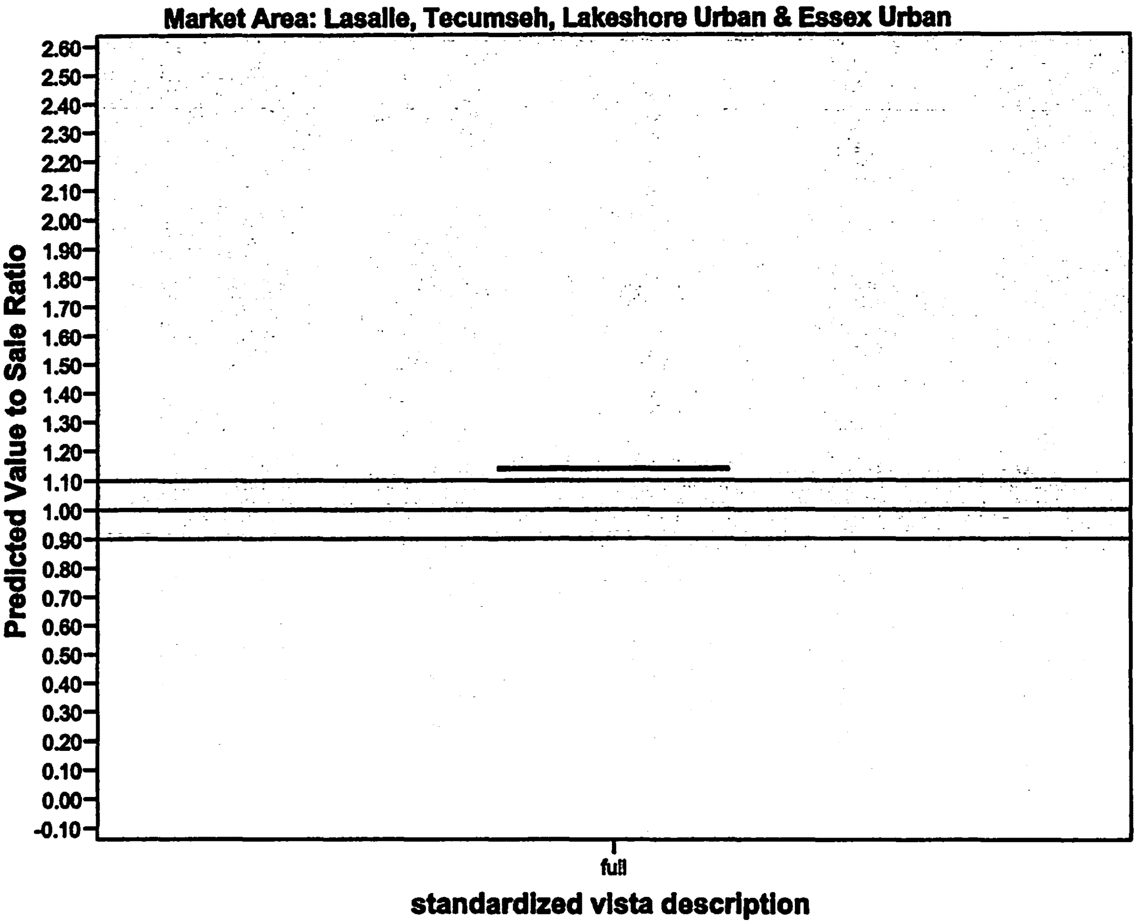
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	1	100.0%	0	.0%	1	100.0%

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

ASRX



Boxplots ASR Sales 1km to 2km by View by Market Area

MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

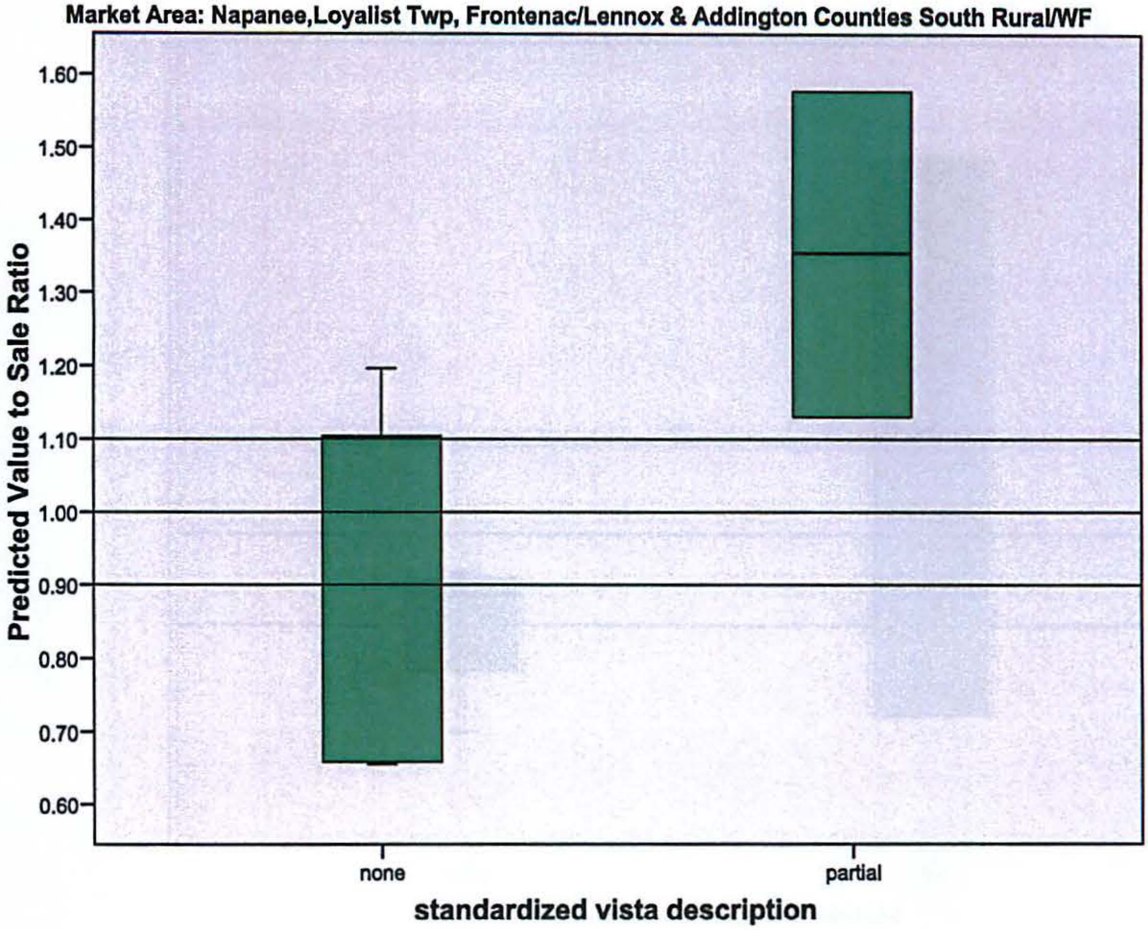
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	none	5	100.0%	0	.0%	5	100.0%
	partial	2	100.0%	0	.0%	2	100.0%

a. MODEL = 05RR030 Napanee,Loyalist Twp, Frontenac/Lennox & Addington Counties South Rural/WF

ASRX



MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

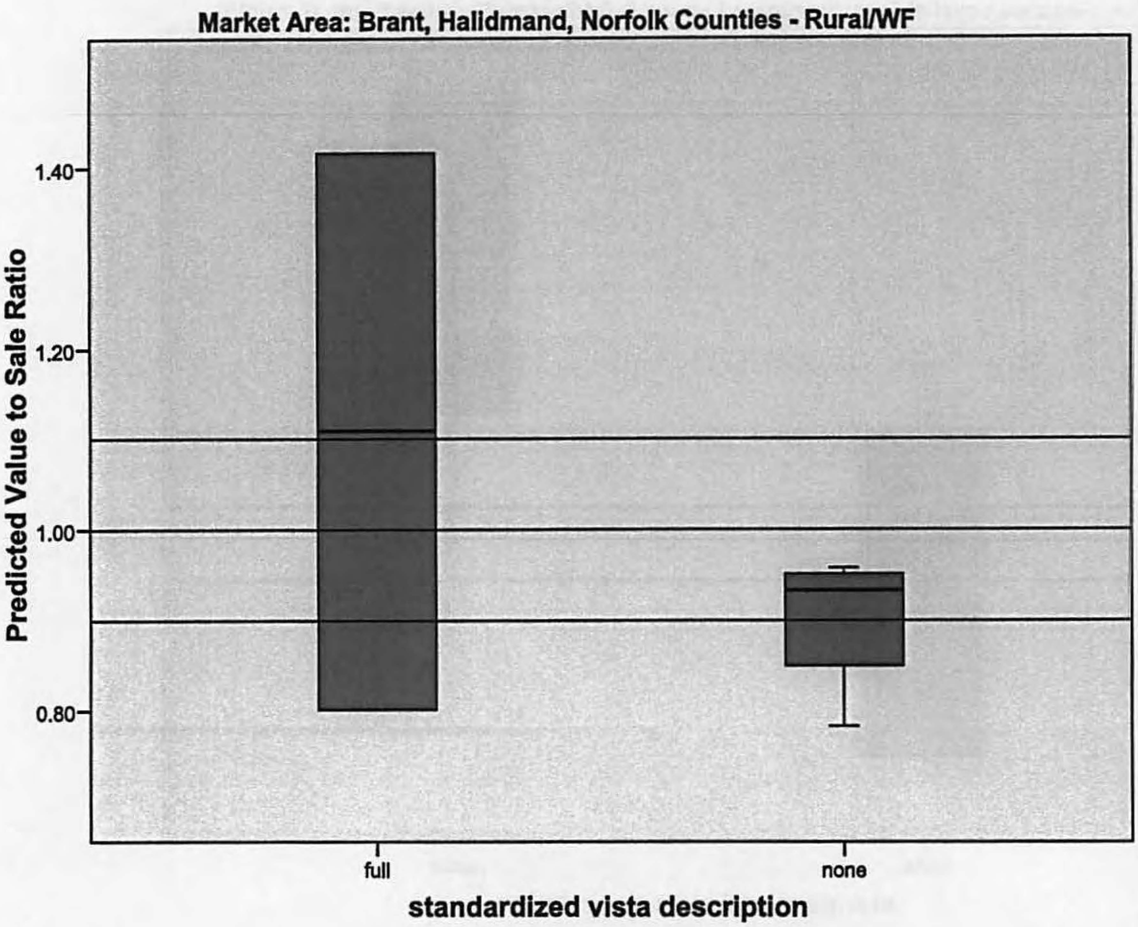
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	2	100.0%	0	.0%	2	100.0%
	none	7	100.0%	0	.0%	7	100.0%

a. MODEL = 20RR010 Brant, Halidmand, Norfolk Counties - Rural/WF

ASRX



MODEL = 22RR010 Dufferin & Wellington Counties - Rural

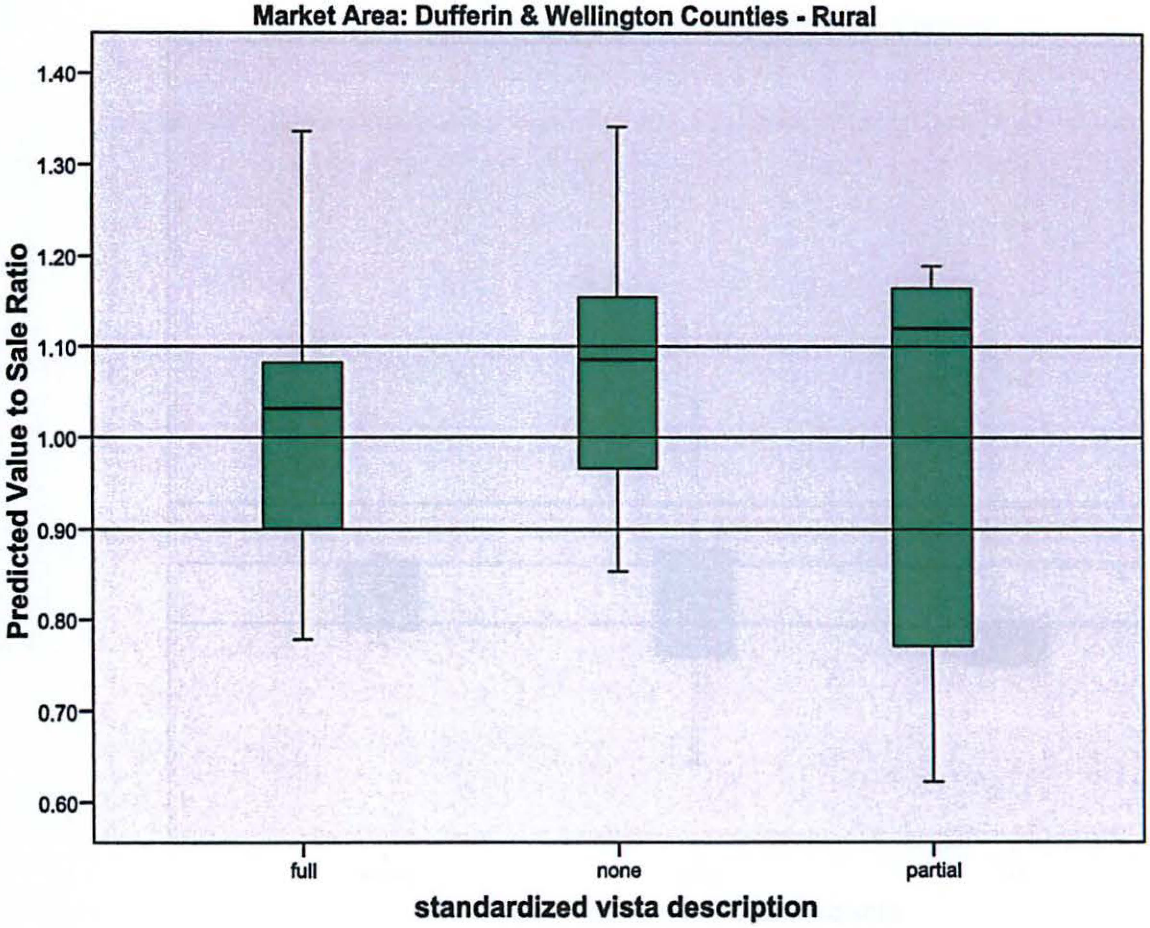
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	10	100.0%	0	.0%	10	100.0%
	none	7	100.0%	0	.0%	7	100.0%
	partial	8	100.0%	0	.0%	8	100.0%

a. MODEL = 22RR010 Dufferin & Wellington Counties - Rural

ASRX



MODEL = 22UR030 Wellington County Villages

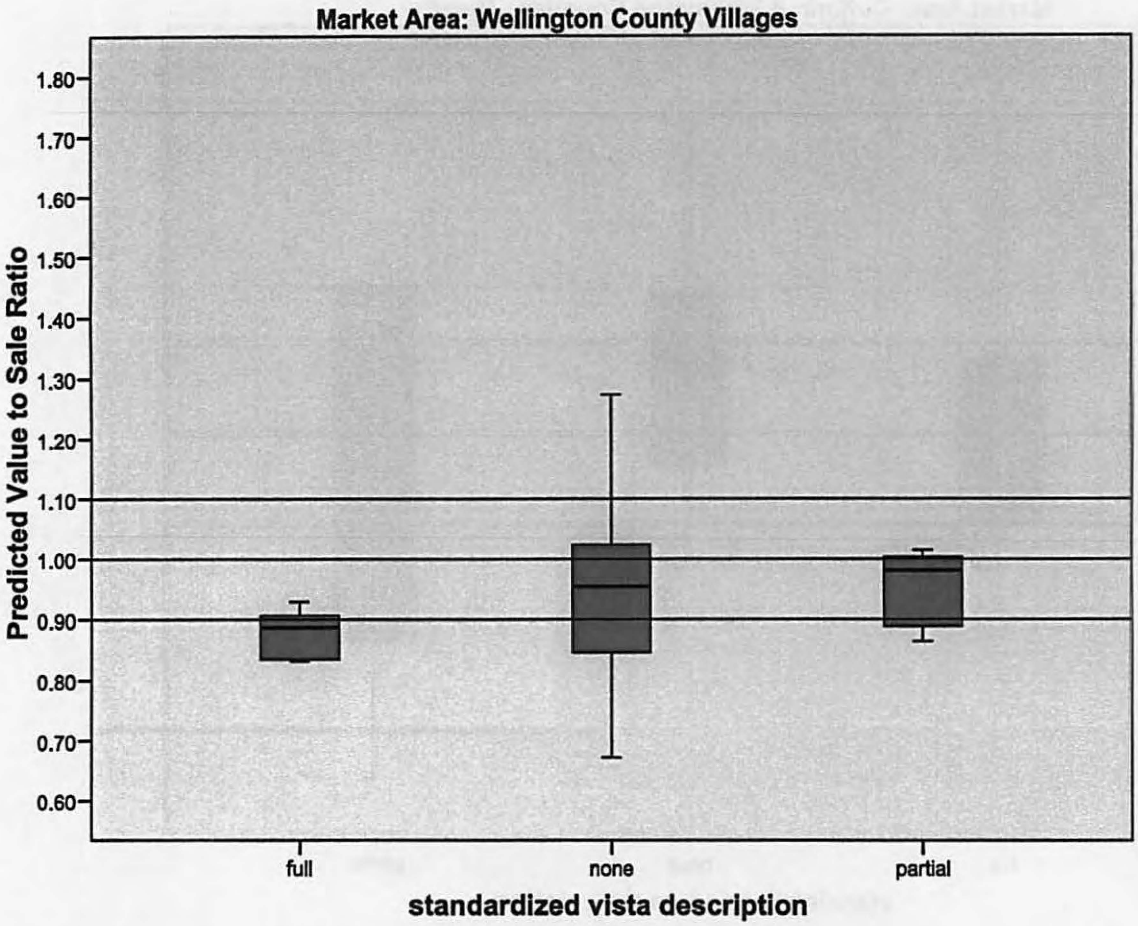
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	6	100.0%	0	.0%	6	100.0%
	none	81	100.0%	0	.0%	81	100.0%
	partial	5	100.0%	0	.0%	5	100.0%

a. MODEL = 22UR030 Wellington County Villages

ASRX



MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

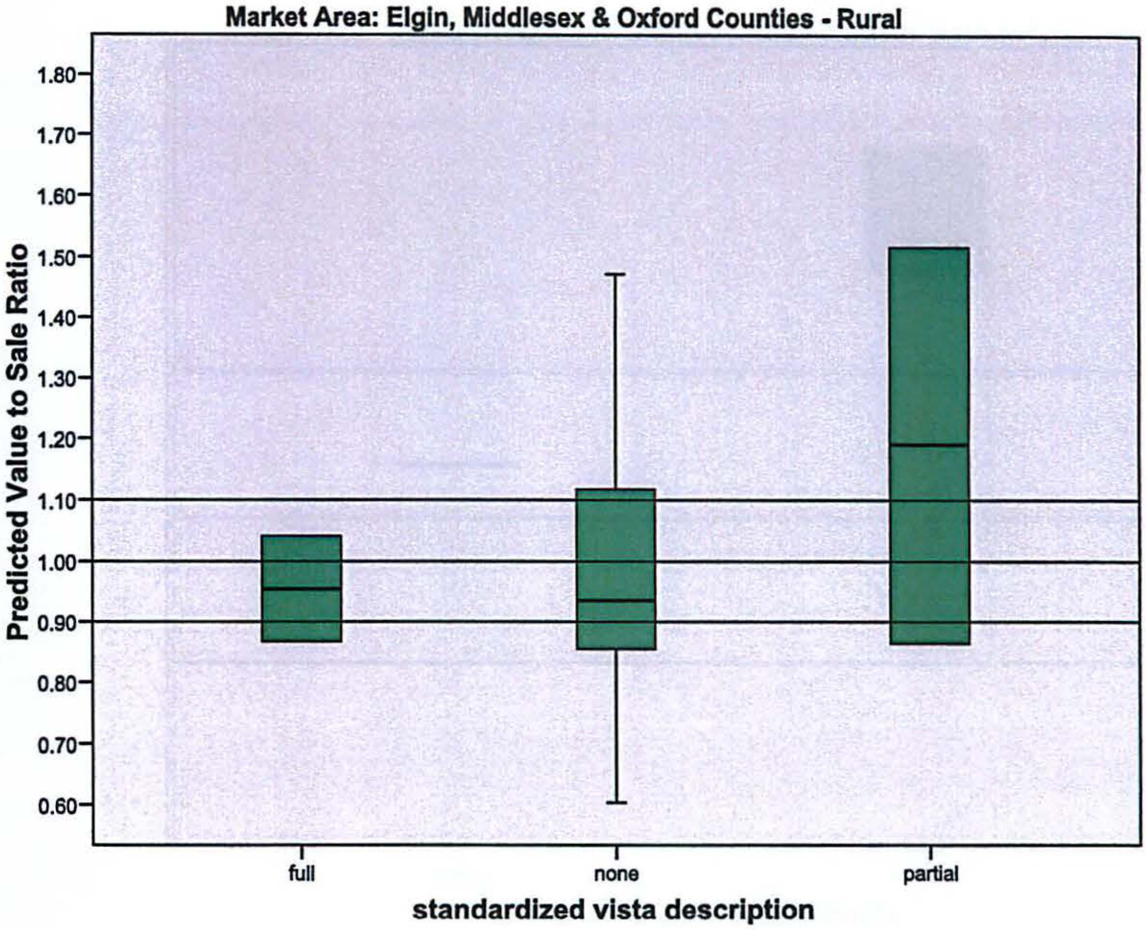
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	2	100.0%	0	.0%	2	100.0%
	none	48	100.0%	0	.0%	48	100.0%
	partial	2	100.0%	0	.0%	2	100.0%

a. MODEL = 23RR010 Elgin, Middlesex & Oxford Counties - Rural

ASRX



MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

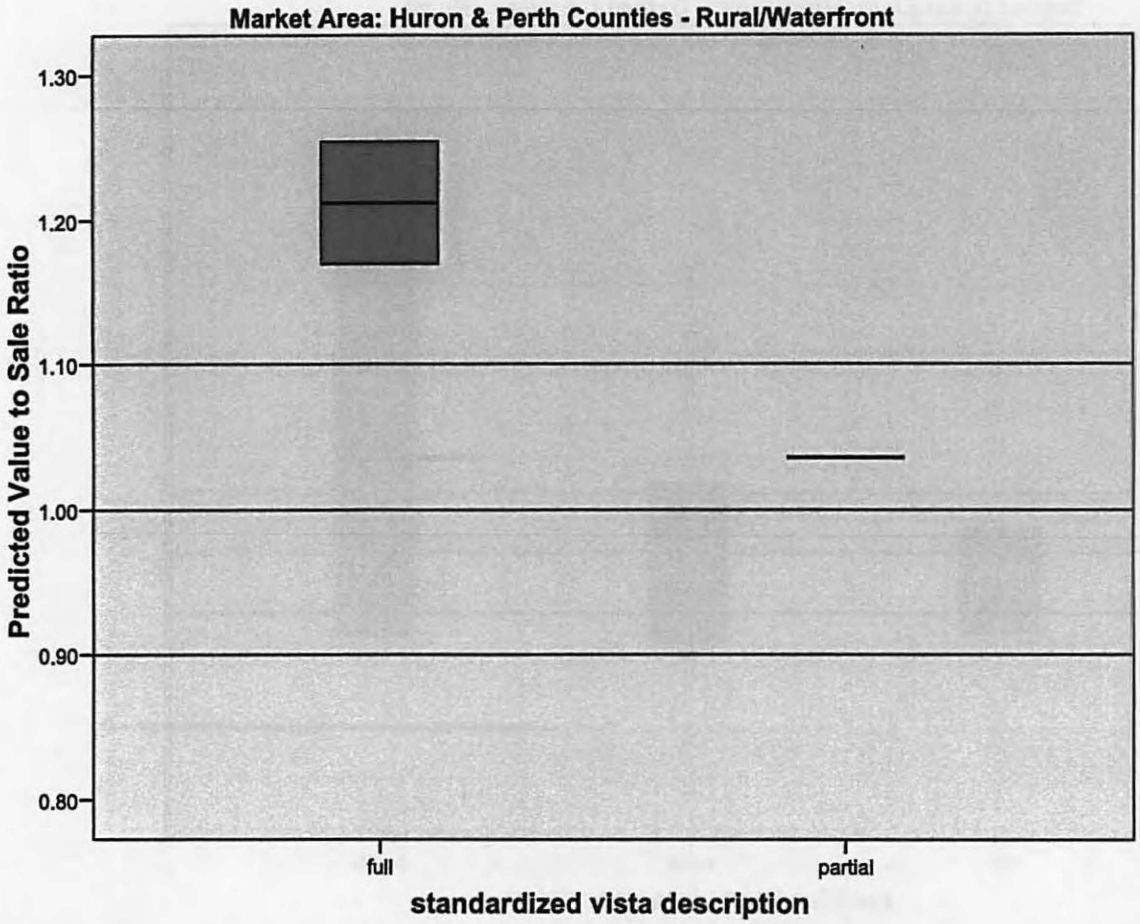
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	2	100.0%	0	.0%	2	100.0%
	partial	1	100.0%	0	.0%	1	100.0%

a. MODEL = 24RR010 Huron & Perth Counties - Rural/Waterfront

ASRX



MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

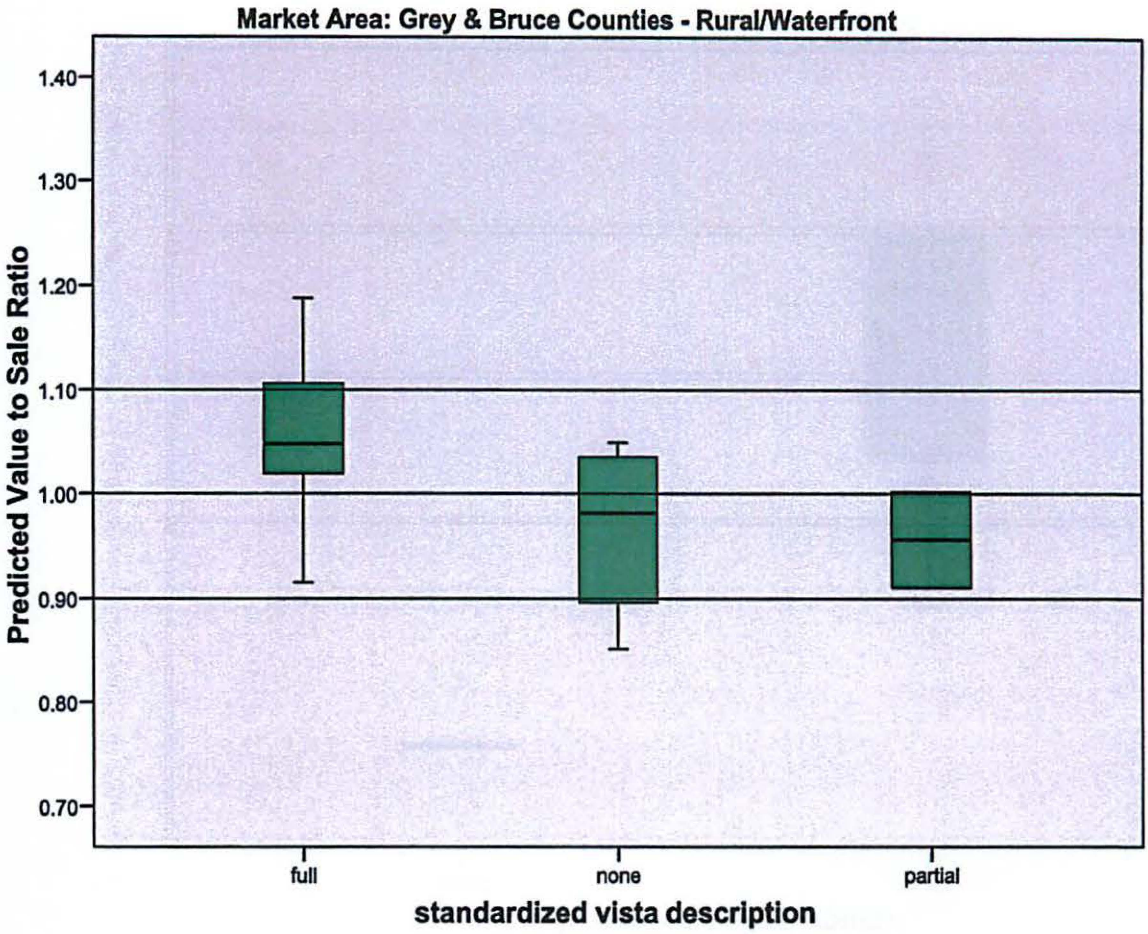
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	13	100.0%	0	.0%	13	100.0%
	none	4	100.0%	0	.0%	4	100.0%
	partial	2	100.0%	0	.0%	2	100.0%

a. MODEL = 25RR010 Grey & Bruce Counties - Rural/Waterfront

ASRX



MODEL = 25UR010 Grey & Bruce Counties - Urban

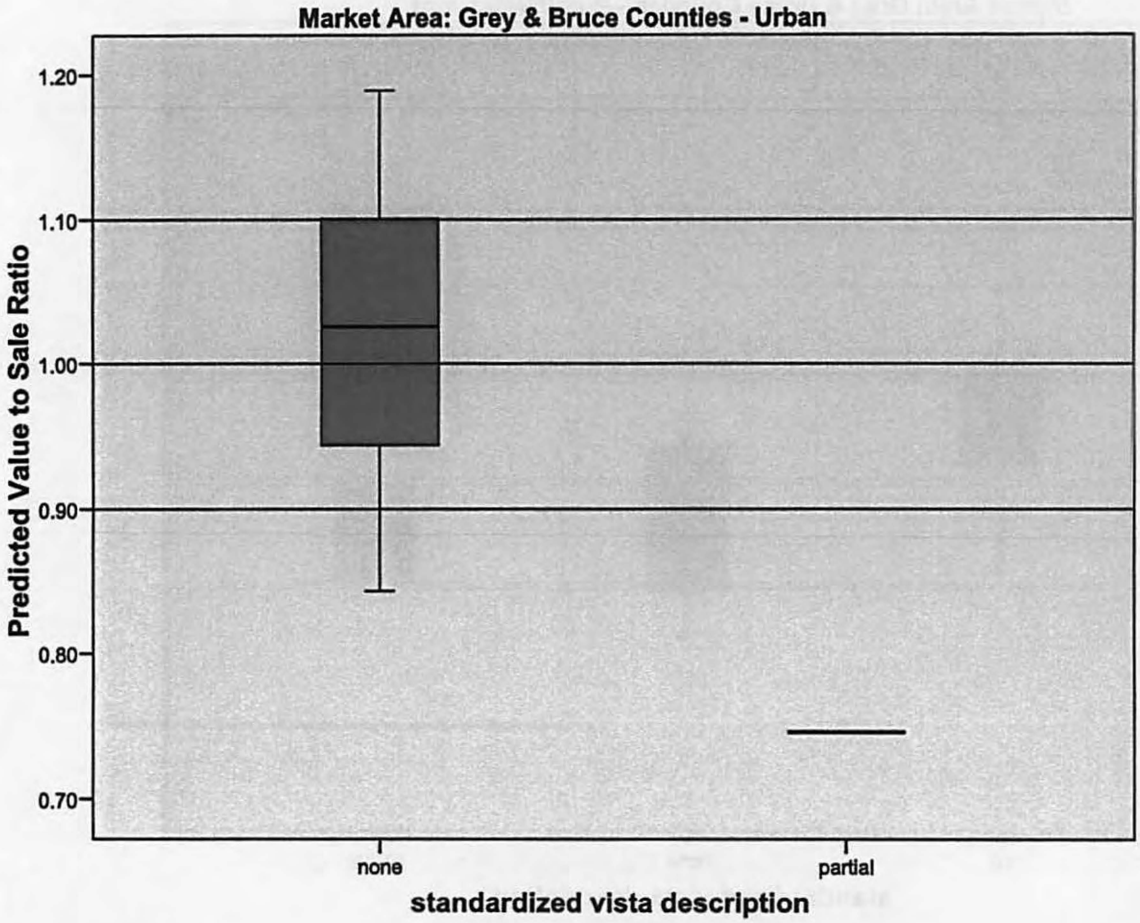
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	none	15	100.0%	0	.0%	15	100.0%
	partial	1	100.0%	0	.0%	1	100.0%

a. MODEL = 25UR010 Grey & Bruce Counties - Urban

ASRX



MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

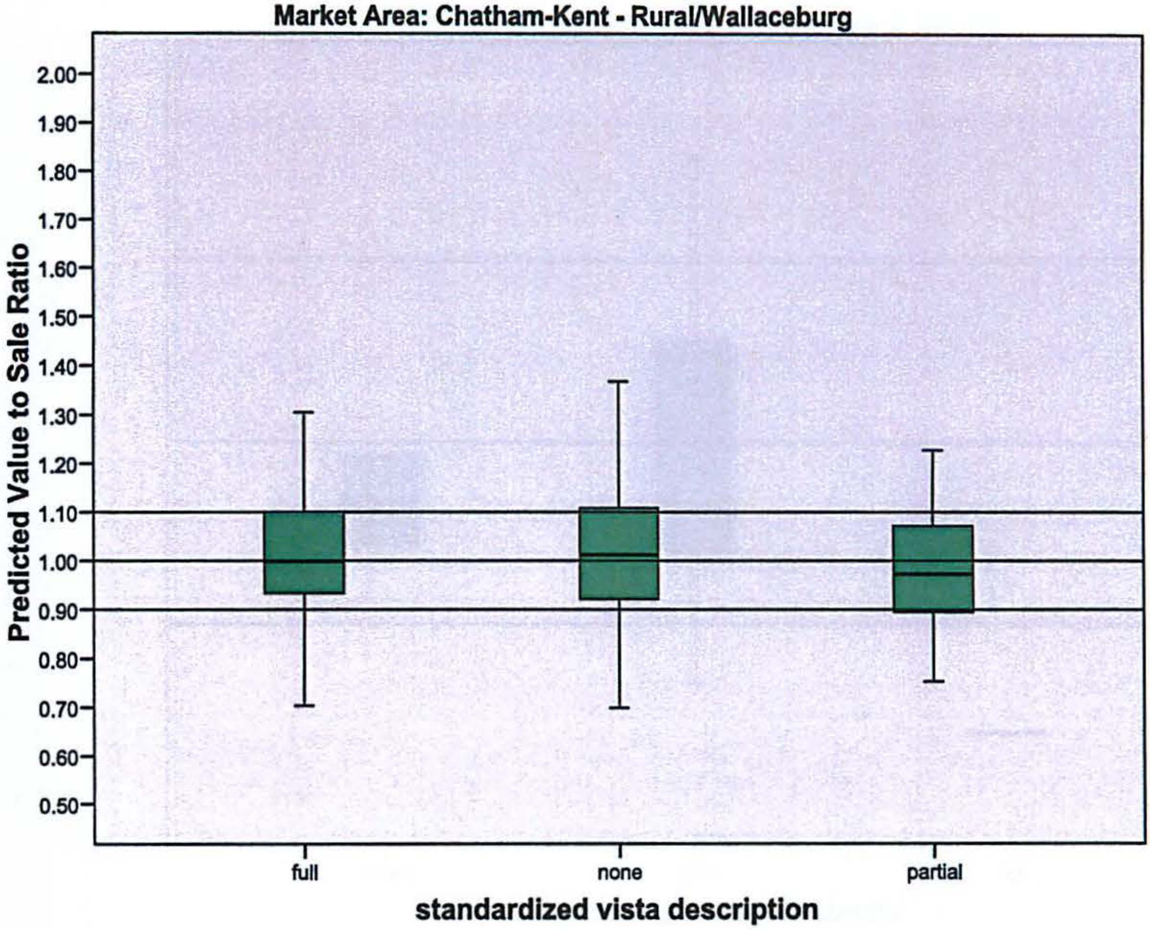
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	78	100.0%	0	.0%	78	100.0%
	none	196	100.0%	0	.0%	196	100.0%
	partial	26	100.0%	0	.0%	26	100.0%

a. MODEL = 26RR010 Chatham-Kent - Rural/Wallaceburg

ASRX



MODEL = 26RR030 Lambton County - Rural/WF

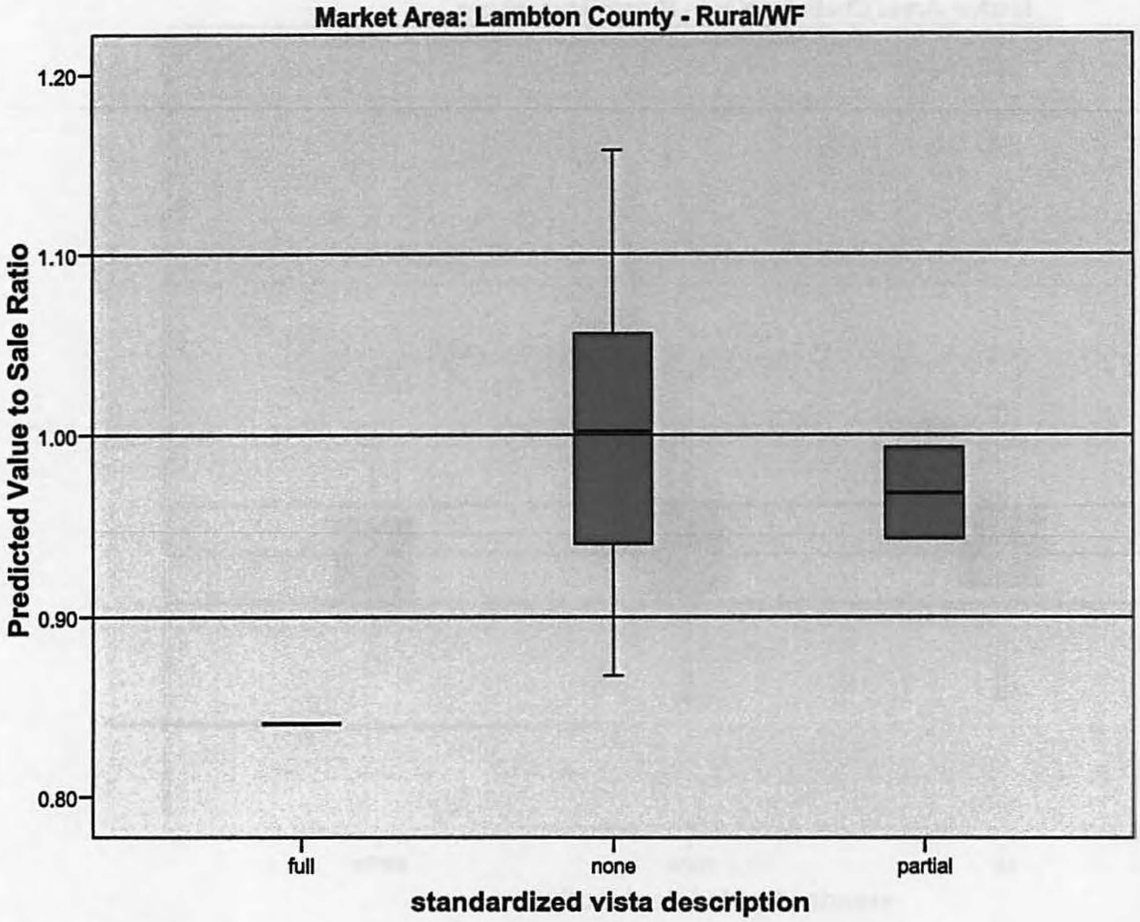
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	1	100.0%	0	.0%	1	100.0%
	none	20	100.0%	0	.0%	20	100.0%
	partial	2	100.0%	0	.0%	2	100.0%

a. MODEL = 26RR030 Lambton County - Rural/WF

ASRX



MODEL = 27RR120 Essex County

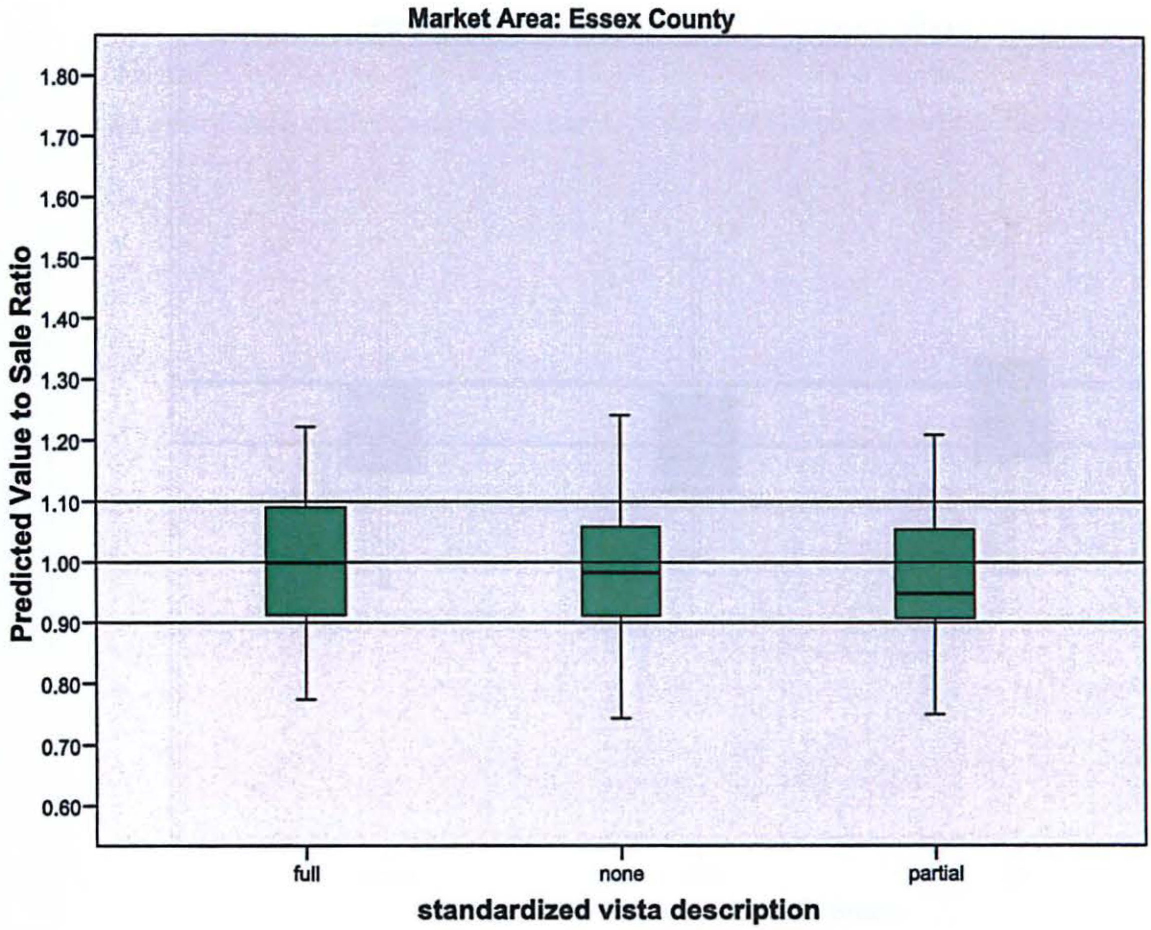
view

Case Processing Summary[a]

	view	Cases Valid N	Valid Percent	Missing N	Missing Percent	Total N	Total Percent
ASRX	full	99	100.0%	0	.0%	99	100.0%
	none	132	100.0%	0	.0%	132	100.0%
	partial	41	100.0%	0	.0%	41	100.0%

a. MODEL = 27RR120 Essex County

ASRX



MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

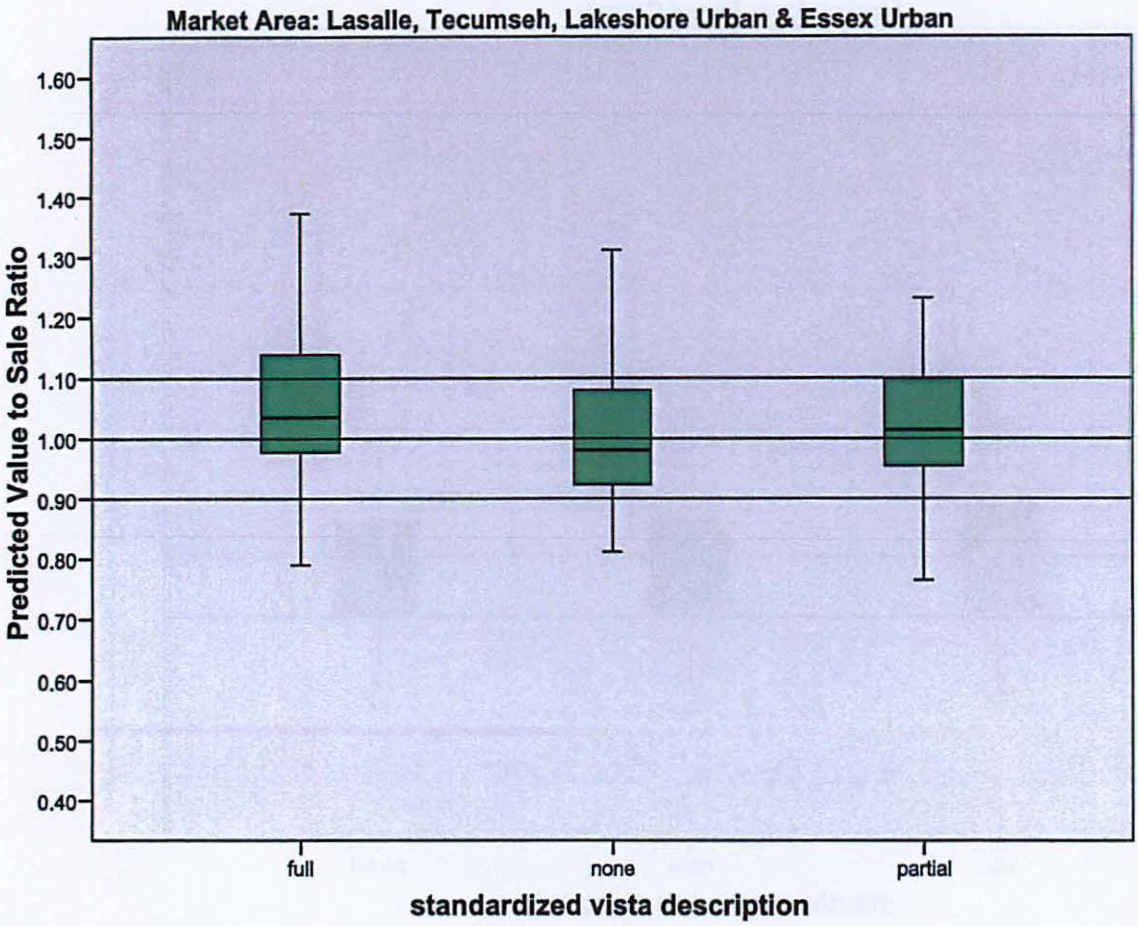
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	full	25	100.0%	0	.0%	25	100.0%
	none	116	100.0%	0	.0%	116	100.0%
	partial	13	100.0%	0	.0%	13	100.0%

a. MODEL = 27UR070 Lasalle, Tecumseh, Lakeshore Urban & Essex Urban

ASRX



MODEL = 31RR010 District of Algoma

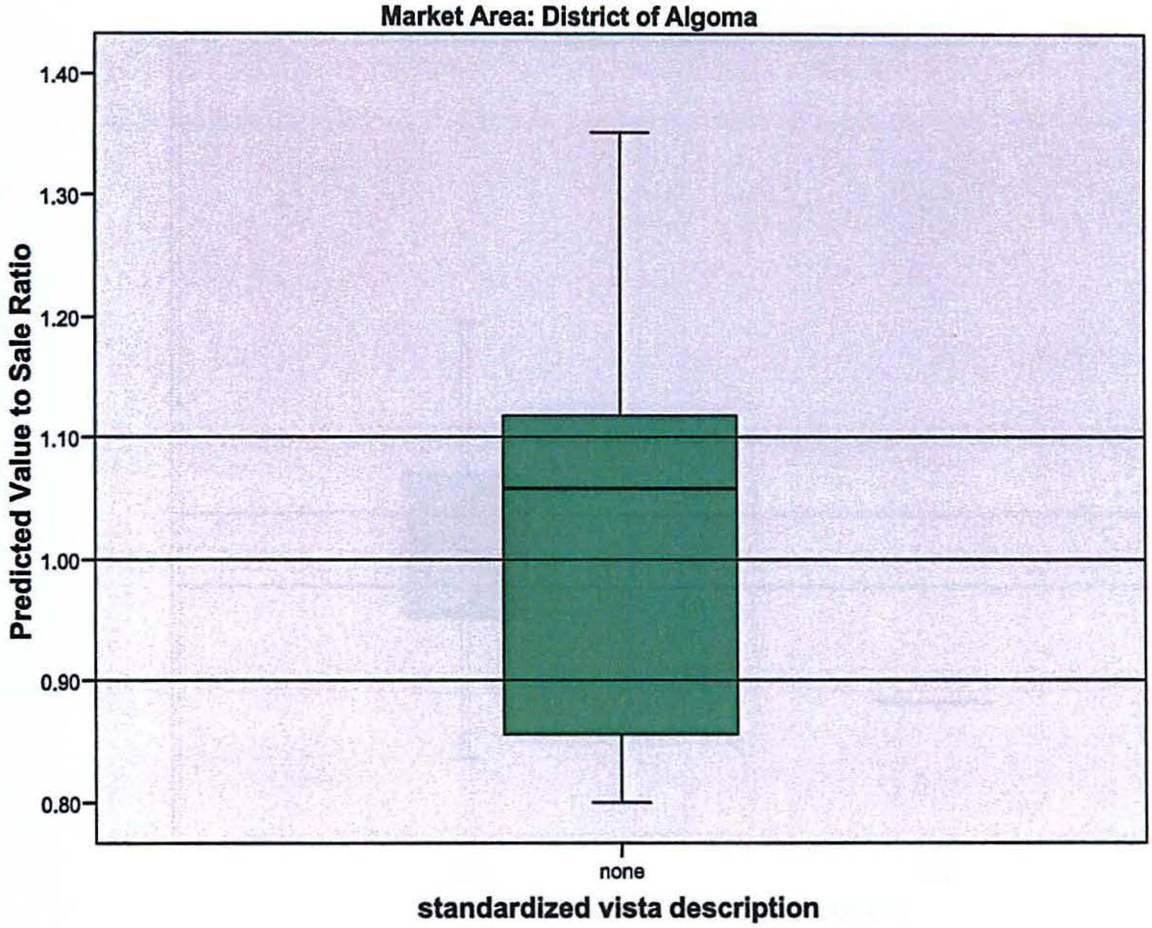
view

Case Processing Summary[a]

		Cases					
		Valid		Missing		Total	
	view	N	Percent	N	Percent	N	Percent
ASRX	none	5	100.0%	0	.0%	5	100.0%

a. MODEL = 31RR010 District of Algoma

ASRX



MODEL = 31UR010 Sault Ste. Marie/Prince Twp

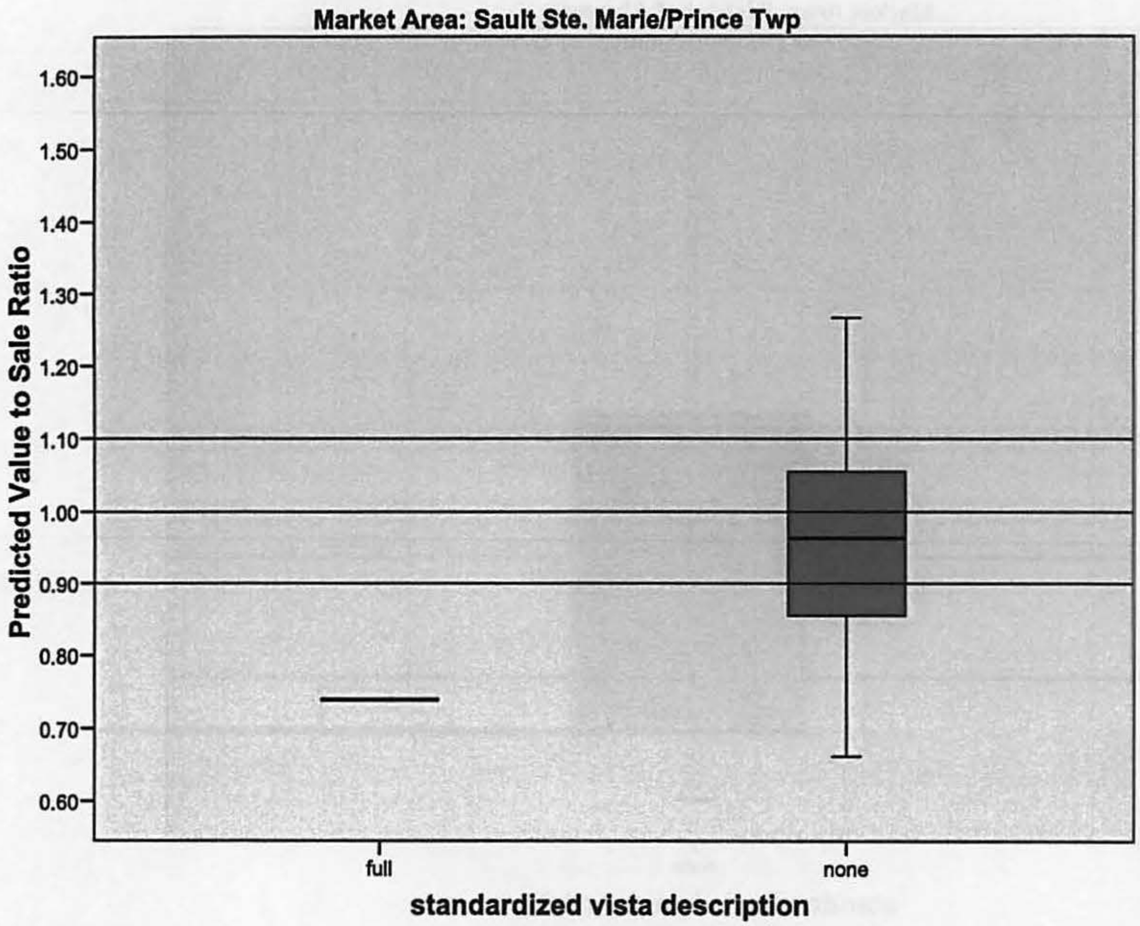
view

Case Processing Summary[a]

	view	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
ASRX	full	1	100.0%	0	.0%	1	100.0%
	none	11	100.0%	0	.0%	11	100.0%

a. MODEL = 31UR010 Sault Ste. Marie/Prince Twp

ASRX


Market Area: Sault Ste. Marie/Prince Twp
Predicted Value to Sale Ratio
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
full
none
standardized vista description

Impact of Wind Turbine Proximity on Sale Price

Background

Concern has been expressed that being in proximity to wind turbines negatively affects the sale prices of homes. To determine if this is the case, MPAC sought to determine if any difference in the market value of these residential homes was evident from its analysis for the 2008 base year reassessment.

Methodology

MPAC does not have a data element that identifies if a property abuts or is in proximity to a wind turbine. Therefore it was necessary to create an inventory of these properties. To do this, MPAC's database was reviewed and every property in the Province with a wind turbine or turbines was flagged. Wind turbines have a unique structure code. Therefore, an extract of every roll number with one or more occurrence of this structure code was completed. Also, the department responsible for valuing wind farms was contacted and a list of all wind farms valued by this group was provided. Using these two sources the inventory was created. It should be noted that if a wind turbine has been recently built and not yet inspected and added to MPAC's database, it would not be included in this inventory.

Next, using MPAC's internal definitions of abuts and proximity (included at the end of this report), we identified any residential property (excluding farms) that met each definition and sold between 2005/01 and 2008/04. The number of wind turbines on the site that abutted or was in proximity was also recorded along with their total wattage. Farm sales were not included in this study because the Assessment Act dictates that they be valued based on their productive value using only farmer-to-farmer sales (Section 19.5). This is different from residential properties that are assessed based on their most probable selling price on the open market (Section 19.1). As a result, assessed values of farms can differ from their sale prices and would skew the results of this study.

Sale prices were time adjusted to reflect the January 1, 2008 valuation date used for MPAC's latest reassessment. These time adjustments were developed by market model area using all valid residential sales that occurred over the time period mentioned above. There are 131 market model areas in the Province. Once identified MPAC can compare its assessed values to the time adjusted sale prices to see if the results indicate any pattern of overassessment or underassessment.

Results

Because MPAC did not make an adjustment for proximity to wind turbines when developing its assessed values, if wind turbines did not affect value, one would expect to see assessment to sales ratios (the assessed value divided by the time adjusted sale price) near 1. If wind turbines had a negative affect, one would expect to see an average assessment to sale ratio (ASR) above 1.

Impact of Wind Turbine Proximity on Sale Price

Province-wide there were 17 sales that met the specified criteria. Six sales abutted wind turbines. Eleven sales were in proximity to wind turbines (Using MPAC's internal definitions). The median assessment to sales ratio was 88% for the abutting properties and 92% for properties in proximity to wind turbines (see attached spreadsheet for full results). Also, there was no apparent relationship with the amount of power generated at the nearby site and the ASR. Given the limited number of sales, it is not possible to draw definitive conclusions. However, at this time it appears that there is not adequate evidence to warrant a negative adjustment to residential properties that abut or are in proximity to wind turbines.

Assessment Act Sections

19.1 The assessment of land shall be based on its Current Value. "Current Value" as defined in the Act means, in relation to land, the amount of money the fee simple, if unencumbered, would realize if sold at arm's length by a willing seller to a willing buyer

19.5 For the purposes of determining the current value of farm lands used only for farm purposes by the owner or used only for farm purposes by a tenant of the owner and buildings thereon used solely for farm purposes, including the residence of the owner or tenant and of the owner's or tenant's employees and their families on the farm lands,

(a) consideration shall be given to the current value of the lands and buildings for farm purposes only;

(b) consideration shall not be given to sales of lands and buildings to persons whose principal occupation is other than farming; and

(c) the Minister may, by regulation, define "farm lands" and "farm purposes".

MPAC's Internal Definitions of Abuts and Proximity

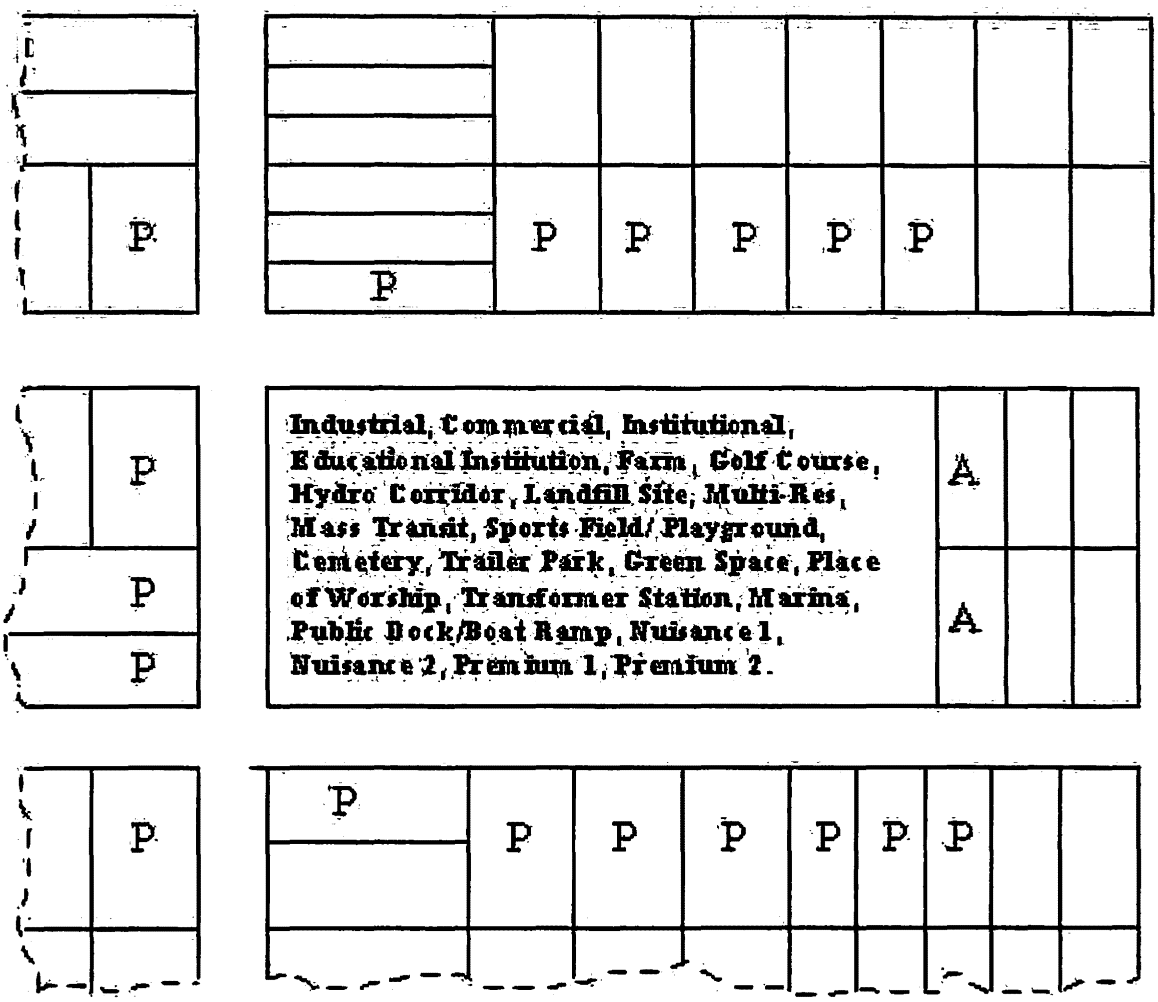
ABUTS: Property is directly and immediately contiguous, physically touching, or sharing a common boundary line with another property or a site characteristic.

PROXIMITY: Property is directly across or diagonally across from the feature or attribute being described. It also includes properties within an economic neighbourhood that are positively or negatively affected by an economic influence, which affects the value within that neighbourhood. This may affect a few houses on a street, the entire street or a larger area. The positive or negative effect of economic influences may be different in some extreme situations and therefore may change the boundaries of what is normally considered 'proximity". Exceptions to the standard definition of proximity require appraisal judgement, common sense and consistency. *See Illustration for standard examples of abuts and proximity properties.*

Impact of Wind Turbine Proximity on Sale Price

ILLUSTRATIONS FOR ABUTS and PROXIMITY

1.



Appendix F – Study # 2 Regression Recalibrations
Excluded Variables by Market Model

05RR030 Excluded Variables

Model: 19

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
SC304SF	-.004(s)	-.565	.572	-.012	.970	1.031	.184
TRAFFIC	-.006(s)	-.873	.383	-.018	.921	1.086	.184
rd_gravl	-.002(s)	-.255	.799	-.005	.825	1.212	.184
IWT_2KM	-.010(s)	-1.091	.275	-.023	.603	1.657	.183

20RR010 Excluded Variables

Model: 58

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
LAND_A92	-.003(fff)	-.606	.545	-.008	.706
LAND_A94	.002(fff)	.345	.730	.005	.678
LAND_A95	.000(fff)	-.057	.955	-.001	.938
LAND_A96	-.004(fff)	-.927	.354	-.013	.911
LAND_A97	-.001(fff)	-.268	.789	-.004	.902
LAND_A98	.001(fff)	.312	.755	.004	.951
LAND_AA8	.004(fff)	.647	.518	.009	.545
LAND_A18	.003(fff)	.475	.635	.007	.626
LAND_A46	-.001(fff)	-.249	.803	-.003	.973
LAND_A77	.004(fff)	.822	.411	.012	.778
LAND_AA6	.004(fff)	.911	.362	.013	.756
LAND_B62	.005(fff)	1.194	.233	.017	.943
LAND_B64	-.003(fff)	-.752	.452	-.011	.928
LAND_B65	.003(fff)	.524	.600	.007	.652
LAND_B67	-.003(fff)	-.512	.609	-.007	.638
LAND_B71	-.002(fff)	-.444	.657	-.006	.925
LAND_A14	-.002(fff)	-.386	.699	-.005	.981
LAND_A20AA2AB2	-.001(fff)	-.236	.814	-.003	.987
LAND_A21	-.005(fff)	-1.207	.227	-.017	.917
LAND_A22	.000(fff)	-.074	.941	-.001	.909
LAND_A23	-.001(fff)	-.265	.791	-.004	.990
LAND_A24	.002(fff)	.391	.696	.005	.983
LAND_A25	.000(fff)	-.009	.993	.000	.989
LAND_A26	-.004(fff)	-1.016	.310	-.014	.984
LAND_A27	.003(fff)	.659	.510	.009	.980
LAND_A31	.002(fff)	.537	.591	.008	.993
LAND_A34	-.007(fff)	-1.524	.128	-.021	.965
LAND_A35	-.002(fff)	-.480	.631	-.007	.988
LAND_A37	-.003(fff)	-.484	.628	-.007	.486

LAND_A38	-.006(fff)	-1.506	.132	-.021	.989
LAND_A53B60	.003(fff)	.622	.534	.009	.987
LAND_A54	.006(fff)	1.365	.172	.019	.983
LAND_A57	-.001(fff)	-.281	.779	-.004	.979
LAND_A62A65	-.001(fff)	-.243	.808	-.003	.990
LAND_A63	-.007(fff)	-1.572	.116	-.022	.967
LAND_A64	-.001(fff)	-.351	.725	-.005	.986
LAND_A80	-.006(fff)	-1.454	.146	-.020	.982
LAND_A76	.004(fff)	.956	.339	.013	.842
LAND_A88	-.006(fff)	-1.337	.181	-.019	.895
LAND_AA3	.002(fff)	.583	.560	.008	.990
LAND_AA4	.005(fff)	1.115	.265	.016	.990
LAND_A05	.006(fff)	1.095	.273	.015	.643
LAND_A07	.007(fff)	1.297	.195	.018	.573
LAND_A09	.001(fff)	.108	.914	.002	.544
LAND_A59	-.005(fff)	-1.264	.206	-.018	.969
SIMCOE_BUILTON	-.015(fff)	-.875	.382	-.012	.062
PORTDOVER_BUILTON	.016(fff)	1.038	.299	.015	.072
HNVILLAGES_BUILTON	.012(fff)	.740	.459	.010	.071
CALEDONIA_VACANT	-.006(fff)	-1.226	.220	-.017	.680
IWT_1KM	-.006(fff)	-1.385	.166	-.019	.913
IWT_2KM	-.002(fff)	-.459	.646	-.006	.978
IWT_5KM	-.002(fff)	-.392	.695	-.005	.716

22RR010 Excluded Variables

Model: 32

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
NB304	-.005(ff)	-.503	.615	-.012	.940
NB306	.008(ff)	.767	.443	.018	.864
NB307	-.005(ff)	-.495	.621	-.012	.915
NB312	.011(ff)	1.027	.305	.024	.771
NB313	.006(ff)	.622	.534	.015	.863
NB331	.006(ff)	.590	.555	.014	.759
NB332	-.009(ff)	-.837	.403	-.020	.697
NB335	.005(ff)	.544	.587	.013	.914
NB341	.003(ff)	.290	.772	.007	.704
NB342	-.004(ff)	-.430	.667	-.010	.905
NB345	.000(ff)	-.042	.967	-.001	.747
SPL_BF	-.001(ff)	-.117	.907	-.003	.963
SPL_SIDE	-.003(ff)	-.358	.720	-.009	.978
corner	-.007(ff)	-.764	.445	-.018	.977
rd_gravl	-.009(ff)	-.877	.381	-.021	.850
IWT_1KM	-.001(ff)	-.089	.929	-.002	.888
IWT_2KM	-.003(ff)	-.268	.789	-.006	.945
IWT_5KM	-.009(ff)	-.961	.337	-.023	.920

23RR010 excluded variables

Model: 73

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
NB0327	-.012(uuu)	-1.229	.219	-.020	.320
NB0367	-.001(uuu)	-.202	.840	-.003	.868
NB0369	.004(uuu)	.600	.549	.010	.664
NB0337	-.010(uuu)	-1.028	.304	-.016	.353
NB0338	.005(uuu)	.837	.403	.013	.851
NB0339	.003(uuu)	.367	.714	.006	.530
PCVLCONDO_BUILT	.000(uuu)	-.042	.967	-.001	.994
dw_shar	-.008(uuu)	-1.407	.159	-.022	.972
ab_playg	-.006(uuu)	-1.006	.314	-.016	.968
ab_walkw	-.002(uuu)	-.393	.695	-.006	.953
ab_cemet	.005(uuu)	.852	.394	.014	.982
ab_chrch	.006(uuu)	1.048	.295	.017	.965
pr_playg	-.006(uuu)	-1.037	.300	-.017	.914
pr_green	-.005(uuu)	-.854	.393	-.014	.971
pr_chrch	-.004(uuu)	-.730	.465	-.012	.940
culdesac	.003(uuu)	.494	.622	.008	.879
tp_steep	.001(uuu)	.220	.826	.004	.821
tp_low	-.005(uuu)	-.858	.391	-.014	.927
H3227X35	.007(uuu)	.940	.347	.015	.596
H3227X61	-.007(uuu)	-1.176	.240	-.019	.791
H3238X61	.(uuu)	.	.	.	.000
H3245B25	.004(uuu)	.606	.545	.010	.696
H3245X30	-.012(uuu)	-.804	.421	-.013	.136
H3202X15	-.002(uuu)	-.317	.751	-.005	.516
H3202X46	.007(uuu)	1.235	.217	.020	.917
H3211X15	-.008(uuu)	-1.428	.154	-.023	.893
H3418E26	-.006(uuu)	-1.028	.304	-.016	.886
H3418E21	.002(uuu)	.406	.685	.006	.931
H3424E04	-.008(uuu)	-1.274	.203	-.020	.829
H3424E05	.006(uuu)	1.047	.295	.017	.913
H3424E10	-.003(uuu)	-.554	.580	-.009	.939
H3424E11	-.001(uuu)	-.179	.858	-.003	.921
H3939A06	-.002(uuu)	-.329	.742	-.005	.890
H3939A07	.008(uuu)	1.359	.174	.022	.942
H3926A12	.005(uuu)	.921	.357	.015	.921
H3906M03	-.009(uuu)	-1.465	.143	-.023	.839
H3906M05	.002(uuu)	.211	.833	.003	.236
H3916A04	.009(uuu)	1.596	.111	.025	.912
H3926A22	.002(uuu)	.312	.755	.005	.940
IWT_1KM	-.008(uuu)	-1.438	.150	-.023	.987
IWT_2KM	-.003(uuu)	-.308	.758	-.005	.286

24RR010 Excluded Variables

Model: 33

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
NB1306	.015(gg)	1.370	.171	.049	.972
NB1307	-.009(gg)	-.823	.411	-.030	.993
NB1308	.000(gg)	.014	.989	.001	.963
NB1309	-.003(gg)	-.240	.810	-.009	.984
NB1310	.002(gg)	.145	.885	.005	.895
NB1311	.003(gg)	.263	.792	.010	.954
NB1312	-.014(gg)	-1.217	.224	-.044	.958
NB1314	-.016(gg)	-1.363	.173	-.049	.941
NB1316	.006(gg)	.557	.578	.020	.973
NB1317	-.006(gg)	-.509	.611	-.018	.956
NB1319	-.004(gg)	-.319	.750	-.012	.911
NB1320	-.013(gg)	-1.122	.262	-.041	.926
NB1322	-.005(gg)	-.407	.684	-.015	.928
NB1324	-.009(gg)	-.834	.404	-.030	.971
NB1330	-.008(gg)	-.744	.457	-.027	.944
NB1331	.000(gg)	.027	.978	.001	.934
NB1402	.007(gg)	.562	.574	.020	.833
NB1403	.005(gg)	.405	.685	.015	.825
NB1404	.007(gg)	.633	.527	.023	.916
NB1405	.012(gg)	.983	.326	.036	.858
NB1407	-.009(gg)	-.732	.464	-.026	.895
NB1408	.008(gg)	.617	.538	.022	.800
NB1410	.012(gg)	1.044	.297	.038	.922
NB1411	.013(gg)	1.157	.248	.042	.972
vl_1321	.015(gg)	1.113	.266	.040	.719
vl_1323	-.013(gg)	-.957	.339	-.035	.719
vl_1332	.008(gg)	.671	.503	.024	.885
RAV_LIN	.004(gg)	.379	.705	.014	.883
sc310sf	.001(gg)	.098	.922	.004	.910
IWT_1KM	-.009(gg)	-.829	.407	-.030	.955
IWT_2KM	-.010(gg)	-.836	.403	-.030	.953
IWT_5KM	.000(gg)	-.006	.995	.000	.572

25RR010 Excluded Variables

Model: 47

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
NB1200	.005(uu)	.716	.474	.013	.817
NB1202	.011(uu)	1.351	.177	.024	.580
NB1206	.008(uu)	1.097	.273	.020	.747
NB1209	-.002(uu)	-.300	.764	-.005	.864
NB1210	-.009(uu)	-1.132	.258	-.020	.638
NB1213	.006(uu)	.746	.456	.013	.558
NB1216	-.006(uu)	-.898	.369	-.016	.920
NB1217	-.002(uu)	-.318	.750	-.006	.958
NB1218	.002(uu)	.255	.799	.005	.836
NB1219	.010(uu)	1.588	.112	.029	.872
NB1221	.001(uu)	.186	.852	.003	.667
NB1222	-.005(uu)	-.848	.396	-.015	.894
NB1225	.006(uu)	.484	.629	.009	.219
NB1226	.004(uu)	.634	.526	.011	.950
NB1227	-.006(uu)	-.950	.342	-.017	.931
NB1228	.001(uu)	.135	.893	.002	.984
NB1229	-.002(uu)	-.267	.790	-.005	.958
NB1230	.002(uu)	.278	.781	.005	.965
NB1231	-.004(uu)	-.697	.486	-.013	.983
NB1232	.001(uu)	.225	.822	.004	.984
NB1233	.003(uu)	.424	.671	.008	.996
NB1235	-.001(uu)	-.129	.897	-.002	.970
NB1236	.010(uu)	1.602	.109	.029	.863
NB1237	.006(uu)	.813	.416	.015	.718
NB1238	-.004(uu)	-.564	.573	-.010	.794
NB1239	.006(uu)	.903	.366	.016	.983
NB1240	-.010(uu)	-1.402	.161	-.025	.750
NB1242	.005(uu)	.741	.459	.013	.831
NB1243	.001(uu)	.171	.864	.003	.811
NB1244	.001(uu)	.090	.928	.002	.459
NB1246	-.008(uu)	-1.308	.191	-.024	.968
NB1247	-.009(uu)	-1.491	.136	-.027	.953
NB1249	-.004(uu)	-.577	.564	-.010	.626
NB1250	.004(uu)	.639	.523	.011	.832
NB1251	.004(uu)	.630	.529	.011	.892
NB1300	.013(uu)	1.323	.186	.024	.374
NB1302	.007(uu)	.879	.380	.016	.664
NB1303	-.007(uu)	-1.156	.248	-.021	.902
NB1305	.004(uu)	.580	.562	.010	.819
NB1307	.010(uu)	1.400	.162	.025	.760
NB1309	.000(uu)	.071	.944	.001	.922
NB1310	-.004(uu)	-.496	.620	-.009	.576
NB1311	.009(uu)	1.437	.151	.026	.941
NB1312	.000(uu)	-.006	.995	.000	.913

NB1313	.002(uu)	.289	.773	.005		.967
NB1314	-.004(uu)	-.641	.521	-.012		.978
NB1315	.006(uu)	.983	.326	.018		.847
NB1316	-.006(uu)	-.971	.332	-.017		.839
NB1317	-.003(uu)	-.521	.603	-.009		.937
NB1318	.003(uu)	.369	.712	.007		.758
NB1319	-.008(uu)	-1.262	.207	-.023		.958
NB1320	-.003(uu)	-.469	.639	-.008		.805
NB1321	.001(uu)	.092	.927	.002		.801
NB1322	.000(uu)	-.050	.960	-.001		.826
NB1323	.008(uu)	1.261	.207	.023		.959
NB1325	-.007(uu)	-1.156	.248	-.021		.990
NB1326	.005(uu)	.724	.469	.013		.930
NB1328	.002(uu)	.352	.725	.006		.994
NB1329	-.005(uu)	-.683	.495	-.012		.598
NB1330	.001(uu)	.179	.858	.003		.925
NB1332	.001(uu)	.207	.836	.004		.842
NB1333	-.010(uu)	-1.433	.152	-.026		.742
NB1334	-.009(uu)	-1.328	.184	-.024		.830
NB1335	.002(uu)	.316	.752	.006		.878
NB1336	.007(uu)	1.015	.310	.018		.813
NB1338	-.002(uu)	-.390	.696	-.007		.932
NB1339	-.009(uu)	-1.454	.146	-.026		.910
NB1340	-.007(uu)	-1.115	.265	-.020		.942
NB1341	-.009(uu)	-1.278	.201	-.023		.725
NB1343	-.012(uu)	-1.454	.146	-.026		.532
NB1344	-.003(uu)	-.484	.628	-.009		.831
NB1345	-.007(uu)	-1.000	.317	-.018		.712
NB1346	-.003(uu)	-.513	.608	-.009		.924
NB1347	-.006(uu)	-.920	.358	-.017		.916
NB1348	.006(uu)	.755	.450	.014		.535
corner	-.003(uu)	-.477	.633	-.009		.946
culdesac	.003(uu)	.490	.624	.009		.831
RAV_LIN	-.007(uu)	-1.047	.295	-.019		.865
IWT_1KM	-.002(uu)	-.273	.785	-.005		.891
IWT_2KM	.001(uu)	.137	.891	.002		.926
IWT_5KM	.001(uu)	.158	.875	.003		.651

26RR010 Excluded Variables

Model: 21

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
NB0184	.005(u)	.652	.514	.017	.688
NB0185	-.003(u)	-.343	.732	-.009	.700
NB0187	.001(u)	.080	.936	.002	.793
NB0200	.004(u)	.498	.618	.013	.874
NB0203	.005(u)	.635	.526	.016	.926
NB0204	.006(u)	.790	.430	.020	.960
NB0212	.003(u)	.400	.689	.010	.961
NB0214	-.004(u)	-.530	.596	-.014	.933
NB0216	-.004(u)	-.581	.561	-.015	.860
NB0220	-.007(u)	-.939	.348	-.024	.886
NB0224	.005(u)	.095	.924	.002	.016
NB0226	-.003(u)	-.464	.643	-.012	.975
NB0232	-.008(u)	-1.051	.293	-.027	.933
NB0241	.003(u)	.457	.648	.012	.917
NB0248	.001(u)	.199	.842	.005	.954
NB0250	-.011(u)	-1.376	.169	-.036	.767
NB0251	.000(u)	-.007	.995	.000	.792
NB0254	-.008(u)	-1.098	.272	-.028	.937
NB0259	.007(u)	.614	.539	.016	.328
NB0270	-.004(u)	-.354	.723	-.009	.464
NB0272	-.018(u)	-.769	.442	-.020	.090
NB0273	.003(u)	.337	.736	.009	.766
NB0276	-.001(u)	-.119	.905	-.003	.425
NB192_B16	.001(u)	.126	.900	.003	.806
NB230_E19	.001(u)	.124	.901	.003	.366
NB251_HIQUAL	.004(u)	.586	.558	.015	.951
PC333SF	.007(u)	.906	.365	.023	.833
PC332	-.036(u)	-1.114	.265	-.029	.047
PC391	.006(u)	.688	.492	.018	.668
PC392	-.003(u)	-.408	.683	-.011	.767
PC392395	.009(u)	1.148	.251	.030	.784
NB183_LOWQUAL	.004(u)	.370	.712	.010	.424
acc_no	-.004(u)	-.531	.595	-.014	.818
FL1_D	-.004(u)	-.494	.621	-.013	.713
floodp_r	.003(u)	.327	.744	.008	.779
no_str_l	.008(u)	.858	.391	.022	.535
zone_com	.003(u)	.452	.651	.012	.895
IWT_1KM	-.004(u)	-.584	.559	-.015	.946
IWT_2KM	.002(u)	.183	.855	.005	.720
IWT_5KM	-.009(u)	-1.153	.249	-.030	.764

26RR030 Excluded Variables

Model: 6

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
FL1_D	-.002(f)	-.308	.758	-.007	.681
PC333TO336_SF	.002(f)	.395	.693	.009	.812
MARKET2	-.003(f)	-.082	.935	-.002	.024
NB407B14_PC100	.001(f)	.211	.833	.005	.784
NB0304	-.004(f)	-.537	.592	-.012	.559
NB0305	.002(f)	.256	.798	.006	.724
NB0306	.004(f)	.646	.518	.015	.827
NB0311	.001(f)	.149	.881	.003	.767
NB0351	-.004(f)	-.714	.475	-.016	.716
NB352_D65	.003(f)	.577	.564	.013	.989
NB0353	.000(f)	-.022	.983	.000	.861
NB0354	-.003(f)	-.532	.595	-.012	.904
NB0355	.000(f)	-.010	.992	.000	.926
NB0357	.000(f)	-.001	.999	.000	.948
NB0362	-.001(f)	-.233	.816	-.005	.713
NB0364	-.003(f)	-.625	.532	-.014	.966
NB0365	.000(f)	.077	.939	.002	.985
NB0368	.008(f)	1.356	.175	.031	.827
NB0370	-.001(f)	-.216	.829	-.005	.917
NB0371	-.002(f)	-.280	.779	-.006	.568
NB0376	.001(f)	.136	.892	.003	.977
NB0378	-.003(f)	-.349	.727	-.008	.487
NB410_B61	-.007(f)	-1.300	.194	-.030	.831
NB415_B56	.000(f)	-.020	.984	.000	.372
NB417_B48	.012(f)	1.338	.181	.031	.330
ab_educ	-.003(f)	-.605	.545	-.014	.962
ab_hydro	-.007(f)	-1.327	.185	-.031	.893
SPLITLIN	.004(f)	.720	.471	.017	.773
SPL_UNCV	-.004(f)	-.767	.443	-.018	.989
zone_com	-.001(f)	-.211	.833	-.005	.931
zone_ind	-.007(f)	-1.185	.236	-.027	.820
ZONE_LIN	-.005(f)	-.831	.406	-.019	.895
IWT_2KM	-.016(f)	-1.417	.157	-.033	.218

27RR120 Excluded Variables

Model: 42

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
NB0165	-.002(pp)	-.256	.798	-.005	.521
NB0166	-.001(pp)	-.200	.842	-.004	.618
NB0169	.004(pp)	.560	.575	.011	.537
NB0170	.007(pp)	1.332	.183	.025	.853
NB0172	.000(pp)	.002	.998	.000	.701
NB0176	-.004(pp)	-.770	.442	-.015	.934
NB0177	.000(pp)	.075	.941	.001	.625
NB0179	-.003(pp)	-.533	.594	-.010	.718
NB0180	-.007(pp)	-.793	.428	-.015	.287
NB0183	-.003(pp)	-.561	.575	-.011	.720
NB0184	.007(pp)	1.374	.170	.026	.719
NB0187	-.003(pp)	-.480	.631	-.009	.433
NB0192	-.004(pp)	-.587	.557	-.011	.455
NB0198	.000(pp)	.032	.975	.001	.297
NB0199	-.003(pp)	-.722	.470	-.014	.980
NB0272	.001(pp)	.131	.895	.002	.498
NB0279	.000(pp)	-.048	.962	-.001	.390
NB0281	-.004(pp)	-.839	.402	-.016	.902
NB0284	.011(pp)	1.496	.135	.028	.394
NB0286	.002(pp)	.344	.731	.007	.607
NB0288	-.007(pp)	-1.220	.222	-.023	.648
NB0293	.001(pp)	.234	.815	.004	.923
VILL_VL	.011(pp)	.939	.348	.018	.154
ab_playg	-.004(pp)	-.844	.399	-.016	.939
ab_u_box	-.003(pp)	-.598	.550	-.011	.919
FL1_D	.000(pp)	.003	.998	.000	.851
DES_LOG_SF	.001(pp)	.303	.762	.006	.974
STOR_114	-.006(pp)	-1.205	.228	-.023	.924
SPLIT_ADJ	.002(pp)	.426	.670	.008	.791
NORTH381	.002(pp)	.344	.731	.007	.582
NB359_A49	.001(pp)	.107	.915	.002	.451
NB383_D47	.006(pp)	1.085	.278	.021	.607
FLOOD_IM	.006(pp)	1.299	.194	.025	.854
NB169_PC100	.002(pp)	.314	.754	.006	.930
NB170_PC311	.001(pp)	.180	.857	.003	.936
NB370_PC100	-.008(pp)	-1.055	.292	-.020	.373
NB372_B74	-.002(pp)	-.404	.686	-.008	.827
NB182_NOT_C80	.005(pp)	.882	.378	.017	.770
IWT_1KM	-.004(pp)	-.703	.482	-.013	.727
IWT_2KM	.006(pp)	1.142	.254	.022	.767
IWT_5KM	-.007(pp)	-1.323	.186	-.025	.712

31RR010 Excluded Variables

Model: 9

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
iwtlt2km	*.003(i)*	*.307*	*.759*	*.006*	*.843*
IWT_5KM	*.016(i)*	*1.487*	*.137*	*.028*	*.705*

Re-sales Analyses - Lansink and MPAC

Introduction

Lansink Appraisal and Consulting released case studies on the impact of proximity to industrial wind turbines (IWTs) on sale prices for properties located near the Melancthon and Clear Creek wind turbine facilities in southwestern Ontario.

The conclusions presented in the Lansink study are based on the analysis of 12 properties that sold and resold between June 2005 and November 2012. In two instances in the Clear Creek study, initial sales date back to March 2004 and September 1995. On other properties in the Clear Creek area, the Lansink study uses MPAC's January 1, 2008 Current Value Assessment (CVA) as a proxy sale price in which to conduct the analysis. All five properties used in the Melancthon study area involved Canadian Hydro Developers (CHD) as the purchaser on the initial sale and the vendor on the re-sale.

The conclusions of the case studies indicate a 30-35% loss in price due to the proximity of the properties to an IWT, based on the sale and re-sale of the 12 properties.

In MPAC's review of the Lansink study, the appropriateness of the price change index is considered and another re-sale analysis is conducted using an alternative price index methodology in over 2,000 re-sales across Ontario.

Basic Methodology in Lansink Study

Each sale and re-sale (or in the absence of an initial sale the 2008 CVA) is presented as a case study. The initial sale price and date are shown along with the Multiple Listing Service (MLS) average sale price for the month of sale. The re-sale price and date are shown along with the MLS average sale price for the month of the re-sale for the property. The MLS average sale prices are based on Canadian Real Estate Association (CREA) data as presented by the local real estate board.

The case study uses the percentage difference between MLS average sale prices to estimate price change over time in the marketplace. The initial sale is trended to the sale date of the re-sale. The difference between the trended sale price and the actual re-sale price is calculated as a dollar amount and a percentage. Any difference in price between the trended sale price and the actual sale price is attributed to the presence of the IWT and presented as a diminution of price.

Table 1 below provides a sample calculation that determines the loss in price in the Lansink case studies.

Table 1: Lansink Case Study Methodology Sample Calculation

	Sale Price	Sale Date	Average MLS Price @ Time of Sale	Percentage Change – MLS Average	Trended Sale Price	Diminution of Price
Initial Sale	$100,000	October 2010	$100,000	25.00%	$125,000	($10,000)
Re-Sale	$115,000	October 2011	$125,000			-8.0%

In this example, using only 2 data points, the property initially sold for $100,000 in October 2010. It sold again in October 2011 for $115,000. The average MLS sale prices were $100,000 and $125,000 respectively at time of sale. This results in a 25% increase over a 12 month period. The initial sale price is trended by 25% (multiplier of 1.25) to produce a trended sale price of $125,000. The Lansink study argues that without the nearby IWT, the property should have sold for its trended sale price and then calculates the loss in price as the difference between the trended sale price and its actual sale price. In the above example, the loss in price is ($10,000) or -8.0%.

Methodology Issues

The first issue with the basic methodology is the use of the average MLS sale price as a proxy for market change. CREA statistics are board-wide and may not accurately represent the average sale price in the local area (i.e., neighbourhood). Some areas of the board will be above average, some will be below average and others will be average. The use of average sale prices that are more local may produce different results. Also, there is no comparison of the housing stock that sold during each time period. If the type of houses that sold each month differs, that could affect the average sale price and produce a misleading time adjustment.

The second issue is the use of only two data points to develop a trend. Two points always produce a straight line and don't give any information on what happened in between. Alternative time adjustment methods are available and used by appraisers using all available sales data and would produce a more reliable market trend[1].

Two sales used in the Clear Creek study area uses re-sales 8 and 17 years apart. One assumption with re-sale analysis is that there are no physical changes between sales. Given the length of time between, it is difficult to imagine this assumption holds true. The remaining sales in the Clear Creek study area only have one sale and use the 2008 CVA as a proxy sale price as of January 2008. MPAC is not aware of any professional literature which states that assessments or appraised values maybe used in a re-sale analysis.

To demonstrate that Canadian Hydro Developers paid market value when they initially purchased the five properties near the Melancthon wind farm, the Lansink study calculated the median sale price per square foot for two groups of properties. Group A was 20 properties northwest of Shelburne and to the northeast and southeast of the IWT's. Group B was four of the five sales purchased by CHD. Because the two groups had similar sale prices per square foot, the Lansink study concluded that the CHD purchase prices represent fair open market prices. One of MPAC's major concerns with this approach is that Group B is made up of only 4 sales. This is a very small sample.

[1] Mike Wolff, Adjusting Market Value over Time, The Appraisal Journal, Fall 2010

Another issue with one of the sales in Group B is that it has an indicated living area in MPAC's database of 900 square feet as opposed to the 1,800 square feet recorded by the Lansink study The property in question appears to be a raised bungalow with a basement walkout. According to the Appraisal Institute of Canada, finished basements are generally not included in total gross living area. Total gross living area being defined as finished above grade residential space[2].

Other articles state that above grade and below grade finished areas should be distinguished between one another. Below grade is generally defined as space on a level with earth adjacent to any exterior wall[3]. MPAC has recorded 563 square feet of finished area on this basement walkout level.

Inclusion of unfinished basement area as total living area by the Lansink study is incorrect. The question is should finished area below grade be included as total living area used to determine the sale price per square foot. This difference is important and significant because of the small size and its impact on the median sale price per square foot for these four properties. If 900 square feet is used, the median and average sale prices per square foot increase to $248.11 and $257.94 respectively. If the finished area below grade is included and 1,463 square feet of living area is used, the median and average are $219.87 and $225.34.

Also, the sample used in Group A is a subset of the available sales in the area. These sales come from four of MPAC's homogeneous neighbourhoods. Homogenous Neighbourhoods are defined to capture the influence of a particular location within a given market area.

When all 113 sales in these four neighbourhoods are looked at, the following values per square foot are indicated:

	Number of Sales	Median Sale Price/ SF ($)	Mean Sale Price / SF ($)
Unused Sales	91	176.64	187.90
Group A Sales	18	212.37	206.16
Group B Sales	4	248.11	257.94
Overall	**113**	**194.88**	**194.28**

Two of the sales included in the Lansink study were coded as builder sales by MPAC and were not included in MPAC's sales database. For this reason, there are 18 sales from Group A included in the above table.

Upon further review, MPAC noted that three of the four CHD purchases (Group B) occurred in one homogeneous neighbourhood (A67). Ten of the 20 Group A sales occurred in this neighbourhood. For this reason MPAC looked at all the sales in this homogeneous neighbourhood separately using 900 square feet for the sale in question.

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2 The Appraisal of Real Estate, 3rd Canadian Edition, (Appraisal Institute of Canada), 2010, p.11.7

3 Dianna LeBreton, How to measure and calculate residential square footage, Canadian Property Valuation Volume 53, Book 1, (Appraisal Institute of Canada), 2009

	Number of Sales	Median Sale Price/ SF ($)	Mean Sale Price / SF ($)
Unused Sales	11	200.00	200.38
Group A Sales	10	210.25	213.24
Group B Sales	3	231.25	255.60
Overall	24	210.25	212.64

These figures indicate there may be a difference between the sale prices paid by CHD and the typical sale prices in this area, albeit on a very small sample. If 1,463 square feet are used for the sale in question, the median and average sale price per square foot drops to $208.48 and $212.13, respectively. This highlights the volatility of using small sales samples.

One final issue with the sales used in the Lansink study was that the second sale price was consistently lower than the first sale price despite the fact the time frame being analyzed was one of inflation. The absence of variability in the study make them suspect.

MPAC's Re-Sale Analysis

MPAC identified over 2,000 re-sales of properties within the database used to conduct its Assessment to Sale Ratio (ASR) analysis, as part of its own study on the impact of IWT's for the 2012 CVAs.

A re-sale analysis using similar logic to the Lansink study was conducted using the Time Adjustment Factors (TAFs) developed as part of MPAC's analysis for each residential market area to prepare and quality check the 2012 CVAs prior to being placed on the assessment roll. Residential time trends can be determined using one of five accepted methods. Paired sales methods and re-sale analysis methods are generally limited to fee appraisal and often too tedious for mass appraisal work. Mass appraisal time trend methods include tracking the sale price per unit over time, sales to assessment ratios over time or including time variables as a variable in the valuation model (i.e., Multiple Regression Analysis (MRA) model). Including time variables in the valuation model is MPAC's preferred approach to developing time trends and TAFs.

The advantages of including time variables in the MRA model is that the effect of time is isolated because the model controls the other value influences as part of the equation and all available sales within each market area can be used. Time trends may be straight-line (constant rate of change and direction over time) or non-linear (different rates of change and direction over time). Non-linear trends require additional terms to be added to the analysis to adequately capture market change.

For valuation purposes, MPAC bases the midpoint of the TAF's on the legislated valuation date of January 1, 2012.

The following is a sample calculation of a time trend:

Coefficient for (Months x Total Living Area) = $0.833

Average Living Area = 1,500 square feet

Average Sale Price = $200,000

Average Increase per month = 0.833*1500 = 1249.5

Time Trend (r) = 1249.5/200,000 = 0.62475% per month

Once the monthly rate is established, a table of Time Adjustment Factors can be calculated for each month using the formula (r*Months) +1.

Table 2 below, provides a sample table for the sales period, from July 2010 to December 2011, a period of 18 months.

To centre the time adjustment factor on a desired month, simply divide the time trend for the desired month by each monthly time trend. To centre the time adjustment on December 2011, divide 1.1186 by each monthly trend.

The ratio of the monthly TAFs will provide the percentage change in the market between the sale dates.

Table 2: Sample Time Adjustment Factor Table

Sale Date	Month Number	Time Trend	Time Adjustment Factor
July 2010	1	1.0062	1.1117
August 2010	2	1.0125	1.1048
September 2010	3	1.0189	1.0979
October 2010	4	1.0252	1.0911
November 2010	5	1.0316	1.0843
December 2010	6	1.0381	1.0776
January 2011	7	1.0446	1.0709
February 2011	8	1.0511	1.0643
March 2011	9	1.0577	1.0577
April 2011	10	1.0643	1.0511
May 2011	11	1.0709	1.0446
June 2011	12	1.0776	1.0381
July 2011	13	1.0843	1.0316
August 2011	14	1.0911	1.0252
September 2011	15	1.0979	1.0189
October 2011	16	1.1048	1.0125
November 2011	17	1.1117	1.0062
December 2011	18	1.1186	1.0000

To conduct its re-sale analysis for this study, MPAC time adjusted the initial sale of each property to that of the second sale using the ratio of monthly TAFs. This produces a trended sale price as of the re-sale date. Table 3 provides an example using the same data as Table 1 above.

Table 3: MPAC's Re-Sale Analysis Sample Calculation

	Sale Price	Sale Date	TAF to Jan 1, 2012	TAF Ratio	Trended Sale Price	Percentage Difference
Initial Sale	$100,000	October 2010	1.0911	1.078	$107,800	
Re-Sale	$115,000	October 2011	1.0125			6.68%

In the example, the property initially sold for $100,000 in October 2010. It sold again in October 2011 for $115,000. The TAF from October 2010 to January 1, 2012 is 1.0911, indicating an overall increase of 9.11% over the time frame. The TAF from October 2011 to January 1, 2012 is 1.0125, indicating an overall increase of 1.25% over the time frame. The ratio of the TAFs is 1.078 (1.0911/1.0125), which indicates a 7.8% increase the 12 months between sales. The initial sale price is trended by 7.8% (multiplier of 1.078) to produce a trended sale price of $107,800.

An examination of the differences between the trended sale price and the actual sale amounts reveals the actual market change indicated by the re-sales as compared to the market change indicated by the entire market area. In other words;

- A difference of 0% would indicate that the market change as shown by the re-sales is exactly the same as that indicated for their respective market areas.
- A difference above 0% means that the re-sales are indicating greater inflation in value than their respective market area.
- A difference below 0% means that the re-sales are indicating greater deflation in value than that of their respective market areas.

In the sample calculation above, the re-sale of the subject property at $115,000 is 6.68% greater than the trended sale price in the market area of $107,800.

Table 4 provides the median percentage change for the 2,051 re-sales in MPAC's sales database using the previously defined distance groupings.

Table 4: Summary of MPAC's Re-sale Analysis

Distance Grouping	Number of Sales	Median Percentage Difference	Minimum Percentage Difference	Maximum Percentage Difference	Number of Sales Less than 0%	Number of Sales Greater than 0%
Within 1km	12	2.84	-15.36	30.61	4	8
1km to 2km	52	6.35	-14.29	63.00	16	36
2km to 5km	150	-0.57	-18.90	88.10	77	73
Outside 5km	1,837	2.05	-28.16	127.02	680	1,157
OVERALL	**2,051**	**1.96**	**-28.16**	**127.02**	**777**	**1,274**

The results in Table 4 indicate that re-sales of properties closest to wind turbines are experiencing greater market increases than their respective market area. In terms of individual re-sale market increases, re-sale's with market shifts greater than 0% out number re-sales with market shifts less than 0% by approximately 2 to 1 for properties within 2 km of an industrial wind turbine. This result would indicate no loss in price due to proximity to the IWT.

Summary of Findings

MPAC's own re-sale analysis using a generally accepted methodology for time adjustment factors indicates no loss in price based on proximity to the nearest IWT. This analysis using similar logic to that used in the Lansink study confirms the previous results from MPAC's report on the impact of wind turbines on 2012 CVAs and is contrary to the conclusions of the Lansink study.

Of the 2,051 sales used in MPAC's re-sale analysis, 2,002 had higher second sales, nine sold for the same price twice and 40 sold for less the second time. Of the 40 that sold for less the second time, 39 are outside 5km of an IWT, 1 is within 2 to 5km of an IWT and none are within 2km. That means 97.5% of these properties sold for more the second time. It is possible that some selection bias may exist in the Lansink studies. MPAC has attempted to prevent this by using all available re-sales in its analysis.

MPAC previously applied the same re-analysis logic to another study conducted by Lansink Appraisal and Consulting on the potential impact of existing or proposed gravel pits on neighbouring residential properties[4]. The gravel pit study followed the same methodology as the Lansink Wind Turbine Study.

Similar to this study, 13 of the 19 properties used had resale prices that were lower than the initial sale used in the study. Of the remaining six sales, one sold for the same price twice, one sold for $1,000 more than five years after the initial sale and one had 20 years between sales. The Lansink Gravel Pit study concluded a potential diminution in price (if any) of approximately 22%. MPAC's internal analysis indicated no loss in price in the study area using the same re-sale analysis process.

[4] Ben Lansink, "Case Studies: Diminution / Change in Price (if any) on Residential Real Estate Located in the Vicinity of an Existing or Proposed Ontario Pit or Quarry," Lansink Appraisals and Consulting, July 2013

MUNICIPAL PROPERTY ASSESSMENT CORPORATION

IMPACT OF INDUSTRIAL WIND TURBINES ON RESIDENTIAL PROPERTY ASSESSMENT IN ONTARIO

2016 ASSESSMENT BASE YEAR STUDY

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Abstract

The Municipal Property Assessment Corporation (MPAC) undertook a study to ensure that the assessments of properties in proximity to industrial wind turbines (IWTs) are fair and accurate. Over the last few years, the subject of IWTs has been the subject of numerous reports and studies – both in Canada and worldwide. Past and current studies undertaken by academics, real estate and health professionals have focused on the potential impacts of IWTs on property value and the health of those residing on the property. Given MPAC's legislated mandate, this report studies whether properties within five kilometres of an IWT are assessed at current value, and whether their assessment is equitable to those situated more than five kilometres from an IWT.

MPAC's study concludes that 2016 Current Value Assessments (CVAs) of properties located within proximity to an IWT are assessed at their current value and are equitably assessed in relation to homes at greater distances. This finding is consistent with MPAC's 2008 and 2012 CVA reports. The study underwent a rigorous independent third-party peer review (conducted by Robert J. Gloudemans) and includes appendices describing the study parameters and documenting the analyses.

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Jamie Stata is a Property Valuation Specialist - Assessment Standards and Mass Appraisal, Office of the Chief Assessor with the Municipal Property Assessment Corporation. Mr. Stata has nearly 27 years of property assessment experience in the province of Ontario. He currently conducts the mass appraisal analysis of commercial and industrial vacant land across eighteen counties in Southwestern Ontario and has completed the residential mass appraisal analysis for Huron, Perth, Grey and Bruce counties over the past five province-wide assessment updates. He has completed research on the combined valuation of residential and commercial properties and recently led a project team researching the acquisition of new cost estimates on farm buildings. Mr. Stata has presented at the International Association of Assessing Officers Annual Conference on Assessment Administration and the Mass Appraisal Valuation Symposium conducted by the International Property Tax Institute.

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Scott Bradfield is a Senior Data Scientist with Assessment Standards and Mass Appraisal, Office of the Chief Assessor, Municipal Property Assessment Corporation. Mr. Bradfield has almost 15 years of experience in regression and statistical analysis for property appraisal and is currently responsible for all residential mass appraisal work for two MPAC field offices responsible for the cities of Hamilton and Brantford as well as the counties of Brant, Haldimand and Norfolk. In addition, he has completed mass appraisal work for multi-residential properties, including both fair market rents and gross income multipliers; and development land properties. He is also MPAC's subject matter expert for residential valuation and data collection and has led several research projects for the corporation. Mr. Bradfield holds an honours Statistics degree from McMaster University and is an associate member of the Institute of Municipal Assessors.

Executive Summary

This report provides the results of the Municipal Property Assessment Corporation's study of the impact of industrial wind turbines (IWTs) on residential property assessment in Ontario (2016 Assessment Base Year Study).

Background

MPAC is responsible for accurately assessing and classifying property in Ontario in compliance with the *Assessment Act* and regulations set by the Government of Ontario. Our assessors are trained experts in the field of valuation and apply appraisal industry standards and best practices. Every four years, we conduct a province-wide Assessment Update and mail Property Assessment Notices to every property owner in Ontario. The most recent Assessment Update was in 2016 when we updated the assessed values of every property in Ontario. All properties were assessed as of the legislated valuation date of January 1, 2016. These updated values and classifications are used by municipalities and taxing authorities to calculate property taxes and are in effect for the 2017-2020 tax years.

When assessing any property, MPAC relies on the real estate market to indicate what influence a factor, such as IWTs, may have on a property's value. MPAC does this through the ongoing study and analysis of the market including the investigation of sales transactions.

Over the last few years, IWTs have been the subject of a number of reports and studies – both in Canada and worldwide. Studies undertaken by academics, real estate and health professionals have focused on the potential impacts of IWTs on property value and the health of those residing on the property. Given MPAC's legislative mandate, this report studies whether properties within five kilometres of an IWT are accurately assessed at their current value, and whether those properties are assessed equitably with properties that are further than five kilometres from an IWT.

To date, MPAC has completed three reviews of the impact of IWTs: 2008, 2012 and 2016 base year studies.

2008 Base Year Study

MPAC undertook a study looking at the impact of IWTs on residential assessments using the 2008 base year CVAs. The 2008 study concluded that the presence of IWTs that are either abutting or in proximity to a property had neither a positive nor negative impact on assessed values.

2012 Base Year Study

With much more sales data available, MPAC was able to conduct a more thorough review using 2012 assessment base year information. The study considered proximity and whether the wind turbine was visible (full, partial or not visible at all). A statistically significant difference was found between homes within one kilometre of an IWT and those farther away but the difference was well within international standards for equity between groups of property. All other tests showed equity between property groups. For more information about the 2012 base year review, see the introduction section of this report (which includes a link to the full report).

2016 Base Year Study

MPAC has continued to monitor the influence of proximity to IWTs over the current values of residential properties and has completed an analysis similar in scope to the 2012 Base Year Study.

To conduct this study, MPAC considered 25 market areas with sufficient sales to allow for analysis and applied industry standard mass appraisal techniques and internationally accepted ratio study standards to current value assessments for these market areas.

MPAC conducted an assessment-to-sale ratio study to determine whether assessments are equitable regardless of whether a property is within close proximity to an IWT. An individual assessment-to-sale ratio study is calculated by dividing the assessed value of each property by its time adjusted sale price. A ratio study is conducted to first establish the level of appraisal for a group of properties and equity is determined by comparing the level of appraisal with other groups of properties. If a group of properties is assessed at market value, the median assessment-to-sale ratio will lie between 0.90-1.10. By definition, equity is said to exist if the difference between the property categories is five per cent or less. This definition follows the International Association of Assessing Officers (IAAO) ratio study standards.

MPAC found that the level of appraisal for properties within one kilometre of an IWT is 1.007. The level of appraisal for properties within one to two kilometres of an IWT is 0.995. These numbers are within 3.3% and 2.1% of the level of assessment of properties more than five kilometres from an IWT (0.974) and are below the 5% noted above.

Conclusions

Following its review, MPAC concluded that 2016 Current Value Assessments of properties located within proximity of an IWT are assessed at their current value and are equitably assessed when compared to the assessments of properties that are not in proximity to IWTs.

Therefore, no adjustments are required for 2016 CVAs. This finding is consistent with MPAC's 2008 and 2012 base year IWT reports.

In addition to the results shared in this report, MPAC also commissioned an internationally recognized expert in the field of mass appraisal and ratio studies to review the report and its findings. This expert has confirmed the findings in this report (Appendix A – Independent Review of Report – Industrial Wind Turbine Ratio Study - R.J. Gloudemans, November 22, 2016).

Introduction

The topic of wind energy has been front and centre in the minds of many Ontarians, particularly those living in rural areas. Much has been written about how industrial wind turbines impact those who live in proximity to them. There has been extensive reporting on the numerous aspects of this subject, including reports of health effects, the approval process for siting IWTs and the potential for property devaluation due to the perceived stigma attached to these developments.

Several studies, based on both scientific and non-empirical methods, have been completed by academics and real estate professionals to determine whether or not the presence of an IWT has an effect on the sale price of a property. A study released by the Berkeley National Laboratory and prepared for the U.S. Department of Energy[1], found minimal impact on property values as a result of being in close proximity to IWTs. A study by the University of Guelph using Ontario data reached a similar conclusion[2]. However, one Ontario case study[3] released in 2013, argues that properties in Ontario in proximity to an IWT are devalued by as much as 30 to 35 per cent.

Also, Health Canada produced a study on the health effects of living near IWTs.[4]

2008 Base Year Study

MPAC conducted a study using 2008 base year Current Value Assessments, to determine whether residential properties located near IWTs were equitably assessed when compared to properties at a greater distance. The study was based on very limited sales information as there were few IWTs in the province at that time. As a result, it was difficult to draw meaningful conclusions with the 2008 study. Based on the available sale information, no adjustment to value was required for the 2008 Current Value Assessments.

2012 Base Year Study

In response to the growing presence of IWTs in Ontario as well as requests for information from stakeholders, MPAC undertook a new study using the 2012 base year CVAs to provide a thorough examination of the impact of IWTs on residential property assessment.

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[1] Ben Hoen et al, "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States", Berkeley National Laboratory, August 2013

[2] Vyn, R. J., and R. M. McCullough. (2014). The effects of wind turbines on property values in Ontario: Does public perception match empirical evidence? *Canadian Journal of Agricultural Economics* 62 (3): 365-392.

[3] Ben Lansink, "Case Studies: Diminution / Change in Price Melancthon and Clear Creek Wind Turbine Analyses, Municipal Property Assessment Corporation (MPAC) Current Value Changes," Lansink Appraisals and Consulting, February 2013

[4] http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php

Specifically, the study sought to examine the following two statements:

1. Determine if residential properties in close proximity to IWTs are assessed equitably in relation to residential properties located at a greater distance. This was referred to as *Study 1 – Equity of Residential Assessments in Proximity to Industrial Wind Turbines*.

2. Determine if sale prices of residential properties are affected by the presence of an IWT in close proximity. This was referred to as *Study 2 – Effect of Industrial Wind Turbines on Residential Sale Prices*.

Study 2 was added to the original scope of the review to respond to enquiries MPAC received from stakeholders and interested parties.

To conduct these studies, MPAC considered 15 market areas with sufficient sales to allow for analysis and applied industry standard mass appraisal techniques and internationally accepted ratio study standards.

To determine the equity of assessments of properties within close proximity to an IWT, MPAC conducted an assessment-to-sale ratio (ASR) study. An individual ASR is calculated by dividing the assessed value of each property by its time-adjusted sale price. A ratio study is conducted to first establish the level of appraisal for a group of properties and equity is determined by comparing the level of appraisal with other groups of properties. If a group of properties is assessed at market value, the median ASR will lie between 0.90-1.10[5]. By definition, equity is said to exist if there is 5% or less difference between property categories (or groups of properties) as per International Association of Assessing Officers (IAAO) ratio study standards.

The level of appraisal for properties within one kilometre of an IWT was 1.034. The level of appraisal for properties at greater distance (one to two kilometres, two to five kilometres and over five kilometres) ranged from 0.989 to 0.992, a 4.2 to 4.5% differential, which is below the 5% noted above.

Following its review, MPAC concluded that 2012 CVAs of properties located within proximity of an IWT were assessed at their current value and were equitably assessed in relation to homes at greater distances from the IWTs. No adjustments were required for 2012 CVAs. This finding is consistent with MPAC's 2008 CVA report.

MPAC's findings also concluded that there was no statistically significant impact on sale prices of

[5] MPAC adopted the IAAO Ratio Study standards for the 2016 assessment update. Therefore, the Target Level of Assessment (LOA) changed between 2012 and 2016 from 0.95 – 1.05 to 0.90 – 1,10. See International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, pp. 17-19

residential properties in these market areas resulting from proximity to an IWT, when including distance to an IWT in its regression analysis for areas with adequate sales.

In addition to the results shared in this report, MPAC also commissioned an internationally recognized expert in the field of mass appraisal and ratio studies to review the report and its findings. This expert confirmed MPAC's findings in his report.

To see the full 2012 base year study click here.

Purpose of This Report

This 2016 base year report has been undertaken to ensure that the assessments on residential properties in proximity to IWTs are accurate and equitable. Specifically, the report examines whether residential properties in close proximity to IWTs are assessed equitably in relation to residential properties located at a greater distance.

Legislation

Sections of the *Assessment Act* relevant to this study include the following:

Section 1 (1): "current value" means, in relation to land, the amount of money the fee simple, if unencumbered, would realize if sold at arm's length by a willing seller to a willing buyer; ("valeur actuelle").

Section 19 (1): The assessment of land shall be based on its current value.

Section 44 (3): For 2009 and subsequent taxation years, in determining the value at which any land shall be assessed, the Board shall,

- determine the current value of the land; and
- have reference to the value at which similar lands in the vicinity are assessed and adjust the assessment of the land to make it equitable with that of similar lands in the vicinity if such an adjustment would result in a reduction of the assessment of the land. 2008, c. 7, Sched. A, s. 13.

Under the *Assessment Act* and associated regulations, (Ontario Regulation 282/98, Section 42.5), IWTs are valued at a prescribed rate per taxation year (Table 1). The value of the IWT, plus the value of the associated land, is placed in the industrial tax class.

Table 1 - IWT Valuation

Property Tax Year	IWT Value Per MW
2013 and earlier	$40,000
2014	$42,658
2015	$43,542
2016	$43,986
2017	$50,460
2018	$50,460
2019	$50,460
2020	$50,460

Valuation of Residential Properties

To estimate value of residential properties, MPAC applies the direct comparison approach through mass appraisals. The direct comparison approach estimates the current value of a subject property by comparing it to similar properties and adjusting the result to account for differences between the two properties. Mass appraisal uses standardized processes and common data to allow for the valuation of a group of properties and the statistical testing of the results. For more information on how residential properties are assessed, go to mpac.ca.

Multiple Regression Analysis

MPAC uses industry standard computer-assisted mass appraisal techniques to apply the direct comparison approach to value through a statistical tool known as multiple regression analysis.

Regression analysis is a statistical technique used to analyze data in order to predict the value of one variable, such as market value, based on known data (e.g., living area, lot size, quality, location, etc.). If only one variable is used, such as living area, the procedure is called simple regression analysis. When two or more variables are used in the analysis, the procedure is called multiple regression analysis.

Multiple regression analysis estimates the value of one variable (i.e., the dependent variable) based on the information from the available data (i.e., the independent variables). Assessing authorities, such as MPAC, develop an equation that estimates current value based on the sale prices and property characteristics of sold properties. The equation, or valuation model, provides the best estimate of current value in statistical terms since it reduces the overall error between sale price and predicted value (estimated current value) to the lowest possible amount in dollar terms.

Market Areas

In Ontario, MPAC has approximately 130 residential market areas. Market areas are geographic areas subject to the same economic influences. One valuation model is built for each market area. A market area could be a section of a large city, like Toronto, a medium sized city like Niagara Falls or a cluster of smaller towns. Also, it could be the rural residential properties within a county or a group of lakes in a recreational waterfront area such as Muskoka or Kawartha Lakes.

Key Factors Affecting Value

Approximately 85% of the current value of a property can be attributed to the following five property characteristics: location, building area, construction quality, lot size and age of the home adjusted for renovations and additions. Other features that may be adjusted for include;

water frontage, building amenities (e.g., basement area, basement finish, bathrooms, fireplaces, heating, air conditioning), secondary structures (e.g., garages, in-ground pools), site features (e.g., abutting green space, abutting a ravine, abutting a commercial property, topography, corner lot, traffic pattern). Value influences differ across the province and therefore will not have the same impact on every market model.

Legislated Valuation Date

All estimates of current value represent market conditions as of January 1, 2016, which is the legislated valuation date for the 2017-2020 property tax years. As a result, part of MPAC's analysis is to determine the amount of inflation or deflation in each market area and adjust sale prices for time in relation to the legislated valuation date.

Assessment-to-Sale Ratio Study

Once each valuation model has been developed, it is tested to ensure it is producing accurate and uniform estimates of value using a sale ratio study, which compares value estimates to actual sale prices. This study ensures that the overall level of assessment for the market area is within international standards for accuracy and uniformity. The second aspect of the ratio study is to ensure that equity has been achieved across all major property characteristics.

Application of Valuation Model

Once the statistical testing has been completed and the valuation model for each market area has been deemed appropriate, it is applied to all the applicable properties in the market area and qualified valuation staff commence individual value review. The purpose of this exercise is to reconcile the value estimates to ensure that an accurate and equitable assessment has been placed on each property. These efforts tend to focus on areas with few sales and properties with features that cannot be captured within mass appraisal models. This review work continues up until the Assessment Roll is provided to each municipality and will include sales before and after the valuation date.

Industrial Wind Turbines

2016 Base Year Analysis

Between 2008 and 2016, Ontario has seen a proliferation of wind turbine projects with the introduction of the *Green Energy Act* in 2009 and the Feed-in-Tariff (FIT) program. This has resulted in a large set of available sales data for properties in proximity to these projects.

For the purposes of the 2016 base year study, MPAC has adopted a definition of an IWT to be one with a capacity of at least 1.5 megawatts. MPAC analyzed sales located within five kilometres of any IWT with this generating capacity. This is consistent with the definition currently being used by Health Canada[6] and was used for the 2008 and 2012 MPAC studies.

Data Collection

To ensure MPAC's inventory of IWTs was as complete as possible, MPAC obtained NAV Canada's entire flight obstacle inventory, which included the geographic coordinates of every self-reported IWT in Ontario. NAV Canada's inventory is subject to voluntary reporting compliance and thus does not include every IWT/flight obstacle. Any IWTs identified by NAV Canada that had not yet been field inspected by MPAC, were inspected by local staff and all relevant data was keyed into MPAC's database. Any IWTs identified in MPAC's database that were not included on NAV Canada's database were either inspected by local MPAC staff and the geographic coordinates were collected, or determined through the use of satellite digital imagery. To track the inventory, MPAC assigns a structure code of 567 to represent IWTs.

To ensure the database inventory was accurate, MPAC staff then conducted quality checks of all IWT data, including its generating capacity and geographic coordinates to ensure accuracy (e.g., co-ordinates not placing the IWTs on the correct property). Of the 2,321 IWTs in MPAC's database after this exercise, 48 were removed for having a capacity below 1.5 MW and two were removed for other reasons, leaving 2,271 IWTs for review. The distribution across MPAC's market areas is as follows:

6 http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/comments_part1-commentaires_partie1-eng.php#a16

Table 2 – Count of IWTs by MPAC Region

MPAC Region	Region Description	IWT Count	Property Count
01 - Cornwall	Prescott & Russell County, Stormont Dundas & Glengarry County	10	9
05 – Kingston	Frontenac County, Lennox & Addington County	91	68
18 – St. Catharines	The Region of Niagara	10	7
20 – Brantford	Brantford City, Brant, Haldimand and Norfolk Counties	234	192
22 – Kitchener	Regional Municipality of Waterloo, Dufferin and Wellington County, City of Guelph	220	153
23 – London	Elgin, Middlesex & Oxford Counties	137	123
24 – Goderich	Huron & Perth Counties	284	217
25 – Owen Sound	Grey & Bruce Counties	280	222
26 – Chatham	Chatham-Kent, Lambton County	602	510
27 – Windsor	Windsor/Essex	173	148
30 - Sudbury	Regional Municipality of Sudbury, Territorial District of Sudbury, Territorial District of Manitoulin	25	24
31 – Sault Ste. Marie	Territorial District of Algoma	162	46
32 – Thunder Bay	Territorial District of Kenora, Territorial District of Rainy River, Territorial District of Thunder Bay	43	43
Overall		2,271	1,762

As some properties had more than one IWT erected on them, the property count does not match the count of IWTs.

Virtually all IWTs are erected on vacant lots or farm properties, with almost 95% located on farms and most of the remainder on vacant lots.

The year of construction of IWTs in the database ranges from 2002 to 2016, with a breakdown as follows:

Table 3 - Typical Physical Characteristics of IWTs Across Ontario

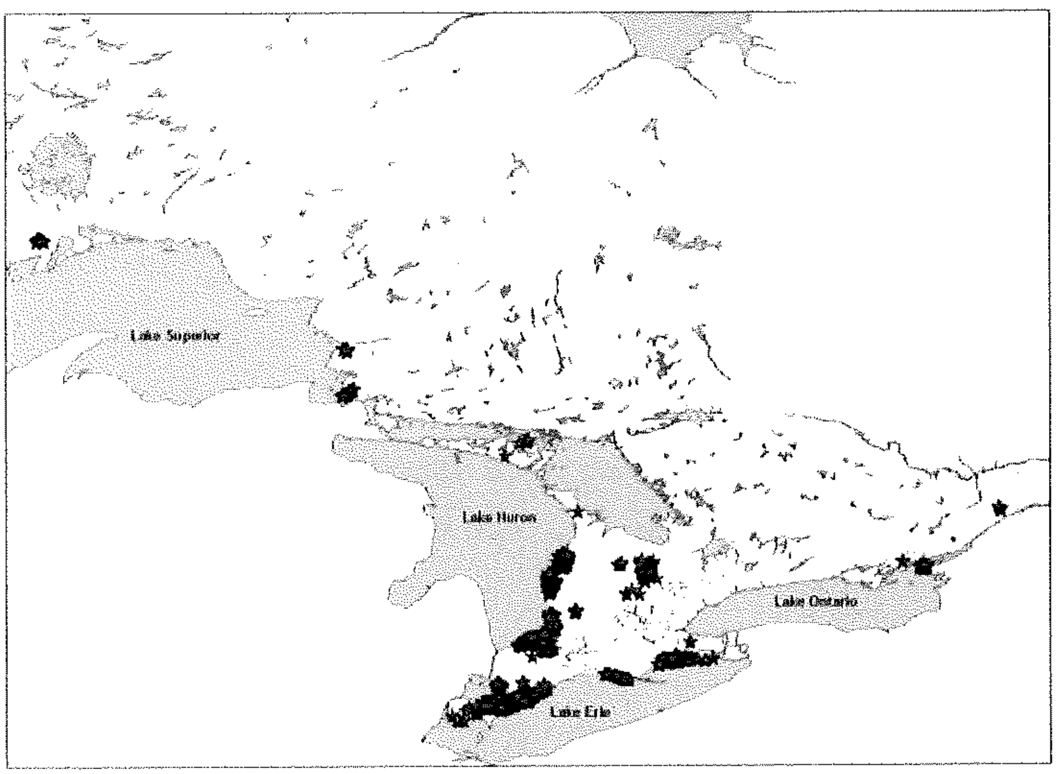
MPAC Region	Median Year of Construction	Earliest Year of Construction	Latest Year of Construction	Median Generating Capacity	Minimum Generating Capacity	Maximum Generating Capacity
01 - Cornwall	2014	2014	2014	3.00	3.00	3.00
05 - Kingston	2008	2008	2014	2.30	1.65	2.30
18 – St. Catharines	2014	2014	2014	1.80	1.80	1.80
20 - Brantford	2013	2007	2014	2.20	1.50	2.30
22 - Kitchener	2008	2006	2014	1.50	1.50	2.75
23 - London	2014	2006	2015	1.62	1.50	2.22
24 - Goderich	2015	2006	2016	1.80	1.50	2.30
25 – Owen Sound	2008	2002	2015	1.80	1.60	2.30
26 – Chatham	2012	2008	2015	2.03	1.50	2.50

27 – Windsor	2010	2010	2013	2.30	1.65	2.30
30 - Sudbury	2014	2004	2014	2.50	1.80	2.50
31 – Sault Ste. Marie	2006	2006	2015	1.50	1.50	1.62
32 – Thunder Bay	2010	2010	2010	2.30	2.30	2.30
Overall	2012	2002	2016	1.80	1.50	3.00

The following map shows the locations of the IWTs used in the analysis.

Figure 1

Location of IWTs Across Ontario



Equity of Residential Assessments in Proximity to Industrial Wind Turbines

For this study, MPAC analyzed open market sales of improved residential properties from January 2012 through October 2016 in the market areas surrounding IWTs. A market area is defined as a geographic area, usually contiguous, subject to the same economic influences, where properties tend to increase or decrease in value together. Improved residential properties would include single detached houses, semi-detached houses, townhouses, and multiplex properties with up to six self-contained units. Farms, commercial and industrial properties were not included in this analysis.

Comparison to the 2012 Base Year Study

This study is similar to the one conducted for the 2012 base year. To provide clarity to readers who are familiar with the 2012 study, a summary of similarities and differences is provided below.

Similarities

The methodology is the same. Both reports contain a sale ratio study which compares the median level of assessment between different groups of properties. The details of the sale ratio study are provided below. The number of sales in proximity to an IWT has increased due to the increase in IWT construction over the past four years (1157 in 2012 vs. 2271 in 2016).

IWTs with a capacity less than 1.5MW have been removed when measuring distance to an IWT: 28 were removed in 2012 vs. 48 in 2016 (note one IWT was removed in 2016 that was situated on a nuclear power plant property).

Differences

For the 2012 study distance from an IWT to a property was measured from the corner of the dwelling to the closest IWT. For 2016, distance was measured from the property boundary nearest the IWT. It was found to be too time-consuming to collect data from the corner of the dwelling as this required a field inspection to obtain the coordinates for the corner of the dwelling, and would require field visits as new IWTs are constructed in the future. As mapping information becomes more sophisticated, MPAC will look for ways to collect this information electronically.

In 2012, MPAC collected data on how much of an IWT was in view (full, partial or none) for all residences within two kilometres of an IWT. This data was not collected for 2016 because it didn't impact the assessment in 2012 and this data was too time-consuming to collect. It required a physical inspection and photos taken at each property whenever a new IWT was constructed and required significant resources to keep the database up to date. MPAC will look to published research and studies and if an efficient method surfaces, we will consider implementing it.

A new measure for the 2016 study is the concentration of IWTs around residential properties. This was measured using Geographical Information Systems (GIS) to determine the number of IWTs within the distance grouping for each sale (i.e. number of IWTs within one kilometre, two kilometres or five kilometres of a sale). This allows MPAC to test if the number of IWTs in proximity to a residence affects the level of assessment.

2016 Base Year Study

Sales

For this study, sales in proximity to IWTs were found in 25 market areas.

Table 4 – MPAC Market Area Descriptions

Market Area	MPAC Region	Description
01RR010	01 - Cornwall	City of Cornwall and the Counties of Prescott & Russell, Stormont, Dundas and Glengarry
05RR030	05 – Kingston	Napanee, Loyalist Township, Frontenac/Lennox & Addington Counties South Rural/Waterfront
16RR030	16 - Barrie	Simcoe West
18RR010	18 – St. Catharines	Niagara Rural
18WF010	18 – St. Catharines	Niagara/Lake Erie Waterfront
19RR010	19 – Hamilton	Hamilton Rural
20RR010	20 – Brantford	Brant, Haldimand, Norfolk Counties - Rural/Waterfront
22RR010	22 – Kitchener	Dufferin & Wellington Counties - Rural
22UR020	22 – Kitchener	Dufferin County Villages

22UR030	22 – Kitchener	Wellington County Villages
23RR010	23 – London	Elgin, Middlesex & Oxford Counties - Rural
23UR030	23 – London	Towns of Tillsonburg, Ingersoll, Woodstock, Aylmer, St. Thomas and Strathroy
24RR010	24 – Goderich	Huron & Perth Counties - Rural
25RR010	25 – Owen Sound	Grey & Bruce Counties - Rural and Inland Lakes
25UR010	25 – Owen Sound	Grey & Bruce Counties - Urban
26RR010	26 – Chatham	Chatham-Kent - Rural/Wallaceburg
26RR030	26 – Chatham	Lambton County - Rural/Waterfront
26UR010	26 – Chatham	City of Chatham
27RR010	27 – Windsor	Essex County Rural and Towns
27UR070	27 – Windsor	Lasalle, Tecumseh, Lakeshore Urban & Essex Urban
30RR010	30 - Sudbury	District of Sudbury
31RR010	31 – Sault Ste Marie	District of Algoma
31UR010	31 – Sault Ste Marie	Sault Ste. Marie/Prince Township
45WF050	24 – Goderich 25 – Owen Sound 26 - Chatham	Lake Huron
78WF040	16 – Barrie 17 – Bracebridge 25 – Owen Sound 28 – North Bay	Georgian Bay

Adjustments for being in proximity to IWTs were not included when establishing CVAs for the 2008, 2012 or 2016 base years in any of these market areas.

Sales Filters

To account for typical minimum sale amounts, any sale below $10,000 was removed in Southwestern or Eastern Ontario, and any sale below $5,000 was removed in Northern Ontario. Any sale of a property on which an IWT sits was removed from analysis to avoid the potential influence that the income stream associated with such properties may exert. As concerns about noise and vibration have been raised by IWT opponents, sales of vacant land were removed (i.e. only properties with a residence were included). There were two market areas with five or fewer sales and these were excluded from the analysis (Goderich urban area and Kingston urban area). Sales that were not open market transactions or suspected to not be arms-length open market transactions were removed from the analysis. Finally, those with extreme ratios of CVA to sale price as defined by the International Association of Assessing Officers (IAAO) Standard on Ratio Studies[7] were also removed from analysis.

Assessment-to-Sale Ratio Study

To establish the level of assessment and test for equity, MPAC conducts an assessment-to-sale ratio study. The assessment-to-sale ratio study is determined for each sold property by dividing the assessed value by its sale price or time adjusted sale price.

International standards state that a group of properties is assessed at current value if the level of assessment lies between 0.90 – 1.10. The preferred measurement of the level of assessment is the median ASR for the group of properties being studied.[8]

The level of assessment (LoA) for different categories of properties can be compared against one another to ensure that they align and if so, the properties between each group are said to be equitably assessed. Groups of properties would be said to be inequitably assessed if there was a statistically significant difference between their respective levels of assessment (at least 5%).

Median ASRs and their 95% confidence intervals were calculated for groups of distance variables. The median always divides the data into two equal parts and is less affected by extreme ratios than other measures of central tendency. Because of these characteristics, the median is generally the preferred measure of central tendency and is used to determine LoA in this report.

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[7] International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, pp. 53-54
[8] International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, pp. 13

When the calculated median is based on sample data, the result is called a point estimate, which is accurate for the sample but is only one indicator of the level of assessment in the population. Confidence intervals around the point estimate provide indicators of the reliability of the sample statistics as predictors of the overall level of appraisal of the population. Note that noncompliance with appraisal level standards cannot be determined without the use of confidence intervals or hypothesis tests9. A confidence interval consists of two numbers (upper and lower limits) that bracket a calculated measure of central tendency for the sample; there is a specified degree of confidence that the calculated upper and lower limits bracket the true measure of central tendency for the population.

MPAC looked at three different data elements in determining if equity exists:

1. Abutting a property with an IWT
2. Distance to closest IWT
3. Number of IWTs within each distance range

1. Abutting a Property with an IWT

Table 5 – Abutting an IWT Sale Ratio Study

Assessment Update Year	Sales Count	LoA	95% LCL	95% UCL	Target LoA[10]	LoA within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
2012	32	1.002	0.929	1.121	0.95 – 1.05	Yes	Yes	No
2016	166	0.997	0.970	1.025	0.90 – 1.10	Yes	Yes	No

There are 166 sales of properties that abut an IWT. The level of assessment is 0.997. There is no inequity with regard to properties that abut an IWT.

2. Distance to Closest IWT

A breakdown of the 110,338 sales used in the analysis, by distance, follows:

[9] International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, p. 13
[10] MPAC adopted the IAAO Ratio Study standards for the 2016 assessment update, hence why the Target Level of Assessment (LOA) changed between 2012 and 2016

Table 6 – Distance Grouping by Market Area

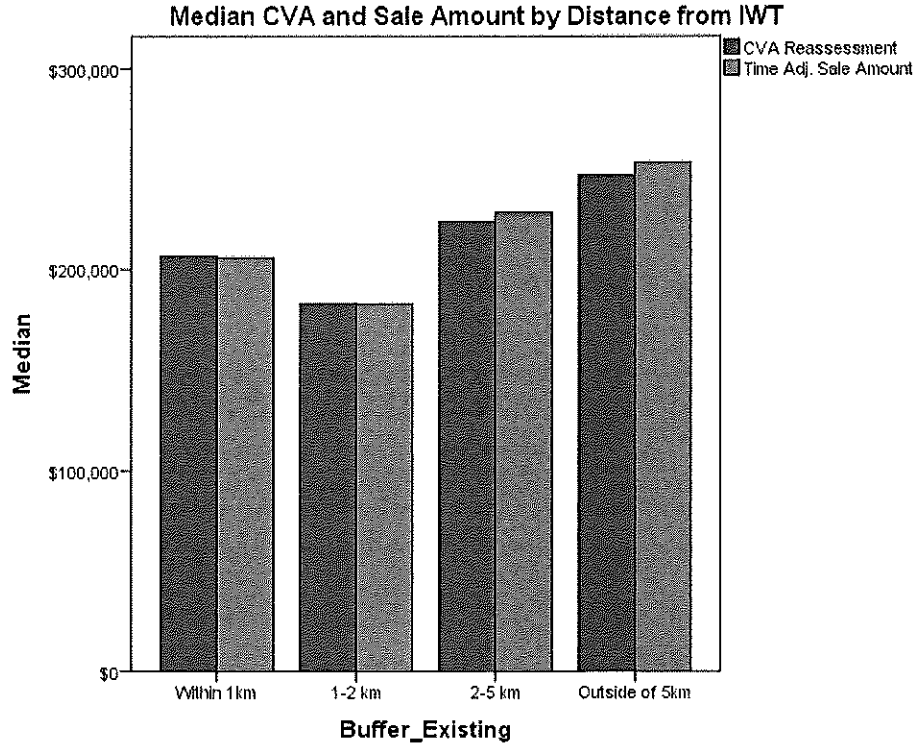
Market Area	MPAC Region	< 1 km	1-2 km	2-5 km	> 5 km	Total
01RR010	01 - Cornwall	9	4	36	11,914	11,963
05RR030	05 – Kingston	30	13	335	3,748	4,126
16RR030	16 - Barrie	0	0	6	6,482	6,488
18RR010	18 – St. Catharines	11	45	95	2,262	2,413
18WF010	18 – St. Catharines	0	18	31	186	235
19RR010	19 – Hamilton	0	8	38	1,742	1,788
20RR010	20 – Brantford	247	351	1,230	6,961	8,789
22RR010	22 – Kitchener	83	67	217	2,570	2,937
22UR020	22 – Kitchener	0	0	689	3,149	3,838
22UR030	22 – Kitchener	0	135	38	3,610	3,783
23RR010	23 – London	13	89	284	7,156	7,542
23UR030	23 – London	0	0	353	9,567	9,920
24RR010	24 – Goderich	23	55	268	3,731	4,077
25RR010	25 – Owen Sound	32	37	250	3,473	3,792
25UR010	25 – Owen Sound	0	24	279	6,130	6,433
26RR010	26 – Chatham	298	920	1,109	847	3,174
26RR030	26 – Chatham	18	152	557	2,530	3,257
26UR010	26 – Chatham	0	0	559	2,125	2,684
27RR010	27 – Windsor	216	483	1,436	3,915	6,050

27UR070	27 – Windsor	4	265	250	4,762	5,281
30RR010	30 - Sudbury	0	4	17	1,883	1,904
31RR010	31 – Sault Ste Marie	0	7	25	2,527	2,559
31UR010	31 – Sault Ste Marie	0	12	31	4,180	4,223
45WF050	24 – Goderich 25 – Owen Sound 26 – Chatham	0	2	596	1,162	1,760
78WF040	16 – Barrie 17 – Bracebridge 25 – Owen Sound 28 – North Bay	0	0	22	1,300	1,322
TOTAL		984	2,691	8,751	97,912	110,338

Refer to Table 1 for market area descriptions.

Comparing the median assessed value to the median time adjusted sale amount by the distance categories shows that the figures are very similar. Consider Figure 2 below. To make this comparison, one must consider the height of the blue and green bars for each of the distance groupings. Similar heights indicate that the median sale price (adjusted to January 1, 2016) and the median assessed value are similar. Comparisons between the different distance groupings should not be made because this chart does not control for differences in the housing stock of each grouping. These differences could be physical (building size or age) or differences due to location (e.g., homes further than 5km from an IWT being closer to urban centers). The results for all sales are provided in Figure 2.

Figure 2 – Comparison of CVA and Time Adjusted Sale Price by Distance Groupings



Appendix B – Current Value Assessment and Sale Amount Bar Charts contains a similar bar chart for each market area.

The following tables compare the 2012 results to the 2016 results.

2. Distance to Closest IWT All Sales

2012 Assessment Update

Table 7 – Distance Grouping Sale Ratio Study 2012 Current Value Assessment

Distance Grouping	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
Within 1 km	279	1.034	1.011	1.057	0.95 – 1.05	Yes	Yes	No
1 km to 2 km	989	0.989	0.979	1.000	0.95 – 1.05	Yes	Yes	No

2 km to 5 km	3,063	0.992	0.988	0.997	0.95 – 1.05	Yes	Yes	No
Outside 5 km	37,093	0.992	0.991	0.993	0.95 – 1.05	Yes	Yes	No
OVERALL	41,424	0.992	0.991	0.994	0.95 – 1.05	Yes	Yes	No

<u>2016 Assessment Update</u>

Table 8 – Distance Grouping Sale Ratio Study 2016 Current Value Assessment

Distance Grouping	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
Within 1 km	984	1.007	0.993	1.019	0.90 – 1.10	Yes	Yes	No
1 km to 2 km	2,691	0.995	0.989	1.003	0.90 – 1.10	Yes	Yes	No
2 km to 5 km	8,751	0.977	0.974	0.980	0.90 – 1.10	Yes	Yes	No
Outside 5 km	97,912	0.974	0.973	0.974	0.90 – 1.10	Yes	Yes	No
OVERALL	110,338	0.974	0.974	0.975	0.90 – 1.10	Yes	Yes	No

The level of appraisal for properties within one kilometre of an IWT has fallen while it has increased slightly for properties with IWTs one to two kilometres away. The difference between both groups and properties outside five kilometres of an IWT is statistically significant (the confidence intervals don't overlap). The difference between sales within one kilometre and sales outside five kilometres is 3.3% (the confidence intervals are 1.9% apart). The difference between sales one to two kilometres from an IWT and outside five kilometres is 2.1% (the confidence intervals are 1.5% apart). Both these differences are well within IAAO standards for equity between groups of properties.

Appendix C – Distance Grouping 2016 Sale Ratio Study by Market Area contains assessment-to-sale ratio data for each Market Area.

Distance to Closest IWT - Rural Properties Only

2012 Assessment Update

Table 9 – Distance Groupings – Rural Market Sale Ratio Study 2012 Current Value Assessment

Distance Grouping	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
Within 1 km	278	1.034	1.011	1.055	0.95 – 1.05	Yes	Yes	No
1 km to 2 km	715	0.996	0.982	1.008	0.95 – 1.05	Yes	Yes	No
2 km to 5 km	2,284	0.999	0.993	1.005	0.95 – 1.05	Yes	Yes	No
Outside 5 km	23,135	0.995	0.993	0.997	0.95 – 1.05	Yes	Yes	No
OVERALL	26,412	0.996	0.994	0.997	0.95 – 1.05	Yes	Yes	No

2016 Assessment Update

Table 10 – Distance Grouping – Rural Market Sale Ratio Study 2016 Current Value Assessment

Distance Grouping	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA Within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
Within 1 km	980	1.007	0.992	1.019	0.90 – 1.10	Yes	Yes	No
1 km to 2 km	2,235	0.999	0.992	1.007	0.90 – 1.10	Yes	Yes	No
2 km to 5 km	5,903	0.986	0.982	0.990	0.90 – 1.10	Yes	Yes	No
Outside 5 km	61,741	0.976	0.974	0.977	0.90 – 1.10	Yes	Yes	No
OVERALL	70,859	0.977	0.976	0.978	0.90 – 1.10	Yes	Yes	No

The 2016 results for rural properties are similar to the results using all sales. The statistics are virtually unchanged.

3. Number of IWTs within each Distance Range

For the 2016 study, MPAC examined how the level of assessment changed when the number of IWTs within each grouping changed to determine whether the concentration of IWTs around a residence impacts the level of assessment. The results are provided below.

Table 11 – Number of IWTs within 1 km Sale Ratio Study 2016 Current Value Assessment

IWT Count	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
1-3 IWTs	900	1.003	0.990	1.016	0.90 – 1.10	Yes	Yes	No
4-6 IWTs	80	1.022	0.990	1.053	0.90 – 1.10	Yes	Yes	No
7-9 IWTs	4	1.002	0.934	1.034	0.90 – 1.10	Yes	Yes	No
OVERALL	984	1.007	0.993	1.019	0.90 – 1.10	Yes	Yes	No

The level of assessment is fairly consistent within one kilometre of an IWT. For properties with four to six IWTs within one kilometre, the ASR is 1.022. There are 80 sales in this grouping.

a. Number of IWTs within one to two kilometres of a Residence (properties within one kilometre of an IWT filtered)

Table 12 – Number of IWTs within 1 km to 2 km Range Sale Ratio Study 2016 Current Value Assessment

IWT Count	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
1-3 IWTs	2,062	0.997	0.990	1.005	0.90 – 1.10	Yes	Yes	No
4-6 IWTs	529	0.983	0.968	1.011	0.90 – 1.10	Yes	Yes	No
7-9 IWTs	54	1.020	0.957	1.111	0.90 – 1.10	Yes	Yes	No
10-15 IWTs	39	0.971	0.937	1.057	0.90 – 1.10	Yes	Yes	No

16-20 IWTs	4	0.907	N/A[11]	N/A	0.90 – 1.10	Yes	Yes	No
21-30 IWTs	3	1.172	N/A	N/A	0.90 – 1.10	Yes	Yes	No
OVERALL	2,691	0.995	0.989	1.003	0.90 – 1.10	Yes	Yes	No

Any properties with IWTs within one kilometer are filtered for this table. There appears to be no pattern for properties that have IWTs within one to two kilometres. The median for properties with seven to nine IWTs is 1.020 but the lower confident limit is 0.957. There are a very small number of observations beyond 15 IWTs which has resulted in median levels of assessment diverging from 1.00. There are too few sales to calculate confidence intervals for these two groups of turbine counts.

b. Number of IWTs within two to five kilometres of a Residence (properties within two kilometres of an IWT filtered)

Table 13 – Number of IWTs within 2 km to 5 km Sale Ratio Study 2016 Current Value Assessment

IWT Count	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA Within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
1-3 IWTs	3,317	0.976	0.971	0.980	0.90 – 1.10	Yes	Yes	No
4-6 IWTs	2,264	0.975	0.969	0.980	0.90 – 1.10	Yes	Yes	No
7-9 IWTs	997	0.988	0.977	0.998	0.90 – 1.10	Yes	Yes	No
10-15 IWTs	1,795	0.976	0.969	0.983	0.90 – 1.10	Yes	Yes	No
16-20 IWTs	204	0.989	0.957	1.017	0.90 – 1.10	Yes	Yes	No
21-30 IWTs	145	0.992	0.961	1.040	0.90 – 1.10	Yes	Yes	No

[11] "When the sample size is five or fewer, the 95 percent confidence interval is nonexistent. When there are six to eight ratios, the lower and upper 95 percent confidence limits equal the lowest and highest ratios in the sample, and caution is advised." Gloudemans, Robert and Richard Almy, *Fundamentals of Mass Appraisal*, International Association of Assessing Officers, Kansas City, Missouri, 2011, p. 366.

31-40 IWTs	13	0.998	0.886	1.112	0.90 – 1.10	Yes	Yes	No
41+ IWTs	16	1.034	0.982	1.103	0.90 – 1.10	Yes	Yes	No
OVERALL	8,751	0.977	0.974	0.980	0.90 – 1.10	Yes	Yes	No

Any properties with IWTs within two kilometres are filtered for this table. The median for properties with more than 40 IWTs within five kilometres is 1.034 with 16 observations. All the lower confidence intervals are below 1.00.

c. Properties more than five kilometres from an IWT (Control Group)

Table 14 – Sale Ratio Study for Properties with no IWTs within 5km (Control Group) 2016 Current Value Assessment

IWT Count	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA Within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
No IWTs within 5km	97,912	0.974	0.973	0.974	0.90 – 1.10	Yes	Yes	No

These are the properties with no IWTs within five kilometres. They are being shown for comparison purposes.

Appendix D –Number of IWTs by Distance Grouping 2016 Sale Ratio Study by Market Area contains assessment-to-sale ratio data for each market area.

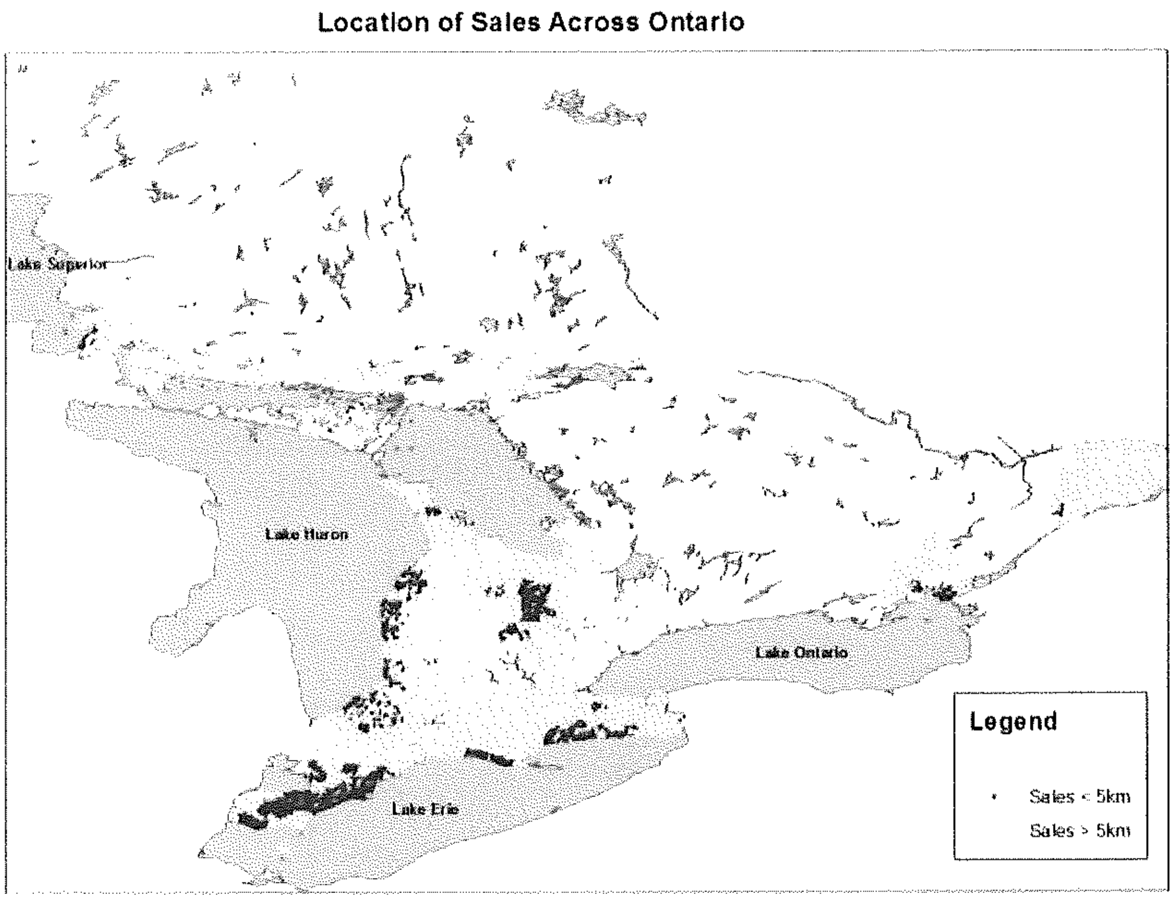
County Results

The statistics below were run at the county level to determine whether there were any patterns across the province. Overall, the results were very consistent with two exceptions: rural areas of Huron and Perth Counties and Grey and Bruce Counties. For properties in Huron/Perth within one kilometre of one or more IWTs the median sale ratio was low at 0.844. For properties in Grey/Bruce within one kilometre of one or more IWTs the median was high at 1.03. This was consistent regardless of the number of IWTs in both cases. Given the close geographical proximity of these counties, the results seem unusual and will require further review.

Table 15 – Sale Ratio Study for Properties within 1 km of IWTs - Regions 24 and 25 2016 Current Value Assessment

County	Sales Count	LoA	95% LCL	95% UCL	Target LoA	LoA within Target LoA	Confidence Intervals Overlap Target LoA	Corrective Action Required
Huron/Perth	23	0.844	0.768	0.949	0.90 – 1.10	No	Yes	No
Grey/ Bruce	32	1.030	0.929	1.081	0.90 – 1.10	Yes	Yes	No

Figure 3 – Location of Sales Used in the Analysis (Red within 5 km of an IWT, Green outside 5 km of an IWT)



Summary of Findings

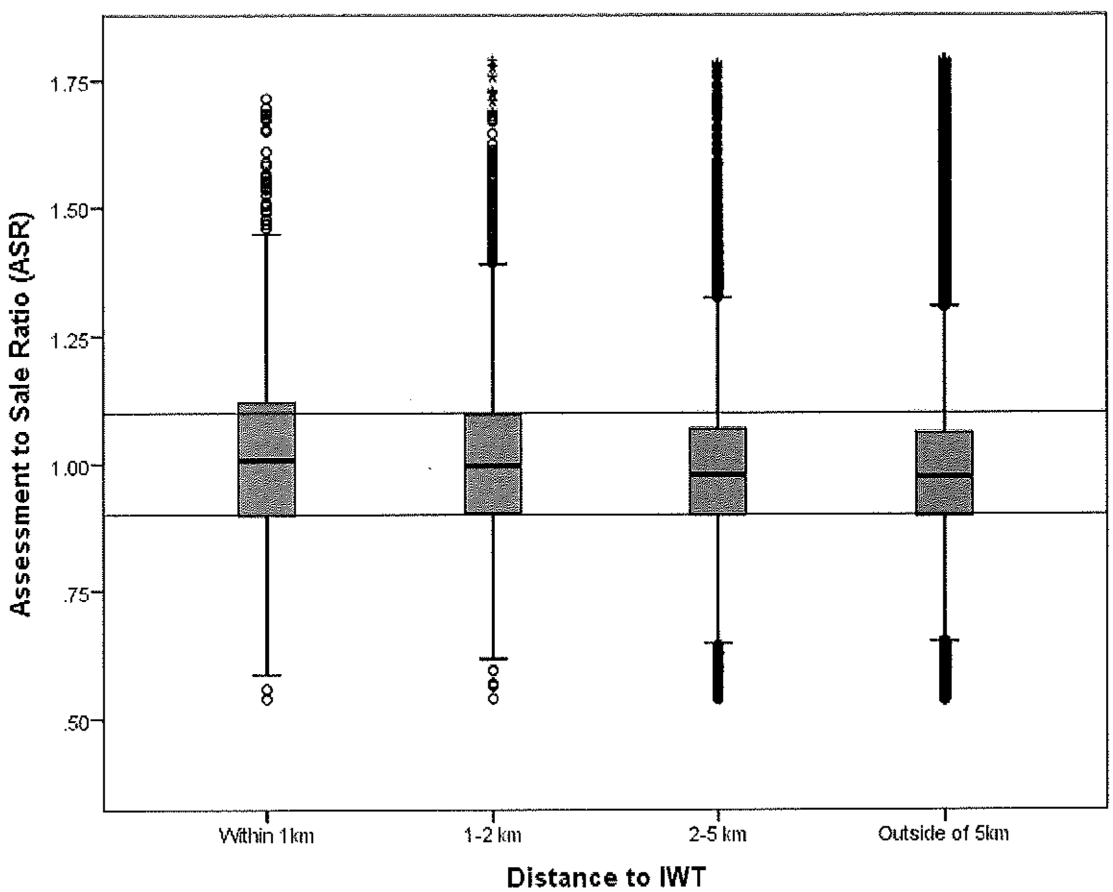
Section 9.2.1 of the International Association of Assessing Officers (IAAO) Standard on Ratio Studies states:

"The level of appraisal of each stratum (class, neighborhood, age group, market areas, and the like) should be within 5 percent of the overall level of appraisal of the jurisdiction. For example, if the overall level of appraisal of the jurisdiction is 1.00, but the appraisal level for residential property is 0.93 and the appraisal level for commercial property is 1.06, the jurisdiction is not in compliance with this requirement. This test should be applied only to strata subject to compliance testing. It can be concluded that this standard has been met if 95 percent (two-tailed) confidence intervals about the chosen measures of central tendency for each of the strata fall within 5 percent of the overall level of appraisal calculated for the jurisdiction. Using the above example, if

the upper confidence limit for the level of residential property is 0.97 and the lower confidence limit for commercial property is 1.01, the two strata are within the acceptable range."

Sales within one kilometre of an IWT showed a level of appraisal that was higher than the median assessment-to-sale ratio of sales further away (median assessment-to-sale ratio of 1.007). The lower confidence level of sales within one kilometre of an IWT is 0.993. This is well within 5% of the overall level of appraisal (0.993 – 0.974 = 1.9%). Sales within one to two kilometres of an IWT showed a level of appraisal that was also higher than the median assessment-to-sale ratio of sales further away (median assessment-to-sale ratio of 0.995). The lower confidence level of sales within one to two kilometres of an IWT is 0.989. This is also well within 5% of the overall level of appraisal (0.989 – 0.974 = 1.5%). So, although sales within two kilometres of an IWT do have a level of assessment above the overall level, the difference is not great enough to require value adjustment according to IAAO guidelines. These findings are illustrated in the following box plot.

Figure 4 – Assessment-to-Sale Ratio by Distance Grouping



The dark line within each box represents the median ASR. The lower and upper ends of the box represent the 25th and 75th percentiles, respectively. This box plot illustrates that the median assessment-to-sale ratio for sales within one kilometre of an IWT is slightly higher than the other groups, but the boxes for all the groups overlap.

In the IAAO Standard on ratio studies from 2013[12], an equity decision-making matrix is provided to allow a jurisdiction to determine if equity exists between groups of properties. This matrix has been populated for the two scenarios described above. The performance standard range is 0.90 to 1.10. Note that if the point estimate is outside of the performance standard range but the confidence interval does overlap the range, action is not required.

Table 16 – Decision Making Matrix

Scenario	Point Estimate	Confidence Interval (CI) Width	CI Overlaps Performance Standard Range	Point Estimate in Performance Standard Range	Action Required
<1 km to IWT	1.007	0.993 to 1.019	Yes	Yes	No
1 km - 2 km to an IWT	0.995	0.989 to 1.003	Yes	Yes	No

Therefore, based on the results of this analysis, there is no inequity with regards to distance to the nearest IWT.

This finding is consistent with MPAC's 2008 and 2012 studies.

MPAC's findings are also consistent with a third party review of this study conduct by Robert J. Gloudemans. Mr. Gloudemans is an independent internationally-recognized mass appraisal consultant. MPAC provided Mr. Gloudemans with a dataset of all sales less than five kilometres from the nearest IWT to conduct his analysis. *Mr. Gloudemans' report is included as* Appendix A – Independent Review of Report – Industrial Wind Turbine Ratio Study - R.J. Gloudemans, November 22, 2016.

[12] International Association of Assessing Officers, *Standard on Ratio Studies*, April 2013, p. 35

List of Report Appendices

Appendix A – Independent Review of Report – Industrial Wind Turbine Ratio Study - R.J. Gloudemans, November 22, 2016

Appendix B – Current Value Assessment and Sale Amount Bar Charts

Appendix C – Distance Grouping 2016 Sale Ratio Study by Market Area

Appendix D – Number of industrial wind turbines by Distance Grouping 2016 Sale Ratio Study by Market Area

Glossary of Terms

assessment roll – An annual listing provided to each taxing authority in the Province of Ontario containing, among other things, the current value and tax classification of each property within the jurisdiction.

assessment-to-sale ratio (ASR) – The ratio obtained by dividing the assessed value of a property by the time-adjusted sale price of a property.

base year – The year that an estimate of a property's value is based on.

Current Value Assessment (CVA) – The estimated value of a property based on a specific date.

direct comparison approach (also known as Sales Comparison Approach) – An approach to valuing a property that estimates the current value of a subject property by adjusting the sale price of comparable properties for differences between the comparable properties and the subject property.

industrial wind turbine (IWT) – A wind turbine used to generate at least 1.5 MW of electricity.

geographic coordinates – A set of two numbers that reference the latitude and longitude of a point on the Earth.

market area – A market area is defined as a geographic area, usually contiguous, subject to the same economic influences, where properties tend to increase or decrease in value together.

market model – Geographic areas subject to the same economic influences.

mass appraisal – The valuation of a group of properties as of a given date using standardized processes, employing common data, and allowing for statistical testing.

median – The median of a group of numbers is the middle number after they have been sorted from lowest to highest. If you have an odd number of cases, the median is the middle value. If you have an even number of cases, the median is the value midway between the two middle values. The median, in comparison to the mean, is less sensitive to extreme values.

megawatt (MW) – A unit of measure in energy generation or consumption.

Municipal Property Assessment Corporation (MPAC) – A body responsible for determining the correct market value and tax classification for all properties in the Province of Ontario, based on current value assessment.

regression analysis – A statistical technique used to analyze data in order to predict the value of one variable, such as market value, based on known data (e.g., living area, lot size, quality, location, etc.).

For more information about MPAC and how MPAC assesses properties, visit mpac.ca.

Effects of Wind Turbines on Property Values in Rhode Island

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Final Report

October 18, 2013

Executive Summary

This study assesses of the effect that onshore wind turbines have on nearby property values in Rhode Island. The state of Rhode Island established the RIWINDS program in 2006 to promote the development of wind energy in the state, with the goal of meeting 15% of the state's electrical consumption with wind energy. Yet progress towards that goal has been slow. Wind energy proposals commonly meet with strong opposition despite widespread public support for wind energy in the abstract, and a major source of opposition that is commonly articulated is a concern that wind turbines may adversely affect property values. As a consequence, it is important to assess the extent to which wind turbines affect transaction prices of nearby properties.

Methodology

The study estimates the effect of wind towers on property prices using the Hedonic Price technique. The Hedonic method is a statistical approach that uses extensive data on property transactions to identify the extent to which transaction prices are affected by various characteristics of the properties and their surroundings. Characteristics of the property include such factors as the size of the house, size of the lot, number of bedrooms, number of bathrooms, among other characteristics of the property. Neighborhood characteristics might include factors such as ocean views, crime rates, nearby industrial developments, among others. The key factor for purposes of this study is the effect, if any, that nearby wind turbines have on property prices.

This study uses data from 48,554 single-family, owner-occupied housing transactions within five miles of turbine sites in Rhode Island over the time period from January 2000 to February 2013. Of these transactions, 3,254 are for properties that are within one mile of the wind turbine, and it is these observations that are critical for estimating the impacts. If wind turbines have an adverse impact on property transaction prices, then we should find that transactions for properties that are located closer to the wind turbine (e.g., within ½ mile) should sell for systematically lower prices than those located further from the wind turbine (e.g., 3 to 5 miles), after controlling for other characteristics of the various properties and their surroundings.

In addition to distance to the wind tower, we also consider other factors related to the wind turbine that could influence effects on property values. First, one might expect a larger wind turbine to have a greater effect on values of nearby properties than would a smaller wind tower, all else equal. Second, some properties may be located near a wind turbine, but potential effects might be mitigated because the view and/or the sound from the wind turbine might be blocked, in whole or in part, by topography or other obstructions, such as trees or large buildings. Third, one might expect that a wind turbine might have a larger impact on property values in a location that is otherwise pristine, as compared to a location that is already highly industrialized prior to construction of the wind turbine. We carry out analyses of these factors by augmenting our housing price sales data with information on size of wind towers, GIS data on the land use categories in the surroundings and site visits to 1,354 properties located closest to wind turbines.

We estimate the effects of wind towers considering three periods: transactions that occurred prior to any consideration of the wind tower at a particular site, transactions occurring after public announcement but before construction begins, and transactions occurring after construction. We employ a difference-in-differences approach, which compares before-and-after price differentials for properties near wind turbines with price differentials for other properties in the same time period and in the same general area, but that are located further away from a wind turbine. The advantage of this approach is it corrects for events in housing markets that have no connection to the wind turbine, but that occurred in the same time period. For example, housing prices might be generally be increasing over the time period in question, or prices might be declining, as during the crash in housing prices that occurred starting in 2006. These factors are general trends that vary over time, but will have the same effect on transactions prices for houses close a wind turbine and houses in the same general area but are further from the wind turbine. As a consequence, the difference-in-differences approach corrects for these kinds of unrelated factors whose timing may just have happened to coincide with construction of the wind turbine.

Results and Conclusions

Across a wide variety of specifications, the results indicate that wind turbines have no statistically significant impact on house prices. For houses within a half mile of a turbine, the point estimate of price change for properties within ½ mile relative to properties 3-5 miles away is -0.2%. So our best estimate is wind towers have no virtually effect on prices of nearby properties.

But by the very nature of any statistical analysis, exact measures of price changes are not constructed. Rather, statistical analyses are based on "confidence intervals", where the analyst might conclude they are 90% sure that any effect on housing prices would fall within some particular range. Our principle finding is that the best estimate is that there is no price effect, and we can say with 90% level of confidence if there is a price effect, it is roughly 5.2% or less. Thus, while we cannot conclude for sure that there is no effect on housing prices, there is no statistical evidence of a large, adverse effect.

One challenge in estimating the effects of wind turbines on housing prices is that most wind turbines were built within the past few years, and there are relatively few property sales in the immediate vicinity of wind turbines (or for that matter, at other specific locations) in such a short time period. We expect that the precision of estimates will increase over time, as more transactions occur. Hence, we recommend that that the analysis be repeated in a few years when a more robust data set with additional property transactions become available.

1. Introduction

Society is highly dependent on high polluting and nonrenewable fossil fuels that constitute roughly 80% our energy supplies. There is increasing recognition that we need to develop new low polluting renewable energy sources, and wind power is among the most promising technologies. As of December 2012, there are over 200,000 wind towers around the world with combined nameplate capacity of nearly 300 GW, and wind energy is among the fastest growing energy sources (Global Wind Energy Council 2013).

Public opinion polls commonly find a strong majority of respondents indicating support for wind power in general, with up to 90% of respondents voicing support for wind energy (e.g., Firestone and Kempton 2007, Mulvaney et al. 2013). Despite the stated preference for wind energy in the abstract, proposed wind energy projects frequently meet with fervent opposition by the local community. Numerous reasons have been given for opposition to wind turbines, ranging from adverse effects on birds, bats and other wildlife, aesthetic effects by compromising views, annoyance and potentially even health problems related to noise and shadow flicker, and a general industrialization of the landscape. One of the most common concerns voiced by nearby residents is the potential impact of wind towers on property values (Hoen et al. 2011).

Property values are an important issue in and of themselves, but also reflect an accumulation of preferences for the suite of impacts caused by turbines. For example, if wind turbines created adverse effects due to noise, visual disamenities or other nuisance effects, nearby property values would likely reflect these effects. Further, hedonic valuation theory (reviewed in Section 2) suggests that property values should decrease enough such that homeowners are indifferent between living near a turbine or paying more to live far away. Importantly, this disparity in house values can quantify the cost to nearby residents to be used in cost-benefit analysis of wind energy expansion.

This paper examines the effect of wind turbines on property values in Rhode Island. While Rhode Island is the smallest state in U.S., it is the second most densely populated. Given this and the fact that 12 turbines have been erected at 10 sites in the past seven years, Rhode Island offers an excellent setting to examine homeowner preferences for wind turbines because there are so many observations on property transactions. We construct a data set of 48,554 single-family, owner-occupied transactions within five miles of a turbine site over the time range

January 2000 to February 2013. Furthermore, 3,254 of these transactions occur within one mile, and it is these observations that are critical for understanding the impacts.

Beyond sample size, Rhode Island is an excellent case study because turbine development is plausibly exogenous to changes in house prices, unlike many other settings. In Rhode Island, the wind turbines have been sited and built by the state government or private parties, often with opposition from nearby homeowners (Faulkner 2013). Thus, the possibility that a community collectively decides to build a turbine and such a community may have different house price dynamics is not an issue here. In addition, these are not large-scale wind farm developments and there is no major wind industry so-to-speak, so there is essentially no local economic impact through job creation or lease payments to property owners as is the case in Iowa and Texas (Brown et al. 2012, Slattery et al. 2011).[1] Thus, Rhode Island sales prices should offer an unadulterated reflection of homeowner preferences.

Within a hedonic valuation framework, we estimate a difference-in-differences (DD) model. In the most basic model, the treatment group is defined by proximity; we create concentric rings around turbines and regard the set of houses in each distance band as a separate treatment group. We define two distinct treatments. The first is when it is publicly announced that a wind turbine will be built at a specific location; this aspect of the model determines if homeowner's expectations of disamenities affects property values. The second is when the construction of the turbine is completed and measures if the realized disamenity has an effect on property values.

Proximity is a crude measure of the potential impacts of a wind turbine, and we took several additional steps to model likely impacts. We delve into heterogeneous impacts by the size of the turbine and the setting (i.e., industrial or residential area). In addition, we account for the fact that other obstructions such as large buildings or trees might mitigate the effects of a nearby wind tower on particular properties. To do so we physically visited 1,354 properties that transacted after construction that are within two miles of a turbine to assess the extent of view of the turbine.[2]

[1] Two exceptions exist. The owner of the North Kingstown Green Turbine pays $150/year to the dozen or so residents in the same development as the turbine and the Tiverton turbine offsets electricity expenditure to residents of the Sandy Woods Farm community. Only a single transaction in our data set occurred after turbine construction for these houses affected by payments, thus we feel confident that our results are unaffected by payments.
[2] In the appendix, we also examine the property value impacts of shadow flicker, though there are very few observations affected.

Across a wide variety of specifications, the results indicate that wind turbines have no negative statistical impacts on house prices, in either the post public announcement phase or post construction phase. For houses within a half mile of a turbine, the point estimate of price change relative to houses 3-5 miles away is -0.4%. While the standard error of the point estimate is not small (3.8%), we can rule out negative impacts greater than 5.2% with 90% confidence. The DD models indicate that turbines are built in less desirable areas to begin with, which is consistent with intuition because several turbines are built near highways or industrial areas. However, even when we isolate residential areas where turbines are likely to contrast most with surroundings, our results still indicate no statistically significant negative price impacts. Further, our results suggest no statistically significant negative impacts to houses with unfettered views of a turbine. A repeat sales model corroborates these results.

The literature examining the impacts of wind turbines on property values is still in its infancy. There are several studies that suffer from small sample sizes or unsound econometric modeling. Sims and Dent (2007) used only post construction observations, and Sims et al. (2008) only had 199 observations – all within a half mile of a single wind farm. Neither of these studies use the DD framework, which is essential for controlling for confounding factors, either that exist prior to wind energy development or that affect all houses regardless of turbine construction. This is most evident for Sims and Dent (2007), who show an aerial picture of one of their study wind farms, and between it and the housing development is an already existent, enormous, open pit quarry, which surely could have affected housing prices prior to the wind farm. More recently, Sunak and Madlener (2012) collect 1,202 observed transactions, both before and after construction, but the model they estimate constrains the effect of construction to be constant across distance and the effect of distance to be constant across time.

Fortunately, better studies have been carried out recently. Heintzelman and Tuttle (2012) examine impacts of wind farms in three counties of Upstate New York using over 11,000 transactions and a specification that treats distance as a single continuous variable. They do find some significant price effects from proximity, though they are not consistent across counties. Their results imply that a newly built wind farm within a half mile of a property can decrease value by 8-35%. It is important to note, however, that the average distance to a turbine of a transaction in their data is over 10 miles, and they interpolate effects to close proximity. The strongest research to date is a recent report from Hoen et al. (2013), which updates Hoen et al.

(2011). They collect over 50,000 transactions within 10 miles of wind farms spanning 27 counties in nine states. They utilize a DD methodology similar to ours with distance bands around the wind farms and both a post announcement and post construction treatment. Similar to our results, Hoen et al. (2013) find no statistical effect of wind turbines on property values. It is important to note that both the Hoen et al. (2013) and Heintzelman and Tuttle (2012) results are for large scale wind farms with as many as 194 turbines, as distinct from our study that examines the case of individual wind turbines.

This paper contributes to the understanding of property value impacts of turbines by providing an econometrically sound analysis with far more observations than all but one existing analysis. Further, we go beyond proximity and offer the most thorough to-date analysis of how impacts may be heterogeneous due to viewshed of a property and size and setting of a turbine. Lastly, because we are working in a single state, we have been able to take part in multiple stakeholder meetings related to wind energy development and gain an understanding of the local perceptions, sentiments, and institutions, which have all informed our analysis. For instance, homeowners feel certain turbines are more odious than others, which suggested we should look for heterogeneous property value effects.

2. Methodology

In the absence of explicit markets, there are generally two approaches that economists use to determine the value of environmental amenities and disamenities: revealed and stated preference methods (e.g., Freeman et al, 2003). Revealed preference methods use actual choices made by people to infer the value they place on an amenity. Stated preference methods infer values using responses of what individuals would do in a given situation, such as what is the most the individual would pay to participate in an activity rather than go without.

The Hedonic Price Method (HPM) is among the most popular revealed preference methods for determining values of non-market environmental amenities. The Hedonic method is based on the concept that many market commodities are comprised of several bundled attributes, and the market prices are determined by their attributes. Applied to residential properties, the price of a property is affected by attributes such as the size of the house, the size of the lot, the number of bathrooms, bedrooms, etc.; the neighborhood attributes such as the condition of nearby homes, the crime rate, quality of schools, etc.; and environmental attributes such as air quality, adjacent open space, ocean views, etc. The basic idea is that houses with desirable attributes (e.g., an ocean view) will be bid up by potential buyers, and the extent to which prices are bid up depends upon how much buyers value the attribute. If one can estimate the price premium associated with an attribute, one can gain insights into the extent to which potential buyers value an environmental amenity. HPM models have been applied to estimate implicit values associated with a wide range of amenities and disamenities: airport noise (Pope 2008), crime (Bishop and Murphy 2011), power plants (Lucas 2011), air quality (Bento et al. 2013), and school quality (Cellini et al. 2010).

This paper applies HPM to the impacts of wind turbines on property values. Within the HPM framework, we estimated a DD model. DD models typically compare treated units to untreated units, both before and after treatment has occurred. There are two modifications to the basic framework for our application. First, treatment is defined by distance and is thus continuous. In order to avoid parametric assumptions, we group houses into *D* discrete bands of concentric circles surrounding the location of a turbine. The furthest distance band is chosen such that no effect of the wind turbine is expected and serves as the control group. Second, instead of two time periods, we have three: 1) pre-announcement (PA), in which no one knows that a wind turbine will be built nearby, 2) post-announcement pre-construction (PAPC), which is after the public has been made aware that a turbine will be built, but prior to the construction, and 3) post construction (PC). PA is the before treatment time period, and we allow the two treatment periods, PAPC and PC, to have differential impacts on property values, the first based on expectations and the second based on the realized (dis)amenity. The specification is:

$$\begin{aligned}\ln(p_i) = {} & \sum_{k=2}^{D} \alpha_k \, dist_{ki} + \beta_1 PAPC_i + \beta_2 PC_i \\ & + \sum_{k=2}^{D} \gamma_{1k} dist_{ki} PAPC_i + \sum_{k=2}^{D} \gamma_{2k} dist_{ki} PC_i \\ & + X_i' \delta + \varepsilon_i \qquad (1)\end{aligned}$$

where p_i is the sales price of transaction *i*, $dist_{ki}$ is a dummy variable equal to one if transaction *i* is within the k^{th} distance band, and $PAPC_i$ and PC_i are dummy variables equal to one if transaction *i* occurs PAPC or PC, respectively. X_i is a set of housing, location, and temporal controls. X_i also includes a constant to capture the omitted group of the 1st distance band in time period PA. Finally, ε_i is the error term.

The coefficients are interpreted as follows. α_k measures the PA (i.e., pre-treatment) difference in housing prices for distance band *k* relative to distance ring 1. β_1 and β_2 measure the change in housing prices for distance band 1 (the control group) in the PAPC and PC time periods, respectively. γ_{1k} and γ_{2k} are the coefficients of interest and measure, for PAPC and PC, respectively, the differential change in property values from the pre-announcement time period for distance band *k* relative to the change in property values of distance band 1.

The timing of our data, 2000-2013, corresponds to the housing boom and bust. Further, as detailed in the next section, the PAPC and PC periods almost always occur during bust years. Relative to a simple before-after estimate of the impacts of wind turbines on property values using only houses in close proximity, the DD model goes a long way to mitigate spurious correlation creeping into the treatment effect coefficients. To further guard against spurious correlation, we follow the advice of Boyle et al. (2012) and include city by year-quarter fixed effects and an interaction of lot size and its square with city fixed effects and year fixed effects. The city by year-quarter fixed effects flexibly controls for the boom and bust in prices for each city separately. The lot size interactions not only allow the value of land to be different in each city, but allow the value to evolve over time with the boom and bust. For more standard reasons, we also include census tract fixed effects and we interact distance from the coast with city. Tract fixed effects capture time invariant locational heterogeneity.[3] Interactions of coast and city allow the value of coastal living to change in different parts of Rhode Island. As with other DD estimators, identification of the treatment effects relies on the assumption that house prices would have changed identically across distance bands in the absence of turbines being built. See Figure A1 in the appendix for suggestive evidence that this assumption is reasonable.

[3] In the spirit of Abbott and Klaiber (2010), one may be concerned that the tract fixed effects and city by year-quarter fixed effects will capture all relevant variation needed for the identification of wind turbines on property values. The spatial scale of influence could reasonably be at the tract level, however, because the tract fixed effects do not vary over time, within tract temporal variation will identify the effect of turbines if there is one. Our intuition is that effects of turbines are much smaller than the scale of a city. Thus, even with the inclusion of city by year-quarter fixed effects will, there will still be within-city variation to identify property value impacts. Further, the five mile radius around each turbine includes 4.1 cities, on average.

Within the framework of Equation (1), we additionally estimate models that examine impacts that vary due to type of turbine, turbine surroundings, and viewshed (and shadow flicker, in the appendix).

Finally, we analyze property value impacts of turbines in a repeat sales model. There are many idiosyncratic features of a property that are unobserved by the researcher, and these may lead to omitted variables bias. A repeat sales model that includes property level fixed effects will account for all unobserved property attributes as long as they are time invariant. We estimate the following model:

$$\ln(p_{it}) = \alpha_i + \beta_1 PAPC_{it} + \beta_2 PC_{it} + \sum_{k=2}^{D} \gamma_{1k} dist_{ki} PAPC_{it} + \sum_{k=2}^{D} \gamma_{2k} dist_{ki} PC_{it} + X'_{it}\delta + \varepsilon_{it} \qquad (2)$$

where p_{it} is the sales price of unit *i* at time *t*, and α_i is a unit-level fixed effect. $dist_{ki}$, $PAPC_{it}$ and PC_{it} are as defined in Equation (1). Due to their time-invariant nature, property characteristics drop out of X_{it}. However, we still can include lot size and its square interacted with year fixed effects to allow for changes in the value of land through the boom and bust. X_{it} also includes city by year-quarter fixed effects. Identification of γ_{1k} and γ_{2k} (the coefficients of interest) comes from properties that transact in more than one of the three periods (PA, PAPC, PC).

3. Data

3.1 Wind turbines

Table 1 provides information on the 10 sites in Rhode Island that currently have turbines of 100 kW or above. All of these are single turbine sites, with the exception of Providence Narragansett Bay Commission, which has three. There is a wide range in the nameplate generation capacity; four turbines are 100 kW, one at 250 kW, one at 275 kW, one at 660 kW, and five at 1.5 mW. Table 1 also lists the date of public announcement that the wind turbine will be built and the date that construction was complete. The date of public announcement is marked by either an abutter notice or a public forum. The first turbine was built in 2006 and the second not until 2009; the remainder were built in 2011 and 2012. Time period PA is defined as before the announcement date, PAPC defined as between the announcement date and construction completed date, and PC is defined as after the construction completed date.[4] The last column of Table 1 describes the location and surroundings of each turbine. Of note is that several are in primarily residential areas. Others are in mixed use areas with either industrial or commercial activity, and sometimes coupled with an existing disamenity such as proximity to a highway or water treatment plant. Figure 1 shows the location of the turbine sites around the state.

One threat to identification could be that turbines are sited in neighborhoods that are strongly in favor of wind energy and that the treatment effect on the treated is substantially different than the average treatment effect (or what the price effect would be if the turbines were randomly placed). With the exception of Tiverton Sandywoods Farm, the turbines have been sited by private or government parties with little to no backing from surrounding neighbors. In fact, several turbines have been sited and erected despite substantial community protest. Given this history, we are not concerned about endogenous placement of turbines threatening identification.

3.2 Housing data

Our housing data include nearly all Rhode Island transactions between January 2000 and February 2013. Figure 1 displays the location of all transactions in our data in relation to the turbines. The data offer information on sales price, date of transaction, street address, living square feet, lot size, year of construction, number of bedrooms, bathrooms and half bathrooms, and whether or not the unit has a pool, fireplace, air conditioning or view of the water. To get latitude and longitude, we geocoded all addresses to coordinates using the Rhode Island GIS E-911 geolocater.[5] Using GIS, we calculated the Euclidian distance to the nearest turbine, as well as the distance to the coast. We limit the sample to arm's length transactions of single family homes within 5 miles of an eventual wind turbine site and with a sales price of at least $10,000. This yields 66,487 observations. From that, we drop 385 observations for incomplete data.

One downside to the housing data is that characteristics of the house (bedrooms, bathrooms, square feet, etc.) come from assessor's data and only reflect the current

[4] Several turbines in our sample were built quite recently, which makes the length of the PC period relatively short in our sample. This could cause problems for estimating true treatment effects if prices are slow to respond to changes in amenities. However, Lang (2013a) examines the dynamic path that house prices take responding to changes in air quality (an amenity more difficult to observe), and finds that owner-occupied house prices capitalize changes immediately.

[5] Available at http://www.edc.uri.edu/rigis/.

characteristics of the house. If a house was remodeled or a property was split into two or more properties, the data do not capture the characteristics of the property or house before the change. One concern is that "flipped" properties could bias our estimates. To deal with this potential problem, we search the data for properties with multiple sales occurring less than six months apart and drop any sale that occurred prior to the last sale in the set of rapid sales. For example, if we observe a property transact 1/1/2000, 1/1/2005, 2/1/2005, and 1/1/2010, we would drop the 1/1/2000 and 1/1/2005 transactions because the characteristics of the property may be dramatically different for those transactions than what is current. This drops 26.5% of observations, leaving us with a sample of 48,554.

We define five distance bands surrounding turbines needed to estimate Equation (1): 0-0.5 miles, 0.5-1 miles, 1-2 miles, 2-3 miles, and 3-5 miles. Table 2 presents the distribution of transactions across the bands for the three time periods. For identifying the effect of proximity on prices, we need a substantial number of observations in close range. There are 584 transactions within half a mile, with 75 occurring PAPC and 74 occurring PC, which should be sufficient for identifying an effect if it is there. This table makes clear the benefits of examining wind turbine valuation in a population dense state. In addition, Table 2 gives the proportion of transactions occurring in each distance band for each time period, which can give a sense of whether transaction volume is substantially different for nearby distance intervals in either PAPC or PC. The proportions appear roughly constant across time suggesting neither announcement nor construction affects transaction volume.

Table 3 presents summary statistics for our sample properties. Prices are adjusted for inflation and brought to February 2013 levels using the monthly CPI. The average price in our sample is $305,800. The average lot size is 0.34 acres and the average living area is 1559 square feet. The average distance from the coast is only 1.59 miles (Rhode Island deserves its nickname "The Ocean State"!). Additionally, Table 3 compares houses in the 0-1 mile band to the 3-5 mile band PA to examine differences between the treatment and control group prior to treatment. The last column gives the difference in means divided by the combined standard deviation, which is the best statistic for assessing covariate balance (Imbens and Wooldridge 2009).[6] Sales price seems well balanced, as do most of the covariates with the exception of Fireplace and Distance

[6] The problem with the frequently used t-statistic is that, as sample size grows, equivalent means can be rejected even when a covariate is well balanced.

from the coast, both of which exceed 0.25, which is considered to be a limit for covariate balance. If the implicit values of these characteristics are different across space or change over time, then the differences in means could be a threat to identification. However, comparing the 0-1 mile band to the 2-3 mile band (not shown), Distance to the coast has much better overlap, and both variables have strong overlap comparing the 0-1 mile band to the 1-2 mile band. Thus, the treated units have common support with the spectrum of control units. Further, as explained in Section 2 (following the advice of Boyle et al. 2012), to guard against changing implicit prices affecting the estimated valuation of turbines, we allow the implicit value of lot size and distance from the coast to vary between cities and for lot size to vary over time too.

3.3 Viewshed

Equation (1) examines how house prices change with proximity to a turbine, but proximity is a crude measure for some of the impacts of living near a turbine. One source of heterogeneity in impacts by proximity could come from whether or not residents can actually see the turbine from their property. Unfortunately, we are unable to capture this variation with GIS due to the presence of obstructions such as trees and buildings that might mitigate the impacts of a nearby wind turbine. To overcome this limitation, we completed site visits to all 1,354 properties that transacted PC and are within two miles of a turbine. Based on what we could see from the street in front of a given house, plus a bit of walking in both directions (to account for the possibility that a turbine may only be visible from certain parts of the house or backyard), the view was rated into one of five categories based on the percentage of the blade spinning diameter visible: no view (0%), minor (1-30%), moderate (31-60%), high (61-90%), extreme (91-100%). While the classification was subjective, a single person did all of the ratings and went to great length to be consistent.

The results of the site visits confirmed substantial heterogeneity in views. Despite Rhode Island's minimal topography, only 0.4% of properties in the 1-2 mile band had any view of the turbine (see Table A1 in the Appendix). Within half a mile, 24.3% have a full view, 13.5% have a partial view, and 63.2% have no view. Figure 2 illustrates the heterogeneity in viewshed for PC transactions surrounding the Portsmouth High School turbine. While viewshed and proximity are certainly correlated, it is far from a perfect correlation and there are several instances of properties with similar location and dramatically different views.

4. Results

Table 4 presents the main DD results on the full sample of transactions. There are three columns that represent three different models that each add additional variables described at the bottom of the table. All three models include housing characteristic controls, detailed further in the notes of the table, and tract fixed effects. The first set of coefficients, corresponding to the α_k in Equation (1), measure the difference in housing values among the various distance bands relative to the 3-5 mile band. All models suggest that there is a negative premium for living near the eventual site of a wind turbine, prior to an announcement that a wind a turbine will be built. For instance, Model 1 indicates that houses located within half a mile of a future turbine site are worth 9.0% less than those houses 3-5 miles away from the future site. This finding implies that turbines are being sited in areas that have lower house prices conditional on property and locational characteristics. This makes sense since several of the turbines are located in less desirable areas, i.e., near the highway or on the grounds of a wastewater treatment facility. The second set of coefficients, which correspond to β_1 and β_2 in Equation (1), measure the change in housing prices for the 3-5 mile distance band in the PAPC and PC time periods, respectively. Across all models, the results suggest that these time periods are associated with lower sales prices relative to PA (due to the crash of the housing market), though given the inclusion of city by year-quarter fixed effects the magnitudes of β_1 and β_2 do not fully reflect the large drop in house prices during those periods. Taken together, the distance and timeline results indicate that a purely cross-sectional or before-after research design would both provide negatively biased estimates of the effect of wind turbines on property values. The DD approach we apply controls for these potential problems.

The third set of coefficients in Table 4 are the DD estimates, corresponding to γ_{1k} and γ_{2k} in Equation (1), which are the estimated treatment effects of PAPC and PC for the various distance bands. The coefficients for the 2-3 mile band are small in magnitude and statistically insignificant. Intuition suggests that 2-3 miles away from a turbine is probably too far for an impact to occur, so observing that these prices closely track those 3-5 miles away gives confidence in the assumption of common trends needed for the DD research design. Moving into closer distance bands, no coefficients are statistically significant and all are small in magnitude. For all models, the Akaike Information Criterion (AIC) is calculated and Model 3 minimizes this statistic, which is the objective, and so we deem Model 3 to be our preferred specification. The point estimates of the treatment effects for this model suggest that for houses within half a mile of a turbine, values decreased 0.4% PAPC and decreased 0.4% PC. The standard error on the PC estimate is 3.8%, which implies a one-sided hypothesis can rule out decreases in prices more than 5.1% with 90% confidence. While a smaller confidence band would be ideal, we can rule out large negative impacts, such as -10% or more, that are routinely hypothesized by opponents of wind development. Results are qualitatively similar using distance bands with increment in thirds of a mile within 1 mile, but standard errors double, which leads to a larger range of possible impacts.

4.1 Repeat sales analysis

Table 5 presents results from a repeat sales analysis. Only properties that transact more than once are included in the sample, which decreases the sample by over half. The first column includes city by year-quarter fixed effects (akin to Column 1 in Table 4), and the second column additionally includes lot size-year interactions (akin to Column 3 in Table 4). Model 2 minimizes AIC, but both are presented for completeness and robustness.

Like Table 4, the results suggest that there is no significant difference in price changes between the 2-3 mile band and the 3-5 mile (control) band. In the 0.5-1 mile band, both columns suggest that house prices decreased PAPC, by 5.7% (statistically significant at the 5% level) in Model 2. The point estimates indicate larger impacts PC (-8.1% for Model 2), but are statistically insignificant. In contrast, the 0-0.5 mile band shows statistically insignificant price increases PAPC (8.1% for Model 2). The PC results for the 0-0.5 mile band are nearly identical to Table 4, indicating a 0.0% change in prices with a standard error of 3.7%.

It is difficult to draw conclusions from the results. On the one hand, the 0.5-1 mile band results indicate that turbines could have a negative and large impact on property values. On the other hand, the 0-0.5 mile band results, where the impacts should be strongest, are incongruent with the 0.5-1 mile results. It will be beneficial to update this analysis in two or so years with more PC transactions.

4.2 Heterogeneity by type of turbine and setting

As explained with Table 1, there is substantial heterogeneity among the Rhode Island turbines in terms of size and placement. The turbines range in size from 100 kW to 1.5 mW, and some are located near highways or industrial areas. The estimates presented thus far group all turbines together, but it is possible the price effects are different based on size and surroundings. Intuition suggests that price impacts would be more pronounced for larger turbines and turbines in primarily residential areas where other disamenities do not already exist.

Table 6 presents DD estimates, returning to Equation (1), for subsets of the data based on turbine characteristics. Columns 1 and 2 use only turbines with a capacity of 660 kW or more – these would be considered the industrial sized turbines. Columns 3 and 4 use only turbines in primarily residential areas. Similar to the repeat sales analysis, the large turbine analysis presents mixed evidence of price impacts. The results suggest negative price impacts of 3.6% PC in the 1-2 mile band and positive impacts of 8.4% PAPC in the 0-0.5 mile band. The point estimates for PC in the 0-0.5 mile band are 4.3%, but insignificant. For the primarily residential locations analysis, all coefficients are statistically insignificant.

4.3 Viewshed

Beyond the size and location of a turbine, another source of heterogeneity is whether or not a house can actually see the turbine, and to what extent. This source of heterogeneity can occur within a group of houses matched to a single turbine, in contrast to the heterogeneity explored in Table 6, which occurs between turbines. Table 7 presents the results of three models exploring the impact of viewshed on prices. Models 1 and 2 match Columns 2 and 3 of Table 4, except additionally include indicator variables for each of the categories of view. Model 3 omits the DD variables from the model, to check if multicollinearity between viewshed and proximity affects coefficients on the viewshed variables. Across the three models, the results suggest that view of the turbine has no statistical impact on property values. Further, the point estimates have a non-monotonic relationship with the extent of view and range from -5.2% to 7.9%.

5. Conclusion

This paper offers an econometrically sound analysis of the effect of wind turbines on property values in Rhode Island. With a sample of 48,554 transactions, we estimate a suite of

DD models that examine property impacts due to proximity, viewshed, and type and location of turbine. Because our sample time period includes the housing boom and bust, we control for city-level price fluctuations and allow the implicit value of housing characteristics to vary by year and city, following the advice of Boyle et al. (2012). Broadly, the results suggest that there is no statistical evidence for negative property value impacts of wind turbines. Both the whole sample analysis and the repeat sales analysis indicate that houses within half a mile had essentially no price change PC. These results are consistent with Hoen et al. (2013), who examine impacts of large wind farms in nine states. However, the results are not unequivocal. First, some models do suggest negative impacts; however, these are often incongruent with other coefficient estimates in the same model. Second, many important coefficient estimates have large standard errors. As time goes on and there are more PC transactions observed, we hope to update this analysis and improve accuracy and consistency of the estimates.

In the past (and likely going forward), proposed wind energy projects have been fervently opposed by homeowners surrounding the turbine site. There are several possible reasons why these stated preferences may be different than preferences revealed through housing market choices, such as we found in this analysis. First, stated preference is completely in the abstract and losses and gains are never realized. Hence, people may behave strategically to try and influence outcomes even if they are not willing to pay for it. Lang (2013b) finds a similar inconsistency with stated beliefs about climate change and what internet search records reveal about people's interests. Second, wind energy is still relatively new in the United States, especially farms and individual turbines that are in close proximity to residential development. It could be that local opposition is driven by fear of the unknown, but that once reality sets in (i.e., the turbines are built) people care much less. Third, there could be a process of preference-based sorting occurring in the housing market in which people who dislike the turbines move away and those that are indifferent or even enjoy the turbines move near.[7] Importantly, these location shifts of certain homeowners may not affect housing prices if there are enough potential buyers who are indifferent or prefer to live near turbines.

[7] See, for example, Banzhaf and Walsh (2008), who examine preference-based sorting in response to toxic emissions from factories. One anecdote in support of this idea is that we talked with one recent home buyer, an engineer, who enjoyed watching a nearby turbine spin.

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Figure 1: Spatial distribution of sales and turbines

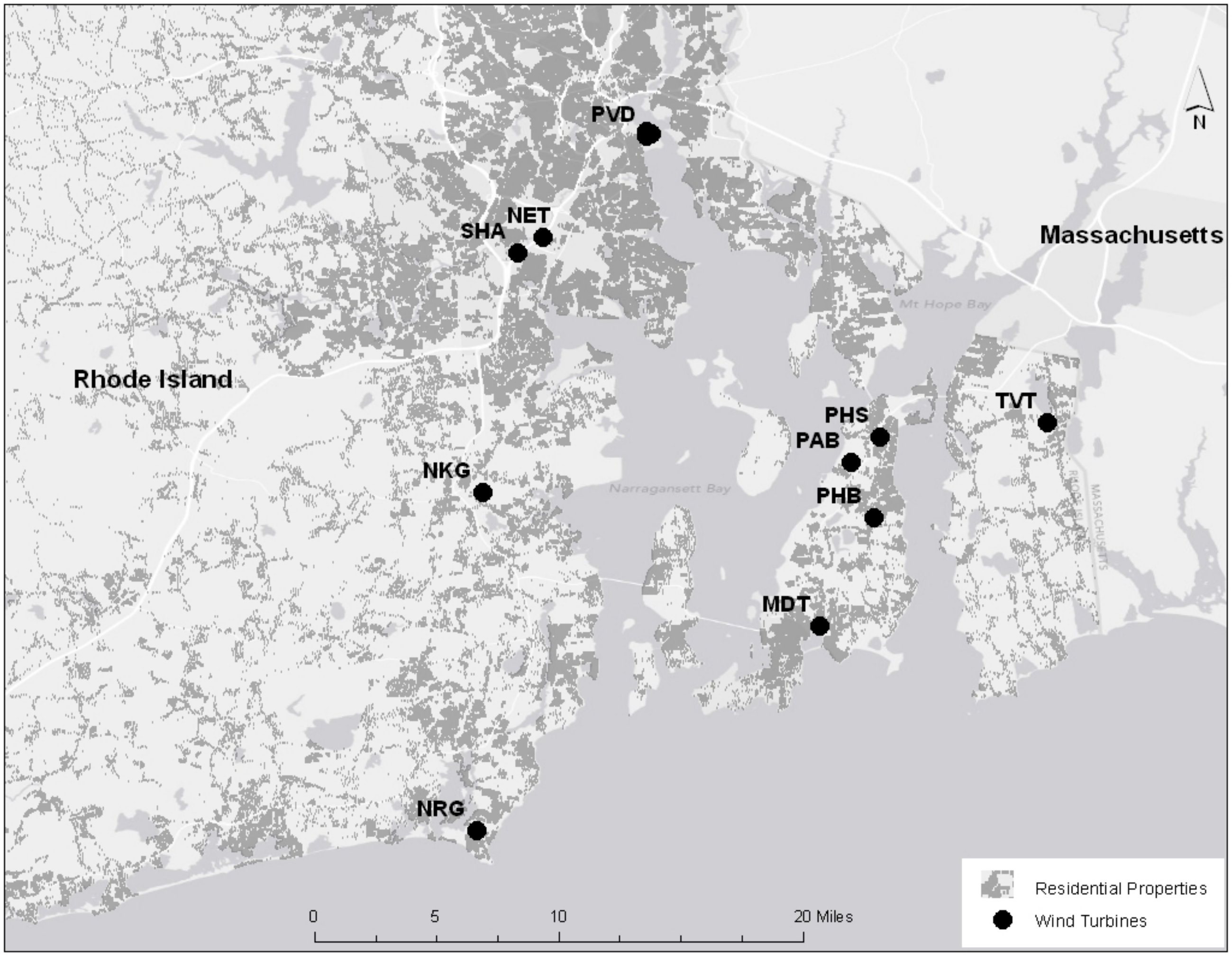

Figure 2: Proximity bands, viewshed, and shadow flicker, for post construction transactions around Portsmouth High School wind turbine

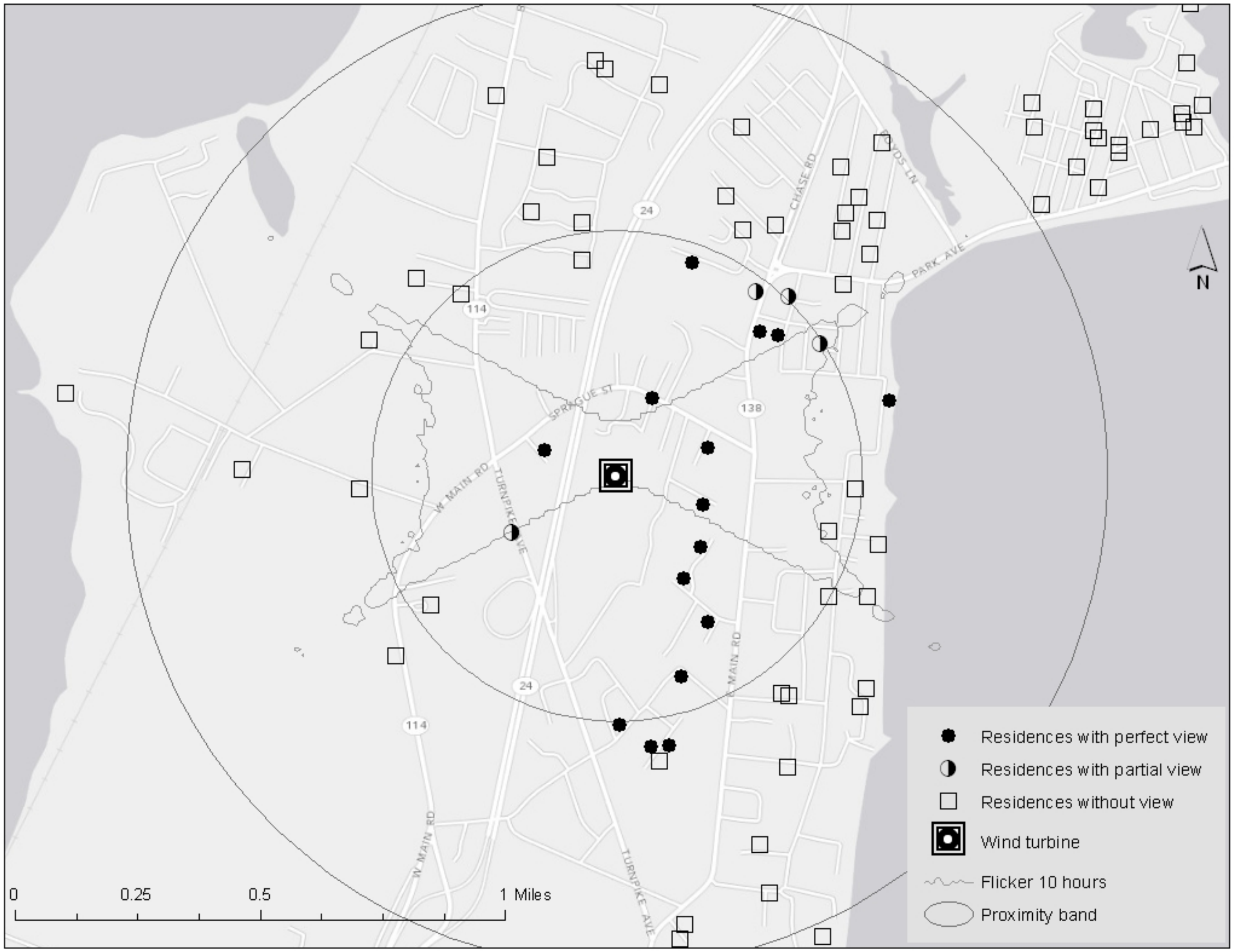

Table 1: Wind turbine characteristics for Rhode Island sample

Name	Abbreviation (match with Figure 1)	Nameplate capacity	Announcement	Construction completed	Comments
Portsmouth Abbey	PAB	660 kW	12/15/2004*	3/27/2006	On grounds of a school/monastery; primarily residential surroundings
Portsmouth High School	PHS	1.5 mW	4/15/2006*	3/1/2009	On grounds of a public school; primarily residential surroundings
Tiverton Sandywoods Farm	TVT	275 kW	7/18/2006	3/23/2012	On grounds of communal residential development; primarily residential surroundings
Providence Narragansett Bay Commission (3 identical turbines)	PVD	1.5 mW each	9/26/2007	1/23/2012	On grounds of water treatment facility; mixed industrial/residential surroundings
Warwick New England Tech	NET	100 kW	10/9/2008	8/6/2009	On grounds of technical college, next to highway
Middletown Aquidneck Corporate Park	MDT	100 kW	4/13/2009	10/9/2009	Mixed residential/commercial surroundings
Narragansett Fishermen's Memorial State Park	NRG	100 kW	7/7/2009	9/19/2011	On grounds of state campground; primarily residential surroundings
Portsmouth Hodges Badge	PHB	250 kW	5/14/2009	1/4/2012	Mixed residential/commercial/agricultural surroundings
Warwick Shalom Housing	SHA	100 kW	8/6/2009	2/2/2011	On grounds of apartment complex, next to highway
North Kingstown Green	NKG	1.5 mW	9/15/2009	10/18/2012	Primarily residential surroundings

Notes: Dates of announcement and construction completed were gathered from personal requests for information and newspaper/online sources. Dates marked with * are approximate, sources could only identify a month and year that the announcement was made, and we chose to use the midpoint of the month.

Table 2: Transaction counts and proportions by distance and time period

Distance Interval (miles)	PA	PAPC	PC	**TOTAL**
0 - 0.5	435 1.2%	75 1.0%	74 1.4%	584 1.2%
0.5 - 1	1979 5.5%	353 4.9%	338 6.4%	2670 5.5%
1 - 2	6120 17.0%	1180 16.3%	942 17.8%	8242 17.0%
2 - 3	10116 28.1%	1877 25.9%	1599 30.3%	13592 28.0%
3 - 5	17375 48.2%	3765 51.9%	2326 44.1%	23466 48.3%
TOTAL	36025 100%	7250 100%	5279 100%	48554 100%

Notes: 'PA' stands for pre-announcement, 'PAPC' for post-announcement/pre-construction, and 'PC' for post-construction. The percentages are the proportion of all transactions for a given time period occurring in that distance band.

Table 3: Housing summary statistics

Variable	Full Sample	Pre-announcement 0 - 1 miles	Pre-announcement 3 - 5 miles	Pre-announcement Difference/std. dev.
Price (000s)	305.8	330.8	323.4	0.03
Lot size (acres)	0.34	0.35	0.41	-0.06
Living area (square feet)	1559	1567	1600	-0.04
Bedrooms	3.03	3.07	3.03	0.06
Full bathrooms	1.49	1.55	1.51	0.06
Half bathrooms	0.45	0.44	0.46	-0.03
Fireplace (1=yes)	0.31	0.13	0.38	-0.44
Pool (1=yes)	0.04	0.03	0.05	-0.09
Air Conditioning (1=yes)	0.30	0.25	0.31	-0.15
Distance from coast (miles)	1.59	1.15	1.94	-0.49
Age at time of sale (years)	52.5	46.0	47.3	-0.04
Observations	48554	17375	2414	

Notes: Housing prices are brought to February 2013 levels using the monthly CPI. The final column equals the difference in means between the 0-1 mile set and the 3-5 mile set divided by their combined standard deviation.

Table 4: Difference-in-differences estimates of the impact of wind turbine proximity on housing prices

Variables		(1)	(2)	(3)
Distance (relative to 3-5 mile)				
2 - 3 miles		-0.008	-0.014	-0.014
		(0.023)	(0.023)	(0.023)
1 - 2 miles		-0.025	-0.030	-0.030
		(0.026)	(0.026)	(0.025)
0.5 - 1 miles		-0.048	-0.060	-0.059
		(0.022)**	(0.020)***	(0.020)***
0 - 0.5 miles		-0.090	-0.087	-0.087
		(0.033)**	(0.032)**	(0.032)**
Timeline (relative to PA)				
PAPC		-0.033	-0.035	-0.038
		(0.014)**	(0.014)**	(0.014)**
PC		-0.055	-0.060	-0.058
		(0.020)**	(0.020)***	(0.019)***
Difference-in-differences				
2 - 3 miles	PAPC	-0.008	-0.009	-0.008
		(0.020)	(0.020)	(0.018)
	PC	0.007	0.008	0.006
		(0.014)	(0.014)	(0.015)
1 - 2 miles	PAPC	-0.041	-0.040	-0.039
		(0.037)	(0.036)	(0.036)
	PC	-0.002	-0.009	-0.010
		(0.017)	(0.019)	(0.018)
0.5 - 1 miles	PAPC	-0.029	-0.032	-0.029
		(0.030)	(0.028)	(0.028)
	PC	-0.001	0.003	0.002
		(0.033)	(0.031)	(0.030)
0 - 0.5 miles	PAPC	-0.009	-0.001	-0.004
		(0.060)	(0.053)	(0.054)
	PC	-0.004	-0.001	-0.004
		(0.042)	(0.039)	(0.038)
City by year-quarter fixed effects		Y	Y	Y
Property-city interactions		N	Y	Y
Property-year interactions		N	N	Y
Observations		48554	48554	48554
R-squared		0.751	0.759	0.760
Akaike Information Criterion		12468.5	10933.5	10801.5

Notes: 'PA' stands for pre-announcement, 'PAPC' for post-announcement/pre-construction, and 'PC' for post-construction. Included in all regressions as control variables are lot size, lot size squared, living area, living area squared, number of bedrooms, full bathrooms, half bathrooms, indicator variables for the presence of a fireplace, pool, air conditioning, view of the water, within 0.25 miles of the coast, and within one mile of the coast, a set of dummy variables for the age of the house at purchase, a set of dummy variables for the subjective condition of the house, and tract fixed effects. Property-city interactions indicate that lot size, its square, and the two coast dummy variables are interacted with a full set of city dummies. Property-year interactions indicate that lot size and its square are interacted with year fixed effects. Standard errors are shown in parentheses and are estimated using the Eicker-White formula to correct for heteroskedasticity and are clustered at the city level. *, **, and *** indicate significance at 10%, 5% and 1%, respectively.

Table 5: Difference-in-differences estimates using repeat sales data

Variables		(1)	(2)
2 - 3 miles	PAPC	0.017	0.019
		(0.012)	(0.014)
	PC	0.032	0.032
		(0.027)	(0.027)
1 - 2 miles	PAPC	-0.067	-0.068
		(0.056)	(0.055)
	PC	-0.023	-0.024
		(0.041)	(0.041)
0.5 - 1 miles	PAPC	-0.058	-0.057
		(0.028)*	(0.027)**
	PC	-0.075	-0.081
		(0.054)	(0.052)
0 - 0.5 miles	PAPC	0.079	0.081
		(0.068)	(0.074)
	PC	0.006	-0.000
		(0.039)	(0.037)
City by year-quarter fixed effects		Y	Y
Property-year interactions		N	Y
Observations		21414	21414
Unique houses		9618	9618
R-squared		0.897	0.898
Akaike Information Criterion		-12939.7	-13058.9

Notes: Sample includes only properties that transact more than once during the sample timeframe. Standard errors are shown in parentheses and are estimated using the Eicker-White formula to correct for heteroskedasticity and are clustered at the city level. *, **, and *** indicate significance at 10%, 5% and 1%, respectively.

Table 6: Heterogeneity of impacts by turbine size and location

Variables		Capacity $\geq$ 660 kW		Primarily residential	
		(1)	(2)	(3)	(4)
2 - 3 miles	PAPC	0.003	0.002	-0.004	-0.011
		(0.016)	(0.016)	(0.075)	(0.061)
	PC	-0.011	-0.012	-0.045	-0.043
		(0.068)	(0.069)	(0.066)	(0.061)
1 - 2 miles	PAPC	-0.056	-0.057	0.048	0.046
		(0.053)	(0.052)	(0.037)	(0.031)
	PC	-0.038	-0.036	-0.022	-0.014
		(0.022)*	(0.019)*	(0.068)	(0.063)
0.5 - 1 miles	PAPC	-0.042	-0.042	0.023	0.022
		(0.041)	(0.038)	(0.048)	(0.036)
	PC	-0.047	-0.047	0.028	0.030
		(0.041)	(0.042)	(0.073)	(0.065)
0 - 0.5 miles	PAPC	0.084	0.084	-0.028	-0.034
		(0.044)*	(0.044)*	(0.124)	(0.126)
	PC	0.039	0.043	0.073	0.078
		(0.098)	(0.101)	(0.110)	(0.115)
City by year-quarter fixed effects		Y	Y	Y	Y
Property-city interactions		Y	Y	Y	Y
Property-year interactions		N	Y	N	Y
Observations		23776	23776	8206	8206
R-squared		0.775	0.776	0.726	0.729
Akaike Information Criterion		7107.2	7021.2	1929.2	1843.8

Notes: See notes to Table 4. The model used in Columns (1) and (3) is identical to that of Column (4) in Table 4, and the model used in Columns (2) and (4) is identical to that of Column (5) in Table 4. Columns (1) and (2) include turbines PAB, PHS, PVD, NKG. Columns (3) and (4) include PAB, PHS, TVT, NRG, NKG.

Table 7: The impact of viewshed on property values

Variables		(1)	(2)	(3)
0 - 0.5 miles	PAPC	-0.001	-0.004	-
		(0.053)	(0.054)	-
	PC	0.007	0.003	-
		(0.061)	(0.059)	-
View of turbine	None (omitted)	-	-	-
		-	-	-
	Minor	0.028	0.021	0.020
		(0.067)	(0.072)	(0.066)
	Moderate	0.079	0.080	0.082
		(0.125)	(0.125)	(0.124)
	High	-0.052	-0.044	-0.042
		(0.177)	(0.172)	(0.144)
	Extreme	-0.019	-0.016	-0.012
		(0.071)	(0.069)	(0.050)
City by year-quarter fixed effects		Y	Y	Y
Property-city interactions		Y	Y	Y
Property-year interactions		N	Y	Y
R-squared		0.759	0.760	0.760
Akaike Information Criterion		10932.3	10800.4	10814.8

Notes: See notes to Table 4. The sample size in all columns is 48554. The model used in Column (1) is identical to that of Column (4) in Table 4, and the model used in Column (2) is identical to that of Column (5) in Table 4. Column (3) includes all control variables that Column (5) in Table 4, but does not include the interaction terms between proximity bands and time periods (i.e., the difference-in-differences terms). Columns (1) and (2) include all difference-in-difference variables shown in Table 4, though only the interaction between the 0-0.5 mile distance band and time period are displayed.

The Effects of Wind Turbines on Property Values in Ontario: Does Public Perception Match Empirical Evidence?

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The Effects of Wind Turbines on Property Values in Ontario: Does Public Perception Match Empirical Evidence?

ABSTRACT

The increasing development of wind energy in North America has generated concerns from nearby residents regarding potential impacts of wind turbines on property values. Such concerns arose in Melancthon Township (in southern Ontario) following the construction of a large wind farm. Existing literature has not reached a consensus regarding the nature of these impacts. This paper applies a hedonic approach to detailed data on 5,414 rural residential sales and 1,590 farmland sales to estimate the impacts of Melancthon's wind turbines on surrounding property values. These impacts are accounted for through both proximity to turbines and turbine visibility – two factors that may contribute to a disamenity effect. The results of the hedonic models, which are robust to a number of alternate model specifications including a repeat sales analysis, suggest that these wind turbines have not significantly impacted nearby property values. Thus, these results do not corroborate the concerns raised by residents regarding potential negative impacts of turbines on property values.

Key words: Wind turbines; property values; visual disamenity; hedonic approach

INTRODUCTION

Global environmental concerns have led to greater emphasis on generating electricity from renewable resources. Energy sources such as wind have received increasing attention and support from governments wanting to cut carbon emissions and reduce dependence on non-renewable energy sources. As a result, the wind energy industry has become one of the fastest growing industries in the world (Herring 2004). However, in spite of its perceived benefits, a number of issues and challenges have been identified in the economic literature regarding the development of wind energy. These include the intermittency of wind power (e.g., van Kooten 2009), forecast errors for wind power output (e.g., Delarue et al 2009) and challenges with accurate estimation of the economic value of wind power (e.g., Kennedy 2005). Wind energy development has also generated controversy, as concerns have been raised by residents living in close proximity to wind turbines regarding potential negative effects on property values. Such concerns are the focus of this paper.

Previous research on turbines and property values suggests that the primary complaints associated with turbines concern the perceived negative visual effects of turbines on the landscape as well as noise created by the turbines. Most recent studies have focused their analyses on assessing the visual disamenity, which has become the more prominent concern. While earlier literature also examined the issue of noise, the reduced emphasis on the noise disamenity appears to reflect improvements in turbine technology (Moran and Sherrington 2007). As noted by Hoen et al (2009), the impact of proximity to turbines may extend beyond the visual disamenity effect to include nuisance effects such as shadow flicker and health concerns. Each of these effects, whether real or perceived, may also impact property values.

Existing literature on the disamenity effects of wind turbines (see Table 1 for an overview of this literature), which has incorporated a variety of techniques such as surveys, contingent valuation, price comparisons, and hedonic regressions, is inconclusive with respect to effects on property values. Several studies have found evidence of negative impacts, both for onshore turbines (Khatri 2004; Groothuis et al 2008; Heintzelman and Tuttle 2012) as well as offshore turbines (Haughton et al 2004; Ladenburg and Dubgaard 2007; Krueger et al 2011). In some cases, these studies did not examine property values specifically, but instead estimated residents' willingness-to-pay to keep turbines out of their viewshed, their required compensation for these turbines, or costs of landscape impacts. However, these findings are likely linked to anticipated negative property value effects occurring due to this disamenity. The results of other studies found no significant evidence of negative effects on property values (Grover 2002; Sterzinger et al 2003; Poletti 2005; Hoen 2006; Rayner 2007; Sims and Dent 2007; Sims et al 2008; Hoen et al 2009). Thus, consensus has not been reached in the empirical economic literature regarding the expected effects on property values of disamenities associated with wind turbines.

The impacts on property values of other types of disamenities have been well-documented, including impacts of hazardous waste sites (e.g., Kohlhase 1991; Kiel and Williams 2007), landfill sites (e.g., Nelson et al 1992; Hite et al 2001), transmission lines (e.g., Hamilton and Schwann 1995), and oil and natural gas facilities (e.g., Boxall et al 2005). Such disamenities are typically found to negatively impact nearby property values. The purpose of this paper is to estimate the property value impacts of the perceived disamenity associated with a wind farm (a term which refers to a set of wind turbines constructed across multiple properties within a local area) in Melancthon Township in the province of Ontario. This wind farm is one of several that have been constructed across Ontario in the past decade. Concerns about potential negative impacts on property values, as well as related concerns about potential health impacts on residents in close proximity to turbines, have become very prominent in Ontario's public forum in recent years. With the recent growth in Ontario's wind energy industry anticipated to continue as a result of government legislation such as the provincial Green Energy and Green Economy Act (2009), and with an increasing number of grassroots organizations across the province taking a stand against future wind farm developments, further examination of this issue to provide a better understanding of these effects that can inform the escalating controversy is imperative. At a more general level, additional in-depth studies on the property value impacts of wind turbines are needed to address the lack of consensus in the literature.

We apply a hedonic approach to detailed datasets of rural residential[1] sales and farmland sales in the area surrounding Melancthon Township to estimate the effects of the wind turbines on nearby property values. To our knowledge, this is the first hedonic study of the property value effects of wind turbines in Canada. This paper adds to the literature in two key ways. First, these effects are accounted for through both the proximity to the nearest turbine and the level of turbine visibility – i.e., the two factors that contribute to the potential visual disamenity. In addition to using each factor separately, we use an approach that combines proximity and visibility to account for the relationship between these two factors in contributing to the disamenity. Previous studies have tended to use either a distance measure or a visibility measure, which may limit the ability to adequately capture these effects. For example, the disamenity effects for two properties at a similar distance from a turbine may vary with the level of visibility from each property, while disamenity effects for two properties for which the nearest turbine is

[1] Rural residential properties are located beyond the municipal boundaries of urban areas. These properties tend to be larger than urban residential properties, and are often purchased by landowners that value visual amenities associated with the surrounding 'green' landscape.

fully visible may vary with distance to the turbine. Hence, combining these factors may permit a more accurate representation of disamenity effects associated with turbines.

Second, this paper provides a direct comparison of the effects of wind turbines on two distinct property types: rural residential and agricultural. As indicated in Table 1, the majority of recent studies has focused on the effects on residential properties, while farm properties have received little attention. The property value effects of turbines are anticipated to be greater for rural residential properties as the values of these properties, which are used primarily for residential purposes, may be more sensitive to visual disamenities and other nuisance effects than properties purchased primarily for agricultural use.

The findings of this paper will provide evidence that may help to resolve the controversy that exists in Ontario regarding the impacts of wind turbines on property values. In response to concerns regarding potential impacts, many residents have been calling on the provincial government to delay wind farm developments until these impacts are better understood. This paper will contribute to achieving a better understanding of these impacts, and subsequently will determine whether concerns regarding negative impacts on property values are validated. The results presented in this paper may also inform further policy discussions and developments related to the future direction of wind energy in Ontario. In addition, these results may have applicability for large-scale wind farms constructed in other jurisdictions similar to Melancthon Township, where rural areas are comprised of farms interspersed with rural residential properties for which value is derived from the surrounding viewshed.

BACKGROUND

In 2003, the provincial government of Ontario set a target of achieving 10% of total electricity production from renewable sources by the year 2010. According to Ontario's Ministry of Energy, the province had only 10 wind turbines operating commercially in 2003 but currently there are in excess of 1,000. This growth can be attributed to programs launched by the government to encourage individuals or firms (proponents) to establish wind projects that contribute to the local power grid, whereby the proponent enters into a power purchase agreement with the Ontario Power Authority through which production is guaranteed for twenty years.

Canadian Hydro Developers was one of the earliest successful proponents under this government policy initiative.[2] They proposed to construct a wind farm, in two phases, in Melancthon Township, Dufferin County, about 100 kilometres northwest of Toronto. The first phase consisted of 45 80-metre turbines with a rated capacity of 67.5 megawatts of electricity, while the second phase consisted of 88 turbines with a rated capacity of 132 megawatts.[3] The government of Ontario awarded Canadian Hydro Developers a contract on November 25, 2004.

The development of Phase I began in 2004 with environmental assessments, which were completed in the spring of 2005. Municipal permits and approvals were then obtained, which allowed construction to proceed. The permits identified the specific properties upon which the turbines would be constructed. Service works such as access roads and necessary upgrades were completed by the end of June 2005, which allowed construction to commence in July. Construction of all Phase I turbines was completed by March 2006. For Phase II, some access roads were installed in the fall of 2007, but due to delays in permitting, construction did not occur until the following year, beginning in March and extending to December of 2008. In most

[2] Canadian Hydro Developers has since been acquired by TransAlta Corporation.
[3] Some of the Phase II turbines are situated in neighbouring Amaranth Township.

cases, the land on which turbines were constructed was leased from local property owners, but in some cases properties were bought outright by Canadian Hydro Developers. The leases extend for a period of 20 years, during which time each property owner receives monthly compensation, based on the performance of the turbine(s) located on their property.

Public discussion began after the government of Ontario announced that Canadian Hydro Developers' bid had been accepted for the Melancthon wind farm. Initially, interest in the project was evident from farmers and large property owners who were potential candidates for turbine development on their property. For example, in a letter to the editor of a local newspaper, a Melancthon farmer stated that: "...a wind turbine on a farm is attractive as it might be a source of local power when central power is cut off, and could offset the rising cost of electricity and provide some income..." (*Orangeville Banner*, January 25, 2005).

As the project progressed and details emerged, such as the height of the turbines and their locations, concerns arose from local residents. At a town hall meeting in Melancthon in February 2005, two primary concerns were raised: setbacks and the devaluation of properties. Residents were concerned that the 150-metre proposed setback of a turbine from a residence would not be enough, and that the resulting viewshed would negatively impact the value of properties. Following this meeting, a related article in a local newspaper noted that "...concern was also raised with the impact a wind farm will have on property values, and despite what developers say, residents feel it will have an unfavourable effect." (*Orangeville Banner*, February 18, 2005). The concerns of residents contrasted starkly with the views of the property owners who were expecting a turbine to be constructed on their property. At a township meeting in April 2005, the 23 property owners that accounted for the 45 Phase I turbines presented a petition to council urging them to expedite the process of permit approval.

Despite many public meetings over the course of the planning and development of the wind turbines in Melancthon Township, the debate regarding the distribution of effects of the turbines in this area remained largely unresolved. Since existing literature does not provide conclusive evidence regarding this debate, we conduct an analysis to examine for property value impacts of these turbines.

METHODS

Previous studies on wind turbines have employed a variety of methods to examine for the effects of the disamenities associated with turbines on property values. These methods include hedonic regression analysis (Hoen 2006; Sims and Dent 2007; Sims et al 2008; Hoen et al 2009; Heintzelman and Tuttle 2012), valuation using choice experiments (Ladenburg and Dubgaard 2007; Krueger et al 2011), contingent valuation (Haughton et al 2004; Groothuis et al 2008), and price-trend comparison (Poletti 2005, 2007; Rayner 2007). A number of studies have also used surveys to examine attitudes toward wind turbines and wind energy (Thayer and Freeman 1987; Krohn and Damborg 1999; Sustainable Energy Ireland (SEI) 2003).

The theory behind the possibility of disamenity effects is based on the concept that potential owners value properties on the basis of various property characteristics as well as environmental amenities and disamenities, subject to their budget constraints. Purchase decisions are made based on households' tastes for specific attributes. These tastes are reflected in the values that households place on these attributes. These values can be estimated through a hedonic approach, which decomposes actual transaction prices into components linked to property attributes.

While hedonic models have not been frequently used in studies on the effects of wind turbines, they have seen extensive use in a wide variety of property value studies. This modeling approach is useful for generating the value associated with specific attributes of properties (see Freeman 2003). In this case, a hedonic model is developed for the purpose of determining the impact on property values of turbine proximity and visibility, specified by:

$$P_j = x_{ij}\beta_i + T_j\delta + \varepsilon_j, \qquad (1)$$

where P_j represents the sale price of the jth property; x_{ij} is a set of property and location attributes that can impact the sale price; T_j is the variable accounting for the disamenity effects of wind turbines; β_i and δ are parameters to be estimated; and ε_j is the error term.

We estimate six models in our primary analysis, which include three models each for rural residential properties and for farm properties. For both property types, the three models are differentiated based on the approach to accounting for turbine disamenity effects, which is discussed in the following section.

A double-log functional form is used for these models,[4] which is consistent with many hedonic models in the literature (e.g., Irwin 2002; Boxall et al 2005; Deaton and Vyn 2010). Recent literature has suggested that flexible functional forms such as the Box-Cox can outperform simpler forms, particularly in models where spatial fixed effects are used to control for omitted variable bias (Kuminoff et al 2010). However, we did not find any differences in sign or significance of the results for our variables of interest under Box-Cox specifications relative to the double-log form.

As described in previous studies (e.g., Irwin and Bockstael 2001), the identification of hedonic models can be affected by issues such as spatial autocorrelation. This issue can cause

[4] Not all explanatory variables are logarithmically transformed. Decisions about which variables to leave in their original form follow the general rules of thumb outlined in Wooldridge (2006). The variables that have been transformed are indicated in the tables of results (Tables 5 and 6).

inefficient parameter estimates due to omitted explanatory variables that are spatially related or due to spatially weighted price influences of proximate properties. As a result, studies have incorporated a spatial component into hedonic models to address this issue. Likewise, as described in the sensitivity analysis, we use a spatial autoregressive model to determine whether the existence of spatial autocorrelation has affected the parameter estimates. Other identification issues associated with the use of hedonic models include multicollinearity and heteroskedasticity. We address heteroskedasticity by generating robust standard errors, while the issue of multicollinearity is examined in the results section.

DATA

The data used in the hedonic models to estimate the property value effects of the Melancthon wind farm is derived from separate datasets collected by the Municipal Property Assessment Corporation (MPAC) to record sales of rural residential properties and farm properties.[5] These datasets consist of open-market sales (as defined by MPAC) between January 2002 and April 2010[6], inclusive, in Melancthon and ten surrounding townships in the counties of Dufferin, Grey, Simcoe, and Wellington. With the focus of this study on the effects of turbines on nearby properties, sales of properties on which turbines are located are excluded from these datasets.[7] Additionally, we restrict farm properties to those greater than five acres in size, in order to exclude farm properties that may be too small for use in agricultural production.[8]

[5] MPAC collects this data for the purpose of assessing property values.
[6] The farm sales data extends only to April 2009.
[7] Only three sales of farm properties with turbines were included in the original datasets. This limited number restricts the ability to estimate the effects on the value of properties on which turbines have been constructed; as such, they have been excluded from the analysis.
[8] This restriction, as well as a variation of this restriction (i.e., 20 acre minimum size), does not impact the results.

With wide ranges in sale prices within each dataset, the possibility of outliers exists. Potential outliers are removed by establishing minimum and maximum prices beyond which the distribution of sale prices becomes sparse. Rural residential properties with sale prices below $10,000 and greater than $2,000,000 are removed, while farm properties with sale prices greater than $2,500,000 are removed from the dataset.[9] Following these restrictions, the datasets used for the analysis consist of 5,414 rural residential sales and 1,590 farmland sales.

Both datasets include many properties that sold more than once during the study period. Among the rural residential (farm) sales, 797 (131) properties sold twice, 114 (10) properties sold three times, and 12 (0) properties sold four times. This allows for conducting a repeat sales analysis, which can be an effective method for controlling for omitted variable bias. The results of this analysis can be compared to those of the full sample. Due to the relatively low numbers of properties in close proximity to turbines in the repeat sales sample, we conduct this analysis as a component of the sensitivity analysis rather than as our primary model.

Variables Accounting for Turbine Impacts

The potential visual disamenity associated with turbines is anticipated to arise due to two factors: proximity to the turbine and the level of visibility of the turbine. Each factor is incorporated separately into the hedonic models to account for this disamenity. In addition, as an alternate approach to accounting for this disamenity, a model is specified that combines both factors. Hence, three separate models are estimated for both property types, each with a different approach to accounting for the disamenity effects of turbines.

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[9] There were 7 rural residential properties (0.13% of sample) and 5 farm properties (0.31% of sample) with sale prices beyond these constraints. Excluding these sales did not affect the nature of the results.

In the first model, the disamenity effects are accounted for by proximity to turbines, which is measured as the inverse of the distance, in kilometres, from the property to the nearest wind turbine. This approach to accounting for turbine disamenity effects is similar to that of Heintzelman and Tuttle (2012). Geographic information systems (GIS) software was used to calculate the distances from each property in the two datasets to each of the 133 turbines in the Melancthon wind farm, from which the distance to the nearest turbine was determined for each property, and then inverted. While this study focuses to a larger extent on visual disamenities, the use of a proximity variable also accounts for noise disamenities associated with turbines. Due to the distance-decaying nature of the visual and noise disamenities associated with wind turbines, any disamenity effects on property values within the affected area are expected to be relatively higher for properties in closer proximity to turbines. Hence, if such disamenity effects exist, the sign of this proximity variable would be negative. Variation in the magnitude of effects based on distance from the disamenity has been demonstrated in related areas of the literature (Kohlhase 1991; Boxall et al 2005).

In the second model, the disamenity effects are accounted for by the level of visibility, which is measured using a rating system similar to that of Hoen (2006). Under this rating system, a score of one point is assigned if only the top of the blade is visible from the property (e.g., above the treeline), a score of two points is assigned if the hub of the turbine is fully visible, and a score of three points is assigned if the entire vertical span of the blades is visible.[10] The development of this rating system required field visits to each of the properties within 5 kilometres of the wind farm, which was determined based on observations of the study area to be

[10] A rating system of 1, 3, and 5 points for the indicated levels of visibility was also examined, but the results were not found to be sensitive to this alternate rating system.

the extent of the visual impact.[11] Similarly, previous studies have specified distance limits within which the effects are assumed to extend, such as five miles (Sterzinger et al 2003; Hoen 2006) and five kilometres (SEI 2003) from turbines. Both the rural residential and farm datasets include properties up to 50 kilometres from the nearest turbine, which permits the comparison of properties in close proximity to turbines with those from which the turbines are not visible (i.e., a control group). Under the assumption that greater visibility of the turbine increases the disamenity effects on property values, the expected sign of this visibility rating variable is negative.

Since sales data are available both prior to and after the Melancthon wind farm was developed, each of the proximity and visibility measures used in the first two models is multiplied by a categorical variable indicating whether the property was sold in the time period during which disamenity effects are expected to occur, referred to as the post-turbine period. However, the existence of two phases of the wind farm complicates the calculation of these interaction terms. Consideration must be given to the date of sale with respect to the post-turbine period specific to each phase and, subsequently, to the determination of visibility rating of or distance to the nearest turbine in existence at the date of sale. As a result, categorical variables are created to represent the post-turbine period for each phase, while for each property, visibility ratings and distances to the nearest turbine are determined separately for Phase I turbines and for Phase II turbines. To capture appropriately the potential disamenity impacts of the Melancthon wind farm, each disamenity measure is specified for both rural residential and farm properties as the maximum of the Phase I and Phase II measures.

[11] GIS applications can also be used to model the topography of the surrounding landscape and resulting viewshed. Hoen (2006) found that field visits were more accurate for rating turbine visibility than a GIS modeling approach.

The post-turbine periods are specified to account for the time periods in which the potential impacts of the turbines would likely be observed in property transaction prices. Since uncertainty exists in identifying the point in time at which impacts are expected to arise, we use three different specifications of the post-turbine period. In our base model, impacts are assumed to arise upon commencement of turbine construction.[12] While the visual impact of the turbines could not be fully observed at this time, market participants would be aware of the locations of the turbines. Construction began in July 2005 for Phase I turbines and in March 2008 for Phase II turbines. Hence, the post-turbine periods specified for our primary models account for all sales that occurred from these months forward.

Unfortunately, there are relatively few observations in the post-turbine periods that are in close proximity to turbines.[13] Table 2 provides the numbers of post-turbine period observations at various distances from the turbines for the base model and two alternate specifications (which are described below). For example, under the base model specification, there are 23 (8) sales of rural residential (farm) properties within 1 kilometre of the nearest turbine and 103 (40) within 5 kilometres (which represent 1.9% (2.5%) of all sales). The numbers of observations for each visibility rating are provided in Table 3 for each of the post-turbine period specifications. For the base model specification, among the rural residential (farm) properties within 5 kilometres of the nearest turbine, 9 (3) properties have a visibility rating of 1, 19 (13) properties have a visibility rating of 2, and 33 (16) properties have a visibility rating of 3.[14] These relatively low numbers of post-turbine period observations, which may impede the ability to detect significant effects, represent a potential limitation of this study.

[12] In a survey conducted by Khatri (2004), the majority of chartered surveyors believed that the impacts of turbines began before construction was completed.
[13] This has been a recurring issue in previous hedonic studies on the effects of wind turbines.
[14] The majority of properties within 5 km of the nearest turbine with a visibility rating of 0 are located in the 3-5 km range. The closer the property to the nearest turbine, the more likely that the visibility rating is greater than 0.

To address the uncertainty that exists regarding the point in time that impacts begin to arise, we examine the sensitivity of the base model results to two alternate specifications of the post-turbine periods. The first alternate specification (Pre-Construction) assumes that impacts begin to arise upon project approval (for Phase I) and upon completion of ancillary activities such as access roads (for Phase II), which could provide some indication of where future turbines may be located. These post-turbine periods include sales occurring after November 2004 (Phase I) and after October 2007 (Phase II), of which 30 (9) rural residential (farm) properties are within 1 km and 123 (52) are within 5 km of the nearest turbine (see Table 2). The second alternate specification (Post-Construction) assumes that impacts do not arise until construction is completed (i.e., turbines are fully visible); thus, the post-turbine periods include sales occurring after February 2006 (Phase I) and after November 2008 (Phase II). Among these sales, 18 (6) rural residential (farm) properties are within 1 km and 79 (27) are within 5 km of the nearest turbine.

While both proximity and level of visibility represent plausible measures of the visual disamenity, and have been used accordingly in previous studies, the use of each measure on its own involves potential issues that may impede the ability to appropriately capture the disamenity effects. For example, the impact of turbine visibility is likely to vary spatially – i.e., the disamenity effect of a 3-point visibility rating is assumed to be greater for a turbine at a distance of 1 kilometre than for a turbine 3 kilometres from the property. To address such issues, an additional model is specified that includes both the proximity and visibility variables as well as an interaction term (*Proximity*Visibility*). This represents an approach to accounting for turbine disamenity effects that has not previously been taken in the literature. The interaction term increases with visibility (holding proximity constant) and decreases with distance from the nearest turbine (holding visibility constant); hence, as with each of the proximity and visibility variables, the sign of this variable is anticipated to be negative.

As an alternative to using a continuous distance specification for the proximity variable accounting for the disamenity effects of turbines (Model 1), a set of discrete distance bands is specified based on proximity to the nearest turbine. Distance bands have been used in a number of previous studies (Thayer et al 1992; Mikelbank 2005; Deaton and Vyn 2010). The set of distance bands specified for this study includes the following ranges: 0-1 km, 1-3 km, and 3-5 km. These ranges encompass the visual extent of the wind turbines, which was determined based on observations of the study area to be about 5 km. Since the specification of 1-km bands would result in relatively few observations within some bands, particularly for farm properties, the use of larger bands (i.e., 2-km bands) increases the numbers of observations within each band and reduces the potential for individual properties to have undue influence on the estimated results. An exception is made with the first band (0-1 km) to permit examining for impacts in the area immediately surrounding the turbines where these impacts are anticipated to be greatest, under the assumption of a distance-decaying disamenity effect.[15] For rural residential (farm) properties, there are 23 (8) properties in the 0-1 km band, 28 (11) properties in the 1-3 km band, and 52 (21) properties in the 3-5 km band. Distance band variables are calculated as the maximum of interaction terms specified for each phase between the categorical variable accounting for the existence of the nearest turbine within the specified range and the post-turbine period categorical variable specific to that phase. The results for this model specification are compared to those of the continuous distance specification in the sensitivity analysis.

[15] Alternatively, two successive bands of 2.5 km (i.e., 0-2.5 km; 2.5-5 km) can be specified, which would increase the numbers of observations within the bands. However, this alternate band specification does not change the nature of the results.

We also examine for the effects of turbine density in the sensitivity analysis. With 133 turbines constructed across the Melancthon wind farm, the disamenity effect may depend not only on proximity to and visibility of the nearest turbine but also on the number of turbines within the viewshed. Thus, a turbine density variable is created to account for the existence of multiple turbines in close proximity to properties. To create this variable, the total number of turbines is calculated within a specific radius of each property. Two separate specifications of this variable are created: one with a 2-km radius (*Density 2 km*) and one with a 5-km radius (*Density 5 km*) in which density effects are measured. The maximum number of turbines within 2 (5) kilometres is 24 (91) for rural residential properties and 17 (60) for farm properties. This approach follows that of Boxall et al (2005), which examined the effects of the density of sour gas wells on nearby property values.

Other Hedonic Covariates

In addition to the turbine variables, there are three other categories of variables (i.e., property, location, and time) that are included in the models to account for differences in sale prices across rural residential and farm properties (see Table 4). Many of these variables are consistent with those used in other hedonic property value studies. Due to differences between rural residential properties and farm properties in the importance of various attributes that contribute to value, the sets of variables included in the two models differ to some degree. While the description below covers all variables included in both models, differences between the sets of variables included in the models are evident in Table 4, where summary statistics are provided only for the variables included in each model.

The property variables include attributes of houses that account for differences in property values, such as square footage, the numbers of bathrooms and fireplaces, the existence of features such as a pool and air conditioning, and a house quality index (on a scale of 0-10). Other property variables include the size of the property in acres, the numbers of acres of Class 1 land, Class 2 land, and wooded area, the existence of water and sewer services, and the value of any secondary structures (e.g., barns, sheds, and garages) on the property.

The location variables account for urban and amenity influences in the surrounding area. Amenity variables include a categorical variable that accounts for the abutment of the property to commercial properties. The influence of urban areas on property values are accounted for by the distances to the nearest city with population greater than 10,000 and to the nearest highway interchange, in kilometres. The distance variables were generated using GIS software. Spatial fixed effects, which have received attention in recent hedonic studies as a means of reducing omitted variable bias associated with unobserved local factors (Kuminoff et al 2010), are accounted for through a set of categorical variables for the 11 townships (with one omitted from the models) represented in the datasets.

The time variables account for changes in property values over time as well as for seasonal influences. To capture these influences, sets of year and month categorical variables are included in the models, with the year 2002 and the month of January omitted.

Summary statistics in Table 4 indicate average sale prices of $287,432.20 for rural residential properties and $353,647.40 for farm properties. The average size of farm properties is 78.91 acres, while the average rural residential property size is 6.14 acres.

RESULTS

Three separate hedonic models are analyzed for both rural residential properties and farm properties, the results of which are provided in Table 5 and Table 6, respectively. These models differ in the variable accounting for turbine impacts, with these impacts accounted for by proximity of the property to the nearest turbine in Model 1 (measured as inverse distance), by visibility of the nearest turbine in Model 2 (measured based on a rating scale of 0-3), and by proximity, visibility, and an interaction of these variables in Model 3. With the disamenity effects of turbines assumed to be increasing with visibility rating as well as distance-decaying (hence, increasing with inverse distance), the coefficient for each variable representing turbine impacts is expected to be negative. However, these anticipated outcomes are not observed for either rural residential properties or farm properties, as the estimated coefficients are not statistically significant, and, in many cases, not negative. It may be the case that the relatively low number of observations in close proximity to turbines contributed to the relatively large standard errors and resulting lack of statistical significance. Hence, within the limitations of the data and estimation methods, significant price effects of the wind turbines in Melancthon Township on surrounding properties are not found. To address some of these limitations and their potential influence on the results, the robustness of the results of Model 1 is examined across a number of alternate model specifications, which include the use of alternate post-turbine periods, distance bands, spatial models, repeat sales models, and turbine density variables.[16] Each of these alternate specifications is discussed below, following a brief overview of the results of the property, location, and time variables.

[16] Only the robustness of the results of Model 1 is described in the sensitivity analysis, as alternate specifications of Models 2 and 3 provide very similar results to those of Model 1.

The results for the remaining variables are consistent across the three models for each property type. The directions of the effects on price for the property and location variables coincide with expectations, with most coefficients being statistically significant. The lack of significance in the remaining coefficients may be due to correlation among variables. The possibility of correlated variables raises the issue of multicollinearity, which may affect the validity of the estimates. An examination of the variance inflation factors (VIFs) for these variables did not indicate any with a VIF greater than 10, which would have been cause for concern (Gujarati 1995).

The results of the fixed effects variables indicate considerable variation in prices across townships for both property types, which may account for the influence of spatially varying omitted variables. The time variables indicate that prices for both property types generally increased from year to year, while seasonal differences are found for rural residential properties where prices in the last few months of the year are significantly higher than prices early in the year.[17]

Sensitivity Analysis

To account for a number of issues and limitations inherent in the approach used in our primary analysis, we examine several alternate model specifications. The results for each specification are compared to those of Model 1 for rural residential properties in Table 7 and for farm properties in Table 8.[18]

[17] In the interest of space, the results for the fixed effects variables and sets of year and month variables are not included in the tables of results. They are available from the authors upon request.
[18] Only the results of the turbine variables are shown in these tables. The results for all other variables are consistent with those of the Model 1.

Given that the assumption imposed regarding the dates that the turbine effects began to arise – July 2005 for Phase I; March 2008 for Phase II – may be somewhat limiting, two alternate post-turbine period specifications are examined. First, pre-construction dates are specified as the points in time at which the effects began to occur: November 2004 for Phase I; October 2007 for Phase II. These dates coincide with project approval (Phase I) and with completion of ancillary activities (Phase II). Second, post-construction dates are specified: February 2006 for Phase I; November 2008 for Phase II. These dates coincide with the completion of turbine construction for the respective phases of the wind farm. The results of the models based on these alternate specifications are displayed in columns 2 (Pre-Construction) and 3 (Post-Construction) of Tables 7 and 8. The results are found to be similar to those of the primary model for both rural residential properties and for farm properties, where no significant effects are observed. This suggests that the lack of significant disamenity effects observed in the primary models is not an artifact of the imposed assumptions for the specifications of the post-turbine periods.

As an alternative to the continuous specification of the proximity variable, a discrete set of distance bands is used to account for the disamenity effects, where variables are specified to account for properties sold in the post-turbine period within bands of 0-1, 1-3, and 3-5 kilometres from the nearest turbine. With the assumed distance-decaying nature of the turbine disamenity effects, the coefficients for the distance band disamenity variables are expected to be negative, with declining magnitudes with distance from the nearest turbine. However, as with the primary models, no significant disamenity effects are observed across the distance bands for either rural residential or farm properties (see column 4 of Tables 7 and 8).

The next component of the sensitivity analysis examines the issue of spatial autocorrelation, which can often arise in hedonic property value models. The results of Moran's *I* tests indicate evidence of spatial autocorrelation in the data for both rural residential sales (I = 0.0723; $p < 0.0001$) and farmland sales (I = 0.0893; $p < 0.0001$). This issue can be accounted for through either a spatial lag model or a spatial error model, depending on the nature of the spatial correlation (see Anselin 1988). Lagrange multiplier (LM) tests can be used to determine which model is most appropriate (Brueckner 1998). Comparisons of the LM statistics for the spatial lag model (rural residential: 1,309.3336; farms: 163.2084) and the spatial error model (rural residential: 393.3383; farms: 95.3762) suggest that the spatial lag model would be more appropriate for addressing this issue for both sets of data.[19] This model is estimated separately for each property type using spatial autoregressive (SAR) models. Building on the hedonic model in equation (1), the SAR model is specified as:

$$P_j = P_j W\rho + x_{ij}\beta_i + T_j\delta + \varepsilon_j, \qquad (2)$$

where ρ is the spatial correlation parameter and W is an n x n spatial weight matrix. This matrix is created based on an inverse distance specification, following a commonly used specification in the spatial econometric literature (Bell and Bockstael 2000), particularly for studies using micro-level data with non-contiguous observations (Bell and Irwin 2002). In this case, a cutoff distance of 5 kilometres is imposed, such that the weight is equal to 1/distance between the two properties if the distance is less than 5 km and zero otherwise.[20]

[19] However, the results are found to be consistent across both the spatial lag and the spatial error models.

[20] Due to uncertainty that typically exists regarding appropriate specification of the spatial weight matrix, Bell and Dalton (2007) note that sensitivity analyses are often conducted across alternate forms of this matrix. Accordingly, we examined the sensitivity of the results under an alternate spatial weight matrix in which the specification is based on the 10 nearest neighbours (e.g., Pace et al 2000). Further sensitivity analysis was conducted for each specification of W by adjusting the cut-off distance and the number of nearest neighbours. In each case, the results were not sensitive to changes in W.

The results of the SAR models (column 5 of Tables 7 and 8) are similar to those of the primary models, where no significant effects of turbines are found. Thus, the existence of spatial autocorrelation does not appear to affect the nature of the results. This is not entirely surprising, given the fact that, as noted in Heintzelman and Tuttle (2012), incorporating spatial fixed effects can be analogous to the use of a spatial lag model for addressing issues arising from spatial autocorrelation. Hence, the use of spatial fixed effects in our primary models may reduce the possibility of biased estimates and, subsequently, eliminate the need to account for this bias through a spatial lag model.

The existence of properties in our datasets that sold more than once during the study period permits a repeat sales analysis, from which the estimated disamenity effects can be compared with those of the full sample models. This analysis allows us to implement fixed effects at the parcel level rather than the township level, which may better control for omitted variable bias, and to examine the sensitivity of the results to an alternate geographic scale of fixed effects. The results of the repeat sales models, based on 2,008 sales of rural residential properties (935 properties) and 292 sales of farm properties (141 properties), are similar to those of the full sample models, where no statistically significant effects of turbines on property values are found (see column 6 of Tables 7 and 8).[21] Similarity of results between full sample models and repeat sales models has previously been demonstrated in related hedonic studies on the effects of wind turbines (Hoen et al 2009; Heintzelman and Tuttle 2012). However, while supportive of our primary results, the results of the repeat sales analysis should be viewed with considerable caution, as the lack of significance may be due in part to limited observations in close proximity to turbines. For example, among rural residential (farm) properties, there are 43

[21] These results also hold for repeat sales models based on the other three specifications of the disamenity effects used in the primary analysis. Further, restricting the repeat sales sample to properties that sold both before and after the turbines were constructed (1,150 rural residential sales; 160 farm sales) produces similar results.

(8) properties sold in the post-turbine period within 5 kilometres of the nearest turbine, of which only 10 (2) are within 1 kilometre. Hence, these numbers of observations are likely too few to detect significant effects, which represents a major limitation of this analysis.

While our primary analysis focuses on disamenity effects associated with proximity to or visibility of the nearest wind turbine, this approach ignores the possibility of disamenity effects arising from the existence of multiple turbines. With 133 turbines constructed within a relatively localized area in Melancthon Township, properties in this area may be in close proximity to multiple turbines. To determine whether the number of surrounding turbines affects sale prices, turbine density variables are specified to account for the numbers of turbines within 2 km and within 5 km of each property. These density variables are incorporated into the hedonic models as an alternate approach to the specification of the turbine disamenity – i.e., in place of the proximity and visibility variables. The results of the models for each density specification (columns 7 and 8 of Tables 7 and 8) indicate no significant impacts of turbine density on rural residential or farm property values within either of these distances. Specifically, an increase in the number of turbines in close proximity to a property is not found to negatively impact its value.

In summary, the sensitivity analysis examines the robustness of our primary results across several alternate model specifications. The results across all components of the sensitivity analysis are consistent with those of our primary models, where no significant disamenity effects are found.

CONCLUSION

In response to concerns raised by residents of Melancthon Township regarding potential effects of surrounding wind turbines on property values and to a lack of consensus in the related body of literature, this paper estimates the impacts of the Melancthon wind farm on nearby rural residential and farm property values. This paper adds to the growing body of literature on the effects of wind turbines by utilizing a hedonic approach, which has not been frequently used in related studies (we are aware of only three peer-reviewed studies: Sims and Dent 2007; Sims et al 2008; Heintzelman and Tuttle 2012), to estimate the disamenity effects of turbines on property values using both proximity to turbines and turbine visibility to account for these effects. In addition, this paper permits the comparison of effects across rural residential properties and farm properties, the latter of which has received little attention in the literature.

The analysis discussed above allows us to address our primary research question: Have the wind turbines in Melancthon Township affected surrounding property values? The empirical results generated by the hedonic models, using three different measures to account for disamenity effects, suggest that these turbines have not impacted the value of surrounding properties. Further, the nature of the results, which indicate a lack of significant effects, is similar across both rural residential properties and farm properties. Thus, the anticipated greater effect on rural residential properties – due to the greater amenity value derived from the surrounding landscape – is not found to occur. After conducting extensive sensitivity analysis to test the robustness of the primary model results, these results are found to be consistent across a number of alternate model specifications.

However, while the results indicate a general lack of significantly negative effects across the properties examined in this study, this does not preclude any negative effects from occurring on individual properties. In fact, a recent appraiser's report on the impacts of Melancthon's wind turbines (Lansink 2012) found that the values of five specific properties in close proximity to turbines declined by up to 59%. While the set of properties examined in this study may not be representative of all open-market sales in close proximity to the turbines (the five properties in question were each purchased by Canadian Hydro Developers and resold after turbines had been constructed[22]), it provides evidence that values of specific properties may be negatively impacted, which supports the claims made by a number of local residents.[23] Indeed, the existence of relatively large standard errors for some of the turbine disamenity variables suggests that some properties may have experienced negative impacts from proximity to turbines. Thus, the results of our study cannot refute the claim that values of some nearby properties have been impacted by wind turbines; however, they do suggest that such impacts may not occur to the same degree across all open-market sales of similarly situated properties (although this finding may be limited by the relatively low frequency of such sales). Similarly, Hoen et al (2009) noted that while significant effects were not found across the large set of properties examined, the possibility of negative impacts on individual properties could not be dismissed.

The results discussed above are similar to those of other prior studies on the effects of wind turbines on property values, particularly those utilizing hedonic regressions (Hoen 2006; Sims and Dent 2007; Sims et al 2008). However, these results differ to some degree from those of the recent hedonic study by Heintzelman and Tuttle (2012), which found evidence of significantly negative impacts of turbines on surrounding property values. But the results of this study were mixed, as significantly negative impacts were only observed in two of three counties

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[22] Our dataset includes four of these properties but only two of the sales by Canadian Hydro Developers in the post-turbine period (the other sales occurred after the study period of our analysis). However, the presence of these two post-turbine sales of rural residential properties, for which the nearest turbines are 200 and 800 metres away, does not appear to influence our results (i.e., cause estimated impacts to be significantly negative). To provide some context, our rural residential dataset also includes 18 other post-turbine period observations within 800 metres of turbines.

[23] In fact, such appraisal evidence may be used in litigation as the basis for claims of property value loss.

examined, while only limited significance was observed among impacts across a set of distance bands specified based on proximity to turbines. Hence, these results do not differ entirely from our results. Heintzelman and Tuttle (2012) suggested that the variation in their results across counties may have arisen due to heterogeneity in consumer preferences across counties. Similarly, this factor may have contributed to the differences that exist between their results and our results. These differences may also stem from similarities between Melancthon Township and the county in which no significant impacts were found by Heintzelman and Tuttle (2012). For example, the population density of this county, which was lowest among the three counties, is very close to that of Melancthon Township. Perhaps negative impacts are more likely to occur in more densely populated areas, where a relatively greater number of properties may be affected. It may also be the case that impacts of wind farms vary across Ontario in a similar manner to the regional variation observed by Heintzelman and Tuttle (2012). Thus, the possibility remains that significant impacts may be observed in other areas of the province with wind turbines. Future research could explore this possibility.

Based on our results and on those of related studies outlined in Table 1, it is evident that, with the exception of the study by Heintzelman and Tuttle (2012), findings of negative impacts of turbines are more likely to occur for studies using surveys than for studies based on actual sales data. While surveys have indicated that residents often perceive that the existence of wind turbines within their viewshed will reduce the value of their property, such perceptions have not often been corroborated by analyses of sales data, perhaps due in part to data limitations with respect to sales in close proximity to turbines.

The existence of limitations in the analysis undertaken in this paper should not be overlooked. The results generated above are based on values of properties that have been sold.

However, properties for which the value may be negatively impacted by turbines may not have been sold. For example, in the event that a property's value is substantially reduced as a result of disamenities associated with nearby turbines, the owner may be unwilling (or unable) to sell at a loss. On a related note, as previously discussed, the relatively low number of sales of properties in close proximity to turbines and with visibility ratings greater than zero represents another potential limitation, as this may reduce the likelihood of finding significant impacts.

The information that can be derived from the results of this paper is of applied importance given the ongoing expansion of the wind energy industry in North America and corollary concerns raised by local residents regarding disamenity effects. Indeed, a perusal of articles in the popular press over the past few years related to wind turbine development in Ontario indicates significant concerns associated with not only the resulting viewshed but also with health impacts, both of which could impact property values. Thus, the lack of significant effects of the Melancthon wind farm is somewhat surprising, given the public outcry regarding the construction of these turbines.

These results also have application for related issues with municipal property tax assessments, as a number of property owners in close proximity to wind farms in Ontario have appealed their assessment on the basis of claims of negative impacts on the value of their property from surrounding wind turbines. However, a recent decision by Ontario's Assessment Review Board ruled against property owners that had made such an appeal, citing a lack of evidence of adverse impacts on property value.

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Table 1. Overview of selected literature related to wind farms and property value effects

Author (date)	Property type	Extent of effect measured	Method	Findings
Heintzelman and Tuttle (2012)	Residential	0 to 10 miles	Hedonic regression	Negative effects on property values found in two of three areas studied
Hoen et al (2009)	Residential	0 to 10 miles	Hedonic regression	No conclusive evidence of effects
Sims et al (2008)	Residential	0.5 to 1 mile	Hedonic regression	No significant effects observed
Sims and Dent (2007)	Residential	0.5 to 4 miles	Hedonic regression	No impact on property values
Hoen (2006)	Residential	Within 1 mile; within 5 miles	Hedonic regression	Inconclusive
Rayner (2007)	Residential	Pre-construction	Price comparison	No impact on property values
Poletti (2007)	Residential & Agricultural	Target area: turbines visible	Price comparison	No significant effects
Poletti (2005)	Residential	Target area: turbines visible	Price comparison	Inconclusive
Sterzinger et al (2003)	Residential	0 to 5 miles	Price trend comparison	No impact on property values
Krueger et al (2011)	Residential	0.9 to 9 miles	Choice experiments valuation	Costs of visual disamenity decrease with distance of turbines from shore
Ladenburg and Dubgaard (2007)	Residential	8 to 50 km	Choice experiments valuation	Residents willing to pay to site turbines at greater distances from shore
Groothuis et al (2008)	Residential	Turbines within viewshed	Survey; contingent valuation	Majority believe views are harmed; require compensation for turbines in viewshed
Haughton et al (2004)	Residential	Turbines visible offshore	Survey; contingent valuation	Opinion that view is worse; decrease in property values
Khatri (2004)	Residential & Agricultural	Wind farm is visible	Survey of chartered surveyors	Residential values decreased; no impact on farms
Sustainable Energy Ireland (2003)	Residential	Turbines visible; 5 km	Survey of attitudes to local wind farms	Little evidence of a NIMBY effect; majority view wind farms favourably
Grover (2002)	Residential	Variable – 2 miles to 25 miles	Survey of tax assessors	No impact on property assessments
Thayer and Freeman (1987)	Residential	Wind farm is visible	Survey of attitudes and impressions	Neutral or negative reaction to appearance

Table 2. Numbers and percentages of sales in the post-turbine period (3 specifications) within specified distance ranges of turbines

Distance from Nearest Turbine	Rural Residential Properties						Farm Properties					
	Base Model		Pre-Construction		Post-Construction		Base Model		Pre-Construction		Post-Construction	
	#	%	#	%	#	%	#	%	#	%	#	%
0 to 1 km	23	0.42	30	0.55	18	0.33	8	0.50	9	0.57	6	0.38
1 to 2 km	11	0.20	13	0.24	7	0.13	4	0.25	4	0.25	2	0.13
2 to 3 km	17	0.31	19	0.35	10	0.18	7	0.44	11	0.69	4	0.25
3 to 4 km	23	0.42	28	0.52	21	0.39	10	0.63	11	0.69	6	0.38
4 to 5 km	29	0.54	33	0.61	23	0.42	11	0.69	17	1.07	9	0.57
Total	103	1.90	123	2.27	79	1.46	40	2.52	52	3.27	27	1.70

Note: Percentages represent numbers as a proportion of the total sample.

Table 3. Numbers and percentages of sales in the post-turbine period (3 specifications) with each visibility rating

Visibility Rating	Rural Residential Properties						Farm Properties					
	Base Model		Pre-Construction		Post-Construction		Base Model		Pre-Construction		Post-Construction	
	#	%	#	%	#	%	#	%	#	%	#	%
1	9	0.17	12	0.22	10	0.18	3	0.19	4	0.25	4	0.25
2	19	0.35	21	0.39	13	0.24	13	0.82	15	0.94	6	0.38
3	33	0.61	41	0.76	26	0.48	16	1.01	20	1.26	11	0.69

Note: Percentages represent numbers as a proportion of the total sample.

Table 4. Description and summary statistics of variables included in the hedonic models

Variable	Description	Rural Residential Properties		Farm Properties	
		Mean	Std. Dev.	Mean	Std. Dev.
Dependent Variable					
Sale price	Sale price of property ($)	287,432.20	177,151.90	353,647.40	243,045.00
Property Variables					
Lot size	Size of property (acres)	6.1390	15.1026	78.9084	41.7261
Square footage	Total floor area of the house (square feet)	1,690.0160	679.8157	1,429.5930	1,092.5450
Bathrooms	Number of bathrooms	1.7529	0.7501	1.1330	0.9635
Fireplaces	Number of fireplaces	0.4941	0.6526	0.2484	0.5513
Pool	= 1 if pool exists on property	0.0573	0.2324		
Air	= 1 if house is air conditioned	0.2152	0.4110		
Quality	House quality index (0-10)	6.1231	0.7145		
Building value	Value of all secondary buildings on the property ($)	15,112.9700	19,881.0900	31,271.5100	51,229.0200
Water/sewer	= 1 if water and sewer services exist on property			0.7874	0.4093
Class 1 land	Total area of Class 1 land (acres)			12.4418	27.1218
Class 2 land	Total area of Class 2 land (acres)			34.8607	34.0552
Wooded area	Total wooded area (acres)			8.4696	15.5694
Location Variables					
Commercial	= 1 if property abuts a commercial property	0.0216	0.1454		
Highway	Distance to nearest highway interchange (km)	51.6053	20.2351		
City	Distance to the nearest city (km)	21.7040	14.1423	26.3604	14.3842
Adjala	= 1 if property is in the township of Adjala-Tosorontio	0.1745	0.3796	0.0692	0.2538
Amaranth	= 1 if property is in the township of Amaranth	0.0643	0.2453	0.0698	0.2549
Clearview	= 1 if property is in the township of Clearview	0.1655	0.3717	0.1358	0.3427
East Garafraxa	= 1 if property is in the township of East Garafraxa	0.0425	0.2017	0.0491	0.2161
East Luther	= 1 if property is in the township of East Luther Grand Valley	0.0153	0.1229	0.0308	0.1729
Grey Highlands	= 1 if property is in the township of Grey Highlands	0.1376	0.3445	0.1767	0.3816
Melancthon	= 1 if property is in the township of Melancthon	0.0600	0.2376	0.0667	0.2495
Mono	= 1 if property is in the township of Mono	0.1047	0.3062	0.0673	0.2506
Mulmur	= 1 if property is in the township of Mulmur	0.0687	0.2530	0.0503	0.2187
Southgate	= 1 if property is in the township of Southgate	0.0539	0.2259	0.1528	0.3599
Wellington	= 1 if property is in the township of Wellington North	0.1129	0.3164	0.1314	0.3380

Table 4. Description and summary statistics of variables included in the hedonic models (cont'd)

Variable	Description	Rural Residential Properties		Farm Properties	
		Mean	Std. Dev.	Mean	Std. Dev.
Time Variables					
Y2002	= 1 if property sold in the year 2002	0.1337	0.3404	0.1616	0.3682
Y2003	= 1 if property sold in the year 2003	0.1431	0.3503	0.1616	0.3682
Y2004	= 1 if property sold in the year 2004	0.1304	0.3368	0.1629	0.3694
Y2005	= 1 if property sold in the year 2005	0.1328	0.3394	0.1447	0.3519
Y2006	= 1 if property sold in the year 2006	0.1169	0.3214	0.1132	0.3169
Y2007	= 1 if property sold in the year 2007	0.1356	0.3424	0.1044	0.3059
Y2008	= 1 if property sold in the year 2008	0.0964	0.2952	0.1327	0.3394
Y2009	= 1 if property sold in the year 2009	0.0996	0.2994	0.0189	0.1361
Y2010	= 1 if property sold in the year 2010	0.0115	0.1064		
January	= 1 if property sold in the month of January	0.0467	0.2111	0.0535	0.2250
February	= 1 if property sold in the month of February	0.0408	0.1979	0.0459	0.2094
March	= 1 if property sold in the month of March	0.0587	0.2352	0.0673	0.2506
April	= 1 if property sold in the month of April	0.0739	0.2616	0.1088	0.3115
May	= 1 if property sold in the month of May	0.0888	0.2845	0.1013	0.3018
June	= 1 if property sold in the month of June	0.1084	0.3109	0.1063	0.3083
July	= 1 if property sold in the month of July	0.1114	0.3146	0.0786	0.2692
August	= 1 if property sold in the month of August	0.1226	0.3281	0.0836	0.2769
September	= 1 if property sold in the month of September	0.0896	0.2856	0.0887	0.2844
October	= 1 if property sold in the month of October	0.1007	0.3009	0.1038	0.3051
November	= 1 if property sold in the month of November	0.0839	0.2772	0.0950	0.2933
December	= 1 if property sold in the month of December	0.0630	0.2430	0.0673	0.2506

Table 5. Estimated coefficients for the hedonic models for rural residential properties

Variable	Model 1			Model 2			Model 3		
	Coefficient		Std Err	Coefficient		Std Err	Coefficient		Std Err
Turbine Variables									
Proximity	0.0165		0.0187				0.1782		0.1480
Visibility				-0.0092		0.0141	-0.0241		0.0191
Proximity*Visibility							-0.0455		0.0488
Property Variables									
ln(Lot size)	0.1348	***	0.0070	0.1349	***	0.0070	0.1348	***	0.0070
ln(Square footage)	0.2794	***	0.0224	0.2787	***	0.0224	0.2795	***	0.0224
Bathrooms	0.0093		0.0111	0.0094		0.0111	0.0095		0.0111
Fireplaces	0.0598	***	0.0096	0.0596	***	0.0096	0.0599	***	0.0096
Pool	0.0704	**	0.0277	0.0702	**	0.0277	0.0703	**	0.0276
Air	0.0173		0.0157	0.0171		0.0157	0.0172		0.0157
Quality	0.1381	***	0.0130	0.1382	***	0.0130	0.1378	***	0.0130
ln(Building value)	0.0075	***	0.0018	0.0075	***	0.0018	0.0075	***	0.0018
Location Variables									
Commercial	-0.1007	***	0.0362	-0.1008	***	0.0362	-0.1010	***	0.0362
ln(Highway)	-0.0620	*	0.0362	-0.0611	*	0.0362	-0.0627	*	0.0363
ln(City)	-0.0671	***	0.0085	-0.0670	***	0.0085	-0.0674	***	0.0085
Constant	9.2178	***	0.2389	9.2166	***	0.2389	9.2229	***	0.2393
R-squared	0.5654			0.5654			0.5656		
Number of Sales	5,414			5,414			5,414		

Note: Asterisks (***, **, *) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Estimated coefficients for the hedonic models for farm properties

Variable	Model 1			Model 2			Model 3		
	Coefficient		Std Err	Coefficient		Std Err	Coefficient		Std Err
Turbine Variables									
Proximity	0.0113		0.0668				-0.7543		0.4600
Visibility				0.0246		0.0246	0.0202		0.0319
Proximity*Visibility							0.2478		0.1558
Property Variables									
ln(Lot size)	0.2742	***	0.0262	0.2743	***	0.0262	0.2738	***	0.0262
ln(Square footage)	0.0366	***	0.0087	0.0365	***	0.0087	0.0363	***	0.0086
Bathrooms	0.0945	***	0.0250	0.0944	***	0.0250	0.0936	***	0.0250
Fireplaces	0.0868	***	0.0247	0.0871	***	0.0248	0.0883	***	0.0248
ln(Building value)	0.0174	***	0.0043	0.0175	***	0.0043	0.0174	***	0.0042
Water/sewer	0.0975	**	0.0493	0.0984	**	0.0494	0.0988	**	0.0493
Class 1 land	0.0035	***	0.0005	0.0035	***	0.0005	0.0035	***	0.0005
Class 2 land	0.0015	***	0.0004	0.0015	***	0.0004	0.0015	***	0.0004
Wooded area	-0.0010		0.0007	-0.0010		0.0007	-0.0009		0.0007
Location Variables									
ln(City)	-0.1327	***	0.0271	-0.1338	***	0.0271	-0.1326	***	0.0272
Constant	10.8291	***	0.1389	10.8328	***	0.1389	10.8220	***	0.1393
R-squared	0.6116			0.6117			0.6127		
Number of Sales	1,590			1,590			1,590		

Note: Asterisks (***, **, *) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Comparison of the coefficients for the turbine variables across alternate model specifications for rural residential properties (standard errors in parentheses)

	1	2	3	4	5	6	7	8
Turbine Variable	Primary Model	Alternate Post-Turbine Periods: Pre-Constr.	Alternate Post-Turbine Periods: Post-Constr.	Distance Band Specification	SAR Model	Repeat Sales	Turbine Density: 2 km	Turbine Density: 5 km
Proximity	0.0165	-0.0274	0.0058		0.0150	0.0300		
	(0.0187)	(0.0335)	(0.0192)		(0.0158)	(0.1046)		
Band 0-1 km				0.0390				
				(0.0442)				
Band 1-3 km				-0.0501				
				(0.0478)				
Band 3-5 km				-0.0452				
				(0.0513)				
Density 2 km							0.0044	
							(0.0032)	
Density 5 km								0.0001
								(0.0008)
R-squared	0.5654	0.5655	0.5654	0.5655	0.5901	0.8098	0.5655	0.5654

Note: Asterisks (***, **, *) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8. Comparison of the coefficients for the turbine variables across alternate model specifications for farm properties (standard errors in parentheses)

	1	2	3	4	5	6	7	8
Turbine Variable	Primary Model	Alternate Post-Turbine Periods: Pre-Constr.	Alternate Post-Turbine Periods: Post-Constr.	Distance Band Specification	SAR Model	Repeat Sales	Turbine Density: 2 km	Turbine Density: 5 km
Proximity	0.0113	0.0183	0.0006		0.0318	-0.6112		
	(0.0668)	(0.0504)	(0.0812)		(0.0620)	(0.5570)		
Band 0-1 km				-0.0579				
				(0.1144)				
Band 1-3 km				0.0694				
				(0.0921)				
Band 3-5 km				-0.1366				
				(0.1401)				
Density 2 km							0.0019	
							(0.0092)	
Density 5 km								0.0008
								(0.0023)
R-squared	0.6116	0.6116	0.6116	0.6122	0.6315	0.9398	0.6116	0.6116

Note: Asterisks (***, **, *) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Relationship between Wind Turbines and Residential Property Values in Massachusetts

A Joint Report of University of Connecticut and Lawrence Berkeley National Laboratory

January 9, 2014

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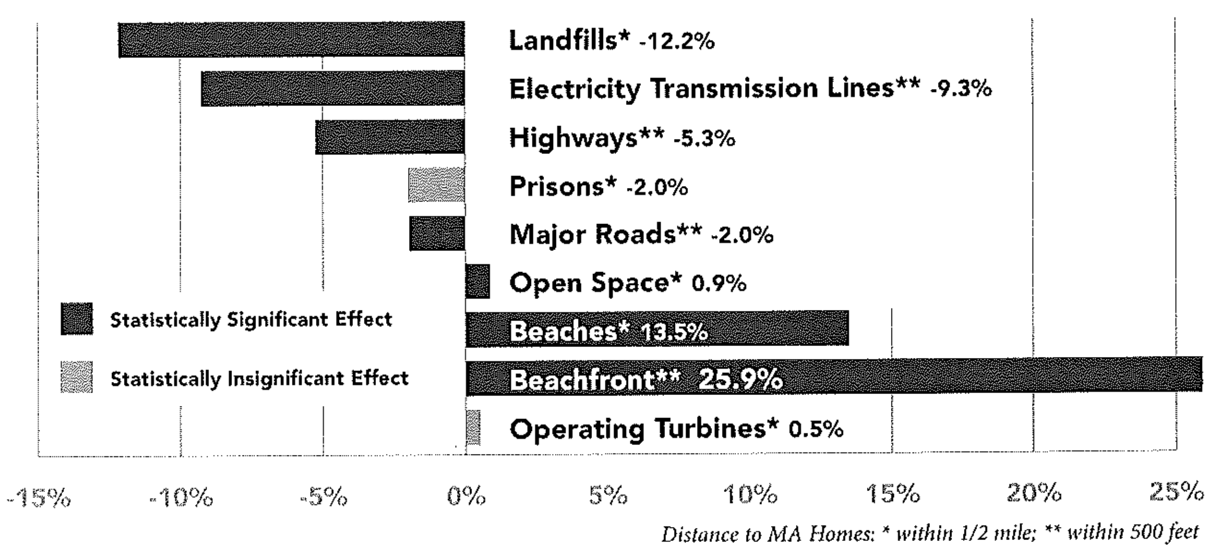
CONTENTS

EXECUTIVE SUMMARY

This study investigates a common concern of people who live near planned or operating wind developments: How might a home's value be affected by the turbines? Previous studies on this topic, which have largely coalesced around non-significant findings, focused on rural settings. Wind facilities in urban[1] locations could produce markedly different results. Nuisances from turbine noise and shadow flicker might be especially relevant in urban settings, where negative features, such as landfills or high voltage utility lines, have been shown to reduce home prices. To determine if wind turbines have a negative impact on property values in urban settings, this report analyzed more than 122,000 home sales, between 1998 and 2012, that occurred near the current or future location of 41 turbines in densely-populated Massachusetts communities.

The results of this study do not support the claim that wind turbines affect nearby home prices. Although the study found the effects from a variety of negative features (such as electricity transmission lines and major roads) and positive features (such as open space and beaches) generally accorded with previous studies, the study found no net effects due to the arrival of turbines in the sample's communities. Weak evidence suggests that the announcement of the wind facilities had a modest adverse impact on home prices, but those effects were no longer apparent after turbine construction and eventual operation commenced. The analysis also showed no unique impact on the rate of home sales near wind turbines. These conclusions were the result of a variety of model and sample specifications detailed later in this report.

Figure 1: Summary of Amenity, Disamenity and Turbine Home Price Impacts



1 The term "urban" in this document includes both urban and suburban areas.

OVERVIEW

Wind power generation has grown rapidly in recent decades. In the United States, wind development centered initially on areas with relatively sparse populations in the Plains and West. Increasingly, however, wind development is occurring in more populous, urbanized areas, prompting additional concerns about the effects of wind turbine construction on residents in those areas.

One important concern is the potential for wind turbines to create a "nuisance stigma"—due to turbine-related noise, shadow flicker, or both—that reduces the desirability and thus value of nearby homes. Government officials who are called on to address this issue need additional reliable research to inform regulatory decisions, especially for understudied populous urban areas. Our study helps meet this need by examining the relationship between home prices and wind facilities in densely-populated Massachusetts.

A variety of methods can be used to explore the effects of wind turbines on home prices. Statistical analysis of home sales, using a hedonic model, is the most reliable methodology because it (a) uses actual housing market sales data rather than perceptions of potential impacts; (b) accounts for many of the other, potentially confounding, characteristics of the home, site, neighborhood and market; and (c) is flexible enough to allow a variety of potentially competing aspects of wind development and proximity to be tested simultaneously. Previous studies using this hedonic modeling method largely have agreed that post-construction home-price effects (i.e., changes in home prices after the construction of nearby wind turbines) are either relatively small or sporadic. A few studies that have used hedonic modeling, however, have suggested significant reductions in home prices after a nearby wind facility is announced but before it is built (i.e., post-announcement, pre-construction) owing to an "anticipation effect." Previous research in this area has focused on relatively rural residential areas and larger wind facilities with significantly greater numbers of turbines.

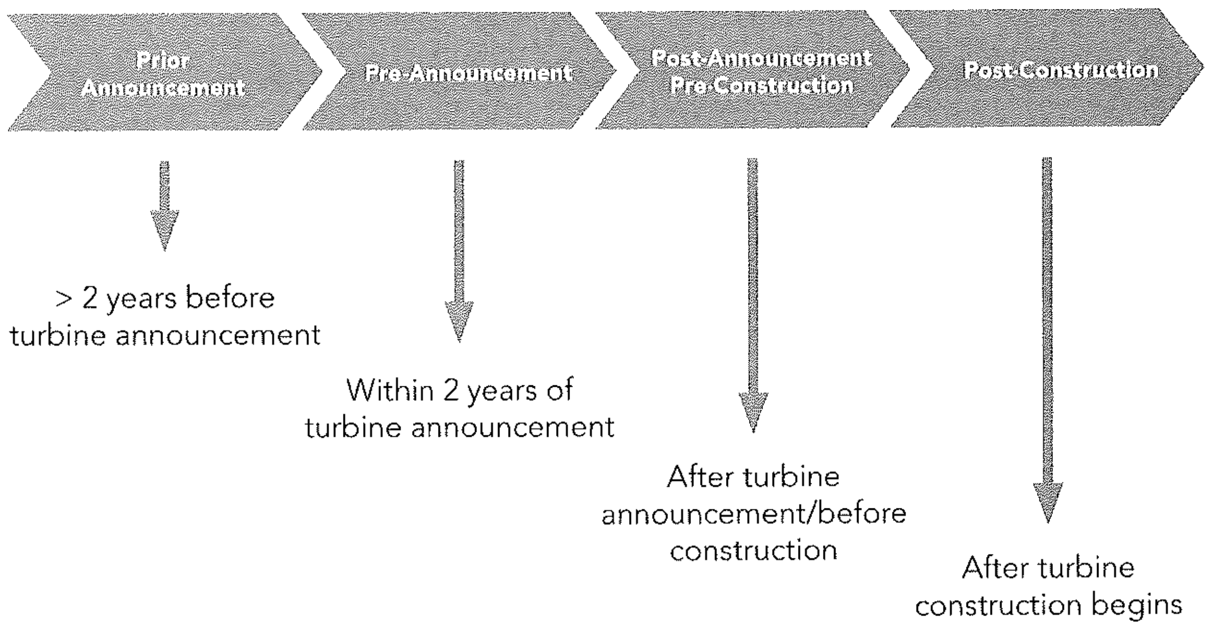
This previous research has done much to illuminate the effects of wind turbines on home prices, but a number of important knowledge gaps remain. Our study helps fill these gaps by exploring a large dataset of home sales occurring near wind turbine locations in Massachusetts. We analyze 122,198 arm's-length single-family home sales, occurring between 1998 and 2012, within 5 miles of 41 wind turbines in Massachusetts. The home sales analyzed in this study occurred in one of four periods based on the development schedule of the nearby turbines (see Figure 2).[2] To estimate the effect proximity to turbines has on home sale prices, we employ a hedonic pricing model in combination with a suite of robustness tests[3] that explore a variety of different model specifications and sample sets, organized around the following five research questions:

2 The analysis focuses on the 41 turbines in Massachusetts that are larger than 600 kilowatt and that were operating as of November 2012.

3 These tests included a comparison of a "base" model to a set of different models, each with slightly different assumptions, to explore the robustness of the study's findings.

Figure 2: Wind Turbine Development Periods Studied

Report Compares Transactions That Each Took Place in One of Four Development Periods



Q1) Have wind facilities in Massachusetts been located in areas where average home prices were lower than prices in surrounding areas (i.e., a "pre-existing price differential")?

Q2) Are post-construction (i.e., after wind-facility construction) home price impacts evident in Massachusetts and how do Massachusetts results contrast with previous results estimated for more rural settings?

Q3) Is there evidence of a post-announcement/pre-construction effect (i.e., an "anticipation effect")?

Q4) How do impacts near turbines compare to the impacts of amenities and disamenities also located in the study area, and how do they compare with previous findings?

Q5) Is there evidence that houses near turbines that sold during the post-announcement and post-construction periods did so at lower rates (i.e., frequencies) than during the pre-announcement period?

The study makes five major unique contributions:

1. It uses the largest and most comprehensive dataset ever assembled for a study linking wind facilities to nearby home prices.[4]

2. It encompasses the largest range of home sale prices ever examined.[5]

3. It examines wind facilities in urban areas (with relatively high-priced homes), whereas previous analyses have focused on rural areas (with relatively low-priced homes).

4. It largely focuses on wind facilities that contain fewer than three turbines, while previous studies have focused on large-scale wind facilities (i.e., wind farms).

5. Our modeling approach controls for seven environmental amenities and disamenities in the study area, allowing the effect of wind facilities to be compared directly to the effects of these other factors.

The models perform exceptionally well given the volatility in the housing market during the study period, with an adjusted-R^2 of approximately 0.80[6] and highly statistically significant[7] and appropriately signed controlling parameters (e.g., square feet, acres, and age of home at the time of sale). The amenity and disamenity variables (proximity to beaches, open space, electricity transmission lines, prisons, highways, major roads, and landfills) are significant in a large portion of the models and appropriately signed—indicating that the models discern a strong relationship between a home's environment and its selling price—and generally accord with the results of previous studies. To test whether the results of the analysis would change if the model was specified in a different way, or run using a differently-specified dataset, we ran a suite of robustness tests. The results generated from the robustness tests changed very little, suggesting that our approach is not dependent on the model specification or the data selection.

The results do not support the claim that wind turbines affect nearby home prices. Despite the consistency of statistical significance with the controlling variables, statistically significant results for the variables focusing on proximity to operating turbines are either too small or too sporadic to be apparent. Post-construction home prices within a half mile of a wind facility are 0.5% higher than they were more than 2 years before the facility was announced (after controlling for

4 Four of the most commonly cited previous studies (Carter, 2011; Heintzelman and Tuttle, 2012; Hinman, 2010; and Hoen et al., 2011) analyzed a *combined total* of 23,977 transactions, whereas the present study analyzes more than five times that number.

5 Existing studies analyzed the impact of wind turbines on homes with a median price of less than $200,000, whereas the current study examines houses with a median price of $265,000 for the 122,198 observations located within 5 miles of a wind turbine (with values ranging from $40,200 to $2,495,000).

6 In statistics, the coefficient of determination, denoted R^2 (pronounced "R squared"), indicates how well data points fit a line, curve or, in our case, a regression estimation. An R^2 of 1 indicates that the regression line perfectly fits the data.

7 Statistical significance allows one to gauge how likely sample data are to exhibit a definitive pattern rather than, instead, have occurred by chance alone. Significance is denoted by a *p*-value (or "probability" value) which can range between 0 and 1. A very low *p*-value, for example <0.001, is considered highly unlikely (in this case with a probability of less than 0.1%) to have occurred by chance. In general, an appropriate *p*-value is chosen by the researchers consistent with the area of research being conducted, under which results are considered "significant" and over which are considered "non-significant". For the purposes of this research, a *p*-value of 0.10 or below is considered "statistically significant", with *p*-values between 0.10 and 0.05 being "weakly statistically significant", between 0.05 and 0.01 being "significant", and below 0.01 being "highly statistically significant".

What Is a Hedonic Pricing Model?

Hedonic pricing models are frequently used by economists and real estate professionals to assess the impacts of house and community characteristics on property values by investigating the sales prices of homes. A house can be thought of as a bundle of characteristics (e.g., number of square feet, number of bathrooms, the size of the parcel). When a price is agreed upon by a buyer and seller there is an implicit understanding that those characteristics have value. When data from a large number of residential transactions are available, the individual marginal contribution to the sales price of each characteristic for an average home can be estimated with a hedonic regression model. Such a model can statistically estimate, for example, how much an additional bathroom adds to the sale price of an average home. A particularly useful application of the hedonic model is to value non-market goods—goods that do not have transparent and observable market prices. For this reason, the hedonic model is often used to derive value estimates of amenities such as wetlands or lake views, and disamenities such as proximity to and/or views of high voltage transmission lines, roads, cell phone towers, landfills. It should be emphasized that the hedonic model is not typically designed to appraise properties (i.e., to establish an estimate of the market value of one home at a specified point in time) as would a bank appraisal, which would generally be only applicable to that particular home. Instead, the typical goal of a hedonic model is to accurately estimate the marginal contribution of individual or groups of characteristics across a set of homes, which, in general, allows stakeholders to understand if widely applicable relationships exist.

market inflation/deflation). This difference is not statistically significant. Post-announcement, pre-construction home prices within a half mile are 2.3% lower than their pre-announcement levels (after controlling for inflation/deflation), which is also a non-significant difference, though one of the robustness models suggests weak evidence that wind-facility announcement reduced home prices. An additional tangential, yet important, result of the analysis is the finding of a statistically significant "pre-existing price differential": prices of homes that sold more than 2 years before a future nearby wind facility was announced were 5.1% lower than the prices of comparable homes farther away from the future wind location. This indicates that wind facilities in Massachusetts are associated with areas where land values are lower than the surrounding areas, and, importantly, this "pre-existing price differential" needs to be accounted for in order to correctly measure the "post construction" impact of the turbines. Finally, our analysis finds no evidence of a lower rate (i.e., frequency) of home sales near the turbines.

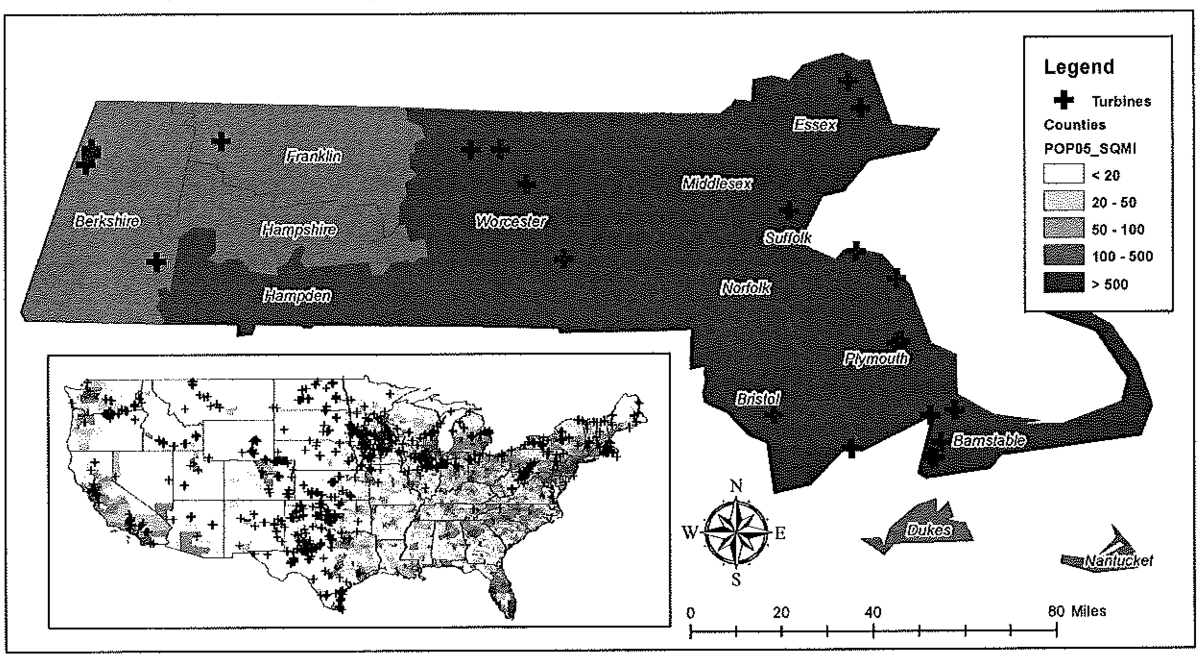
As discussed in the literature review, the effects of wind turbines may be somewhat context specific. Nevertheless, the stability of the results across models and across subsets of the data, and the fact that they agree with the results of existing literature, suggests that the results may be generalizable to other U.S. communities, especially where wind facilities are located in more urban settings with relatively high-priced homes. These results should inform the debate on actual impacts to communities surrounding turbines. Additional research would augment the results of this study and previous studies, and our report concludes with recommendations for future work.

1. INTRODUCTION

Growing concern about global climate change and energy security are prompting reconsideration of how energy—particularly electricity—is generated, transmitted, and consumed in the United States and across the globe (Ekins, 2004; Devine-Wright, 2008; Pasqualetti, 2011). Internationally, greater use of renewable wind energy to mitigate the threat of climate change has broad-based support, primarily because, once facilities are constructed, wind power emits no greenhouse gases (Hasselmann et al., 2003; Watson, 2003; Jager-Waldau and Ossenbrink, 2004). Many jurisdictions have set ambitious renewable energy goals, targeting 20% to 33% of their electricity to be generated by renewable sources by 2020 (see for example, the European Union target of 20% EU, 2012 and California's updated RPS goal of 33%). Wind energy offers several advantages over other low-emission alternatives such as nuclear power and large-scale hydropower projects, but the siting of wind projects remains controversial in many countries (Firestone and Kempton, 2007; Moragues-Faus and Ortiz-Miranda, 2010; Nadai and van der Horst, 2010; Wolsink, 2010).

Figure 3: Map of Massachusetts Turbines included in study (through November 2012) and U.S. Wind Turbines through 2011 and population densities

Population Density in US and Massachusettes (2005 pop per sq. mile)



Source: Lawrence Berkeley National Laboratory, FAA, Ventyx, US Census Bureau, MassCEC

In the United States, large-scale wind installations have tended to be built in sparsely populated locations in the Plains and West (Figure 3). Given that many existing turbines have been located in fairly rural areas, opposition to wind power has largely been attributed to concerns about the transformation of natural landscapes into "landscapes of power" (Pasqualetti et al., 2002 p. 3). Some have extended this place-based perspective and framed the wind-energy debate as being a new kind of environmental controversy, which divides environmentalists of different persuasions who attach contrasting priority to global and local concerns (see for example Warren et al., 2005). Others have delved more deeply into the discourse surrounding renewable energy projects in general, and wind-energy projects specifically, and pointed out that, depending on the narrative, they can be portrayed as representing either development or conservation, localization or globalization (van der Horst and Vermeylen, 2011).

Regardless of what is driving community attitudes towards wind power, government at all spatial scales needs to navigate the complex political terrain of introducing public policies that reduce carbon emissions and fossil fuel dependency in ways that simultaneously protect private property rights and meet with the community's approval (Jepson et al., 2012; Slattery et al., 2012). As such, one of the roles of government is to support independent research to characterize and communicate the potential impacts that public policy decisions, for example for wind facilities, may have on the price of surrounding private property. Existing studies of the effect that wind turbines have had on the price of residential properties have tended to focus on large-scale wind farms located in rural settings, because this is where the majority of projects have been developed. To date, no large-scale studies have focused on smaller-scale facilities in more urban settings, but Massachusetts affords such an opportunity. Massachusetts also has relatively high-priced homes near turbines compared to homes near turbines in other, less urban parts of the country.

Massachusetts has regions with substantial wind resources and strong policies that support the adoption of clean energy. Its first utility-scale (600 kW and larger) wind turbine was installed in Hull in 2001. Since then, wind generation capacity has increased substantially. As of January 2013, Massachusetts had 42 wind projects larger than 100 kW, consisting of 78 individual turbines totaling 99 MW of capacity. This compares to less than 3 MW in Rhode Island and Connecticut combined (Wiser and Bolinger, 2012). Turbines have been located in a variety of settings across the state, including the mountainous Berkshire East Ski Resort, heavily urbanized Charlestown, and picturesque Cape Cod. The average gross population density surrounding the Massachusetts turbines (approximately 416 persons per square mile, based on 2005 population levels and turbines as of 2012) far exceeds the national average of approximately 11 persons per square mile around turbines (Hoen, 2012).

In this study, we analyze the effect of Massachusetts' wind turbines larger than 600 kilowatts (kW) of rated capacity on nearby home prices to inform the debate about the siting and operation of smaller-scale, wind projects across a broad range of land use types in high-home-value areas of the United States. Our study makes five major unique contributions:

1. It uses the largest and most comprehensive dataset ever assembled for a study linking wind facilities to nearby home prices.[8]

2. It encompasses the largest range of home sale prices ever examined.[9]

3. It examines wind facilities in areas across a range of land use and zoning types from rural to urban/industrial (with relatively high-priced homes), whereas previous analyses have focused on rural areas (with relatively low-priced homes).

4. It largely focuses on wind facilities that contain fewer than three turbines, while previous studies have focused on large-scale wind facilities.

5. Our modeling approach controls for seven environmental amenities and disamenities in the study area, allowing the effect of wind facilities to be compared directly to the effects of these other factors.

The remainder of this report is organized as follows. The next section (Section 2) reviews literature related to public opposition to and support for wind turbines, the hypothetical stigmas associated with turbines near homes, policies and guidelines which address the siting and operation of wind facilities, ways to quantify whether turbines are a disamenity, and the impact on home values of other types of environmental amenities and disamenities—followed by a discussion of gaps in the literature. Section 3 presents our empirical analysis, including descriptions of the study area, data, methods, and results. The final section (Section 4) discusses the findings, provides preliminary conclusions, and offers suggestions for future research.

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8 Four of the most commonly cited previous studies (Carter, 2011; Heintzelman and Tuttle, 2012; Hinman, 2010; and Hoen et al., 2011) analyzed a *combined total* of 23,977 transactions, whereas the present study analyzes more than five times that number.

9 Existing studies analyzed the impact of wind turbines on homes with a median price of less than $200,000, whereas the current study examines houses with a median price of $265,000 for the 122,198 observations located within 5 miles of a wind turbine (with values ranging from $40,200 to $2,495,000) and a median price for the 312,674 observations located within 10 miles of a wind turbine of $287,000 (with values ranging from $41,100 to $2,499,000).

2. LITERATURE REVIEW

2.1 Public Acceptance of and Opposition to Wind Energy

Wind energy is one of the fastest growing sources of power generation in the world, and public and political support for it are generally strong (Ek, 2005; Graham et al., 2009). Despite this strong support, the construction of wind projects provokes concerns about local impacts (Toke et al., 2008; Jones and Eiser, 2009; Devine-Wright and Howes, 2010; Jones and Eiser, 2010; Moragues-Faus and Ortiz-Miranda, 2010; Wolsink, 2010; Pasqualetti, 2011). Thus, some researchers have studied the factors shaping public attitudes toward wind energy and renewable energy technologies in general (see for example Devine-Wright, 2005; Firestone and Kempton, 2007; Pedersen et al., 2007; Wolsink, 2007; Devine-Wright, 2009; Jones and Eiser, 2009; Devine-Wright and Howes, 2010; Jones and Eiser, 2010; Swofford and Slattery, 2010; Brannstrom et al., 2011; Devine-Wright, 2011). Others have downplayed the importance of local opposition to wind energy in hindering wind's expansion, pointing instead to hindrances related to institutional barriers, such as how wind energy projects are funded, and the heavy handedness of "legislate, announce, defend" approaches to siting turbines (Wolsink, 2000).

In the early stages of wind development, opposition to wind turbines was often simplistically conceptualized as NIMBY-ism, with NIMBY ("not in my backyard") referring to people opposing the local installation of technologies they otherwise support in principle (Devine-Wright, 2005; Wolsink, 2007; Devine-Wright, 2009). More recently, researchers have suggested that the factors shaping public sentiment towards renewable energy technologies are much more complex than the concept of NIMBY-ism suggests. Of note is the quantitative research aimed at understanding public attitudes towards wind farms in the Netherlands conducted by Wolsink (2007). His work, and the work of others (e.g., Devine-Wright, 2012), which is grounded in theories from social psychology, found that public attitudes towards wind projects were shaped by perceptions of risk and equity. Based on these findings, Wolsink concluded that a collaborative—rather than a "top-down"—approach to siting wind farms was the most likely to produce positive outcomes. These findings were echoed in an examination of public attitudes towards wind turbine construction in Sheffield, England, where researchers found little evidence of NIMBY-ism in respondents living close to proposed developments compared to a control group (Jones and Eiser, 2009). Rather, opposition could be attributed to uncertainty regarding the details of the facilities being constructed, which underscores the importance of continued and responsive community involvement in siting wind turbines.

Some researchers have studied whether communities are more accepting of wind turbines if the facilities are community owned (Warren and McFadyen, 2010). Comparing attitudes towards wind farms on two islands in Scotland, one community owned and one not, the researchers discovered that residents near the community owned facilities had a much more positive perception of the facilities. Locals affectionately referred to their wind turbines as "The Three

Dancing Ladies," which the researchers interpreted as indicating the positive psychological effects of community ownership. Warren and McFadyen (2010) concluded that a change of development model towards community ownership could improve public attitudes towards wind farms in Scotland.

Another strand of research has focused on community perceptions before and after wind-facility construction. Some studies showed that local people become more supportive of wind facilities after they have been constructed (Wolsink, 2007; Eltham et al., 2008; Walker et al., 2010) and that the degree of support increases with proximity to the facilities (Braunholtz and MORI, 2003; Warren et al., 2005; Slattery et al., 2012).

2.2 Hypothetical Stigmas Associated with Wind Turbines

To understand the basis of public opposition to wind facilities, researchers have hypothesized the existence of three types of stigma that might be associated with these facilities (Hoen et al., 2011). An "area stigma" would be a concern that wind-turbine construction will alter the rural sense of place; this resonates with the suggestion made by Pasqualetti et al. (2002) that people object to the creation of "landscapes of power." This is distinct from a "scenic vista stigma," the possible concern that homes might be devalued because of the view of a wind facility. Finally, a "nuisance stigma" would be associated with people located near turbines who might be affected by the turbines' noise and shadow flicker,[10] which fade quickly with distance. Our study focuses on the potential existence of a nuisance stigma by searching for turbine-related impacts on the sale of homes located a short distance away. However, if they exist, the effects of all three stigma types hypothetically could interact, and all are described briefly below.

The spatial and temporal combinations of community and wind-facility characteristics that might produce one or more of these stigmas are not entirely clear. Theoretically, an area stigma would have the largest geographic impact, although its exact reach would depend on the spatial distribution and types of land use in the surrounding area. In their comprehensive analysis, Hoen et al. (2009, 2011) were unable to uncover area stigma effects across their large set of U.S. wind facilities. Recent research has suggested, however, that this type of stigma depends on the "place identity" of local residents (Pedersen et al., 2007; Devine-Wright, 2009; Devine-Wright and Howes, 2010). For those who view the countryside as a place for economic activity and technological development or experimentation, which is potentially consistent with the locations studied in Hoen et al. (2009, 2011), wind turbines might not carry a stigma because they could represent a new use for the land, and the turbine sounds and sights might be insignificant in the context of existing machinery and land practices. Conversely, rural residents who view the countryside as a place for peace and restoration might oppose turbines even if they do not live near them. The "place identity" of the landscape likely varies among wind facility- locations and among individuals in those locations, making some local residents more accepting of turbines than others.

Acceptance of turbines might also relate to their economic benefits. For example, a study in West Texas and Iowa found that community members had positive impressions of large-scale wind facilities built to generate long-term social and economic benefits, including creation of a local industry that

10 Shadow flicker occurs when the sun is behind rotating turbine blades and produces an intermittent shadow.

brought jobs and increased property values as well as increased tax revenue that benefited the community and schools (Slattery et al., 2012; Kahn, 2013). These findings conform to other research suggesting that equitable distribution of economic benefits is a key method of increasing local support for turbines (Pasqualetti et al., 2002) and that the perception of how tax benefits will be shared locally can influence people's acceptance of wind projects (Toke, 2005; Brannstrom et al., 2011). Economic factors appear to be more of a consideration where the economy is perceived to be in decline (Toke et al., 2008); this finding is echoed in studies of other environmental disamenities that show that communities are more willing to accept facilities if jobs are associated with them (Braden et al., 2011). Many of these studies were conducted in rural areas, thus their findings may not be generalizable to more urban settings, where community reactions might be entirely different.

Similarly, if a scenic vista stigma exists, it might have different levels of impact depending on wind-facility locations, the place identity of nearby residents, and the distance of residents from the turbines. Hoen et al. (2009, 2011) meticulously examined effects from views of turbines at many different spatial scales and predicted levels of impacts in rural areas, but they found no evidence of impacts to support the scenic vista stigma claim. However, an urban setting might connote different landscape values and therefore generate different reactions to turbines and produce different effects on home values. For example, Sims et al. (2008) found weak evidence that a house's orientation to a wind facility (and therefore the prominence of the view of the turbines) affected its sales price in Cornwall, United Kingdom, an area of relatively high population.[11]

11 As of 2011, Cornwall had a population density of 390 persons per square mile. (See http://en.wikipedia.org/wiki/Cornwall)

More than the other stigma types, any potential wind-related nuisance stigma would depend on the close proximity of residents to turbines and likely would have the most constrained spatial scale. Two studies in Germany evaluated more than 200 participants living near wind turbines with regard to shadow flicker exposure, stress, behaviors, and coping and found that stress levels and annoyance increased the closer people were to wind turbines in all directions (Pohl et al., 1999, 2000). Similarly, wind turbine noise, which is less direction dependent than shadow flicker, might have an even greater impact on stress levels. Studies have shown that residents experience genuine annoyance and stress responses to "normal" turbine noise levels (Pedersen and Waye, 2007), perceiving the noise as an intrusion into their space and privacy, especially at night (van den Berg, 2004; Pedersen et al., 2007) and when the turbines can be seen (Pedersen and Waye, 2007). Governments around the world have addressed potential turbine-related nuisances via regulations and guidelines, which are discussed in the next subsection.

2.3 Policies and Guidelines Which Address the Siting and Operation of Wind Facilities

Noise is the most prominent potential nuisance associated with wind turbines and thus has been the focus of much regulatory effort. The quality and magnitude of sound produced by turbines results from the complex interaction of numerous variables, such as the size and design of the turbine as well as the wind speed and direction, temperature gradients that affect wind turbulence, and vertical and directional wind shear (Hubbard and Shepherd, 1991; Berglund et al., 1996; Oerlemans et al., 2006; Pedersen et al., 2010; Bolin et al., 2012; Wharton and Lundquist, 2012). For practical purposes, governments, both here in the U.S. and abroad, at a variety of spatial scales have tended to adopt setback metrics for the distance between a wind turbine and housing as a proxy for noise limits (NARUC, 2012). Very few countries have mandatory turbine setback distances beyond what would be required for safety in the event of a collapse (and therefore 1-1.5 times the turbines' height), nor do they often impose mandatory limits to shadow flicker; they do often have mandatory or, at least, stronger regulation of noise.

Although there is no worldwide standard limit for noise associated with wind turbines (Haugen, 2011), many European countries base their regulations on recommended noise limits published by the World Health Organization (WHO) Regional Office for Europe (WHO, 2011). The WHO recommends noise limits of 40 (A-weighted) decibels dB(A) for the average nighttime noise outside a dwelling, which translates to a noise limit of 30 dB(A) inside a bedroom.[12] These limits are based on noise levels that do not harm a person's sleep. Above these limits, it is believed, people have a lower amount and quality of sleep, which can lead to major health issues (WHO, 2011).

In the United States, turbine sound and setback regulation is limited: only "a handful of states have published setback standards, sound standards, or both" (NARUC, 2012, p. 15). Ten states have published voluntary guidelines for wind siting and zoning, and five have published model ordinances intended to guide local governments. Similar to other countries, required or recommended setbacks vary widely from state to state, both in terms of the distances cited and the legal weight they carry (some are formal limits while others are merely guidelines).

In Massachusetts, the Model Wind Bylaw and the Massachusetts Department of Environmental Protection (MADEP) Noise Policy provide guidelines and regulatory standards respectively for the siting and operation of wind facilities to address public safety and minimize local impacts. The former provides some guidance on setbacks from the nearest existing residential or commercial structure using a multiple (e.g., 3 times) of blade tip height (BTH) (i.e., the hub height plus the length of the blade) as a means to determine the project specific setback.[13] However, all of the wind turbines in the state have been permitted at the local level, with varying degrees of adherence to the guidance, while still others were permitted prior to the Model Bylaw's preparation, and still others have had few structures near the turbines from which to setback. Therefore, in practice, setbacks to the nearest structure have varied from as much as 4,679 feet (0.89 miles, 24.4 x BTH) to as little as 520 feet (0.1 miles, 1.3 x BTH), with an average Massachusetts project being 1,925 feet (0.36 miles, 5.9 x BTH) (Studds, 2013).[14] Because, in part, of the variety of ways in which the guidelines have been applied, setbacks remain one of the more controversial aspects of wind-facility siting. Also, adding to the controversy are the results of one recent study of two wind facilities in Maine that claimed noise effects are experienced as far as 1.4 kilometers (4,590 feet, 0.87 miles) from the turbines (Nissenbaum et al., 2012).

12 A-weighted decibels abbreviated to dBa, dBA or dB(a), are an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced, compared with unweighted decibels, in which no correction is made for audio frequency (http://whatis.techtarget.com)

13 MA EEA/DOER Model Wind Bylaw. Accessed on 1/23/12 from: http://www.mass.gov/eea/docs/doer/gca/wind-not-by-right-bylaw-june13-2011.pdf. The Executive Office of Environmental Affairs, Department of Environmental Quality Engineering, Division of Air Quality Control, "DAQC Policy 90-001," February 1, 1990.

14 These setbacks do not include structures of participating landowners, that either might own the turbine, or are being compensated by the turbine owner.

Finally, in response to noise concerns, wind-technology developers are investigating numerous ways to suppress noise including passive noise reduction blade designs, active aerodynamic load control, new research on inflow turbulent and turbine wakes, low-noise brake linings, and cooling fan noise mufflers (Leloudas et al., 2009; Wilson et al., 2009; Barone, 2011; Petitjean et al., 2011), some of which have been shown to lower annoyance when applied (Hoen et al., 2010; Hessler, 2011). How these strategies might eventually affect setback and noise regulations and guidelines is unclear.

For the purposes of this study, suffice it to say that wind turbine setbacks vary, and they are often smaller than the distances at which (at least some) turbine noise effects have been claimed to exist. If a resulting nuisance stigma exists near turbines, it should be reflected in nearby home prices. By evaluating the relationship between wind turbines and home prices this study might help inform appropriate setbacks and noise recommendations in Massachusetts.

2.4 Methods to Quantify Whether Wind Turbines are a Disamenity

If a wind turbine near homes does produce a meaningful stigma, it could be considered a disamenity similar to other disamenities such as proximity to electricity transmission lines and major roads. A variety of research techniques can be used to determine the impact of wind energy projects on residential properties, including homeowner surveys, expert surveys (such as interviewing real estate appraisers), and statistical analysis of property transactions using cases studies or the well-established method of hedonic modeling (see e.g., Jackson, 2003). The latter technique is firmly established in the literature as the most reliable approach to determining the impact of a particular development on property prices, because it (a) uses transactions data that reflect actual sales in the housing market rather than perceptions of potential impacts; (b) controls for a set of potentially confounding home, site, neighborhood and market influences; and, (c) is flexible enough to allow a variety of potentially competing aspects of wind development and proximity to be tested simultaneously (Jackson, 2001).

An extensive meta-analysis of studies that had quantified the effect of environmental amenities and disamenities found that the use of case study techniques provide larger estimates of property losses associated with environmental disamenities than regression studies using hedonic models (Simons and Saginor, 2006). Simons and Saginor attributed this differential to the fact that case studies may be subjective based on the case researcher, and they argue that case study observations may even have been chosen because of their dramatic, atypical conditions. Surveys, which were generally based on respondents' estimates of impacts, were considered to suffer from similar bias due to the subjectivity of respondents and their potential lack of effect-estimation expertise.

The hedonic-modeling approach is based on the idea that any property's sales price is composed of a bundle of attributes, including the characteristics of the individual property and its location (Rosen, 1974). Sales can be compared to one another, taking into account the effects of time (i.e., inflation/deflation), to determine the value of any specific attribute (Butler, 1982; Clapp and Giaccotto, 1998; Jackson, 2001; Simons and Saginor, 2006; Jauregui and Hite, 2010; Kuminoff et al., 2010; Zabel and Guignet, 2012).

The approach has been used extensively to quantify the effects of public policies (specifically infrastructure) on home prices by examining the value associated with being close to a facility before and after it was constructed (see Atkinson-Palombo, 2010 and the extensive references therein). If the particular initiative being studied (for example, a transportation facility) is perceived as an amenity, it would be expected to increase property values, all else being equal. If the initiative is perceived as a disamenity, it would be expected to decrease property values. This hedonic method measures average impacts across the study area and therefore can help policy makers understand costs and benefits at a broad scale.

Our study uses the hedonic-modeling approach to quantify the effect of wind facilities on home values. This involves creating a statistical model with an expression of home price as the dependent variable and independent variables consisting of factors that influence home price. These independent variables include features of the specific housing unit, locational characteristics, a variable that represents distance to a wind turbine at discrete stages of the construction process, and various controls such as the time when a transaction took place to account for changes in the housing market over time (inflation and deflation). If a wind turbine creates a disamenity, then house prices closer to the turbine would be expected to decline (all else being equal) compared to their values before the turbine was installed and compared to the prices of houses farther away that sold during the same period.

The peer-reviewed, published studies that used hedonic modeling largely agree in finding non-significant post-construction effects (i.e., non-significant effects on home prices occurring after construction of wind turbines) (Sims et al., 2008; Hoen et al., 2011; Heintzelman and Tuttle, 2012), implying that average impacts in their study areas were either relatively small or sporadic near existing turbines. Three academic studies found similar results (Hoen, 2006; Hinman, 2010; Carter, 2011). The geographic extent of these studies varied from single counties (Hoen, 2006; Hinman, 2010; Carter, 2011), to three counties in New York (Heintzelman and Tuttle, 2012), to eight states (Hoen et al., 2011), showing that results have been robust to geographic scale. Although the academic and peer-reviewed literature has largely focused on post-construction impacts, some studies have found evidence of pre-construction yet post-announcement impacts (Hinman, 2010; Hoen et al., 2011; Heintzelman and Tuttle, 2012). This "anticipation effect" (Hinman, 2010) correlates with surveys of residents living near wind facilities that have found that once wind turbines are constructed, residents are more supportive of the facilities than they were when the construction of that facility was announced (Wolsink, 2007; Sims et al., 2008). Analysis of home prices related to other disamenities (e.g., incinerators) also has shown anticipation effects and post-construction rebounds in prices (Kiel and McClain, 1995).

2.5 General Literature on the Effects of Amenities and Disamenities on House Prices

While wind turbines are typically limited to high-wind-resource areas, disamenities such as highways, overhead electricity transmission lines, power plants, and landfills are ubiquitous in urban and semi-rural areas, and they have been the focus of many studies. This more established "disamenity literature" (see for example, Boyle and Kiel, 2001; Jackson, 2001; Simons and Saginor, 2006) helps frame the expected level of impact around turbines. For example, adverse home-price effects near electricity transmission lines, a largely visual disturbance, have ranged from 5% to 20%, fading quickly with distance and disappearing beyond 200 to 500 feet, and even in some cases, when afforded with access to the transmission line corridor, home-price effects have found to be positive signaling net benefits over costs of transmission line proximity (e.g., Des Rosiers, 2002). Landfills, which present smell and truck-activity nuisances and potential health risks from groundwater contamination, have been found to decrease adjacent property values by 13.7% on average, fading by 5.9% for each mile a home is further away for large-volume operations (that accept more than 500 tons per day). Lower-volume operations decreased adjacent property values by 2.7% on average, fading by 1.3% per mile, with 20% to 26% of the lower-volume landfills not significantly impacting values at all (Ready, 2010). Finally, a review of literature investigating impacts of road noise on house prices, which might be analogous to noise from turbines, found price decreases of 0.4% to 4% for houses adjacent to a busy road compared to those on a quiet street (see for example Bateman et al., 2001; Day et al., 2007; Kim et al., 2007; Andersson et al., 2010).

Community amenities also have been well studied. Open space (i.e., publicly accessible areas that are available for recreational purposes) has been found to increase surrounding prices (Irwin, 2002; Anderson and West, 2006a); Anderson and West estimated those premiums to be 0.1% to 5%, with an average of 2.6% for every mile that a home is closer to the open space. Proximity to (and access to and views of) water, especially oceans, has been found to increase values (e.g., Benson et al., 2000; Bond et al., 2002); for example, being on the waterfront increased values by almost 90% (Bond et al., 2002).

Although much of the literature on community perceptions of wind turbines suggests that local residents may see turbines as a disamenity, this is not always the case. As discussed above, perceptions about wind turbines are shaped by numerous factors that include the size of the turbine(s) or project, the sense of place of the local residents, the manner in which the planning process is conducted, and the ownership structure. In contrast to disamenities universally disliked by local residents (as discussed above), some literature suggests that wind turbines could be considered amenities (i.e., a positive addition to the community), particularly if benefits accrue to the local community. Thus, whether wind turbines increase or decrease surrounding home prices—and by how much—remains an open question.

The evidence discussed above suggests that any turbine-related disamenity impact likely would be relatively small, for example, less than 10%. If this were the case, tests to discover this impact would require correspondingly small margins of error, which in turn requires large amounts of data. Yet much of the literature has used relatively small numbers of transactions near turbines. For example, the largest dataset studied to date had only 125 post-construction sales within 1 mile of the turbines (Hoen et al., 2009, 2011), while others contained far fewer post-construction transactions within 1 mile: Heintzelman and Tuttle ($n \sim 35$), Hinman ($n \sim 11$), and Carter ($n \sim 41$). Although these numbers of observations might be adequate to examine large impacts (e.g., greater than 10%), they are less likely to discover smaller effects because of the size of the corresponding margins of error. Larger datasets of transactions would allow smaller effects to be discovered. Using results from Hoen at al. (2009) and the confidence intervals for the various fixed-effect variables in that study, we estimated the numbers of transactions needed to find effects of various sizes. Approximately 50 transactions are needed to find an effect of 10% or greater, 200 to find an effect of 5%, 500 to find an effect of 3.5%, and approximately 1,000 to find a 2.5% effect.

Additionally, there is evidence that wind facilities are sited in areas where property prices are lower than in surrounding areas—what we are referring to as a "pre-existing price differential". For example, Hoen et al. (2009) found significantly lower prices (-13%) for homes that sold more than 2 years prior to the wind facilities' announcements and were located within 1 mile of where the turbines were eventually located, as compared to homes that sold in the same period and were located outside of 1 mile. Hinman (2010) found a similar phenomenon that she labeled as a "location effect." To that end, Sims and Dent (2007), after their examination of three locations in Cornwall, United Kingdom, commented that the research "highlighted to some extent, wind farm developers are themselves avoiding the problem by locating their developments in places where the impact on prices is minimized, carefully choosing their sites to avoid any negative impact on the locality" (p. 5). Thus, further investigation of whether wind facilities are associated with areas with lower home values than surrounding areas would be worthwhile. It is important to emphasize that any "pre-existing price differential" does not exist because of the turbines, but instead is likely the result of the fact that wind turbines may be located in areas of relative disamenity. For example, in Massachusetts, wind turbines have typically been co-located with industrial facilities such as waste water treatment plants. While we included seven different amenities and disamenities in our model, we could not include all of them because of a lack of accurate data, especially for waste water treatment plants and industrial sites that may have been co-located with wind turbines. Some of the "pre-existing price differential" may therefore be attributable to other disamenities that have not been included in the model. Regardless of the reason, any "pre-existing price differential" needs to be taken into account in order to accurately calculate the net impacts that wind turbines may have on property prices.

Finally, there have been claims that the home sales rate (i.e., sales volume) near existing wind turbines is far lower than the rate in the same location before the turbines' construction and the rate farther away from the turbines, because homeowners near turbines cannot find buyers (see sales volume discussion in Hoen et al., 2009). Obviously, many homes near turbines have sold, as recorded in the literature. If it were true that homeowners near turbines have *chosen* to sell less often because of very low buyer bids, then sales that did take place near turbines should be similarly discounted on average, but evidence of large discounts has not emerged from the academic literature (as discussed above). Moreover, homes farther away from turbines would be taken off the market for similar reasons (sellers do not get offers they accept), thus the comparison group is potentially affected in a similar way. In any case, although Hoen et al. (2009) found no evidence of lower sales volumes near turbines, further investigations of this possible phenomenon using different datasets are warranted.

2.6 Gaps in the Literature

This literature review suggests several knowledge gaps that could be studied further: exploring wind turbine impacts on home prices in urban settings, where the "sense of place" might be different than in the previously studied rural areas; examining post-announcement/pre-construction impacts; testing for relatively small impacts using large datasets; determining whether wind facilities are sited in areas with lower home values; examining turbine impacts in concert with impacts from other disamenities and amenities; and investigating whether home sales volumes are different near existing wind turbines. Our study seeks to address each of these areas.

3. EMPIRICAL STUDY

Because of Massachusetts' density of urban homes near enough to wind turbines to produce potential nuisance effects, our study analyzes Massachusetts data to address gaps in knowledge about turbine effects on home prices. Specifically, the study seeks to answer the following five questions:

Q1) Have wind facilities in Massachusetts been located in areas where average home prices were lower than prices in surrounding areas (i.e., a "pre-existing price differential")?

Q2) Are post-construction (i.e., after wind-facility construction) home price impacts evident in Massachusetts, and how do Massachusetts results contrast with previous results estimated for more rural settings?

Q3) Is there evidence of a post-announcement/ pre-construction effect (i.e., an "anticipation effect")?

Q4) How do impacts near turbines compare to the impacts of amenities and disamenities also located in the study area, and how do they compare with previous findings?

Q5) Is there evidence that houses near turbines that sold during the post-announcement and post-construction periods did so at lower rates (i.e., frequencies) than during the pre-announcement period?

The following subsections detail the study's hedonic-modeling process and base model, the extensive robustness tests used to determine the sensitivity of the base model, the study data, and the results.

3.1 Hedonic Base Model Specification

The price of a home can be expressed as follows:

$$P = f(L, N, A, E, T)$$

where L refers to lot-specific characteristics, N to neighborhood variables, A to amenity/disamenity variables, E to wind-turbine variables, and T to time-dependent variables.

Following from this basic formula, we estimate the following customarily used (see, e.g., Sirmans et al., 2005) semi-log base model to which the set of robustness models are compared.

$$\ln(P) = \beta_0 + \sum \beta_1 L \cdot D + \beta_2 N + \sum \beta_3 A \cdot D + \sum \beta_4 E \cdot D + \sum \beta_5 T + \varepsilon'$$

An explanation of this formula is as follows:

The dependent variable is the log of sales price (P).

L is the vector of lot-specific characteristics of the property, including living area (in thousands of square feet); lot size (in acres); lot size less than 1 acre (in acres if the lot size is less than 1, otherwise 1); effective age (sale year minus either the year built or, if available, the most recent renovation date); effective age squared; and number of bathrooms (the number of full bathrooms plus the number of half bathrooms multiplied by 0.5).

D is the nearest wind turbine's development period in which the sale occurred (e.g., if the sale occurred more than 2 years before the nearest turbine's development was announced, less than 2 years before announcement, after announcement but before construction, or after construction).

N is the U.S. census tract in which the sale occurred.

A is the vector of amenity/disamenity variables for the home, including the amenities: if the home is within a half mile from open space; is within 500 feet or is within a half mile but outside 500 feet of a beach; and, disamenities: is within a half mile of a landfill, and/or prison; and is within 500 feet of an electricity transmission line, highway and/or major road.[15]

T is the vector of time variables, including the year in which the sale occurred and the quarter in which the sale occurred.

E is a binary variable representing if the home is within a half mile from a turbine, and

ε is the error term.[16]

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are coefficients for the variables.

The vectors of lot-specific and amenity/disamenity variables are interacted with the development period for three reasons: 1) to allow the covariates to vary over the study period, which will, for example, allow the relationship of living area and sale price to be different earlier in the study period, such as more than 2 years before announcement, than it is later in the study period, such as after construction of the nearest turbine;[17] 2) to ensure that the variables of interest do not absorb any of this variation and therefore bias the coefficients; and 3) to allow the examination of the amenity/disamenity variables for subsets of the data.[18]

The distance-to-the-nearest-turbine variable specified in the base model is binary: one if the home is within a half mile of a turbine and zero if not. The distance can be thought of as the distance, today, when all the turbines in the state have been built. Obviously, for some homes, such as those that sold before the wind facility was announced, there was no turbine nearby at the time of sale, so in those cases the distance variable represents the distance to where the turbine eventually was built. By interacting this distance variable with the turbine development period, we are able to examine how the distance effects might change over the periods and whether or not there was a pre-existing price differential between homes located near turbines and

15 Each of the amenity/disamenity variables are expressed as a binary variable: 1 if "yes," 0 if "no."

16 The error term (i.e., "unexplained variation" or "residual value") defines the portion of the change in the dependent variable (in this case the log of sale price) that cannot be explained by the differences in the combined set of independent variables (in this case the size and age of the home, the number of bathrooms, etc.). For example, a large portion of one's weight can be explained by one's gender, age and height, but differences (i.e., unexplained variation) in a sample of people's weight will still exist for random reasons. Regardless of how well a model performs, some portion of unexplained variation is expected.

17 As discussed in greater detail in the results, the coefficients for the variables of interest are quite small in magnitude, and therefore even a relatively small change in the size of the coefficients can be problematic to the correct interpretation of the results. Moreover, the lot-specific and amenity/disamenity variables vary over the development periods, further reinforcing the need to interact them with period. The results for the wind turbine variables presented herein are robust to alternative specifications without these interactions.

18 While the coefficients associated with the amenity/disamenity variables interacted with the facility development periods are not particularly meaningful, creating the subsets enables examination of the data represented by the different wind turbine development periods and shows how stable the amenity/disamenity variables are within these subsets of data.

those farther away that existed even before the turbines were announced.

Further, we used a binary variable as opposed to other forms used to capture distance. For example, other researchers investigating wind turbine effects have commonly used continuous variables to measure distance such as linear distance (Sims et al., 2008; Hoen et al., 2009), inverse distance (Heintzelman and Tuttle, 2012; Sunak and Madlener, 2013), or mutually exclusive non-continuous distance variables (Hoen et al., 2009; Hinman, 2010; Carter, 2011; Hoen et al., 2011; Heintzelman and Tuttle, 2012; Sunak and Madlener, 2013). We preferred the binary variable because we believe the other forms have limitations. Using the linear or inverse continuous forms necessarily forces the model to estimate effects at the mean distance. In some of these cases those means can be quite far from the area of expected impact. For example, Heintzelman and Tuttle (2012) estimated an inverse distance effect using a mean distance of over 10 miles from the turbines, while Sunak and Madlener (2013) used a mean distance of approximately 1.9 miles. Using this approach makes the model less able to quantify the effect near the turbines, where they are likely to be stronger. More importantly, this method encourages researchers to extrapolate their findings to the ends of the distance curve, near the turbines, despite having few data in this distance band. This was the case for Heintzelman and Tuttle (2010), who had less than 10 sales within a half mile in the two counties where effects were found and only a handful of sales in those counties after the turbines were built. Yet they extrapolated their findings to a quarter mile and even a tenth of a mile, where they had very few, if any, cases. Similarly, Sunak and Madlener (2013) had only six (post-construction) sales within a half mile, yet they extrapolated their findings to this distance band.

One method to avoid using a single continuous function to describe effects at all distances is to use a spline model, which breaks the distances into continuous groups (Hoen et al., 2011), but this still imposes some structure on the data that might not actually exist. By far the most transparent method is to use binary variables for discrete distances that therefore impose only slight structure on the data (Hoen et al., 2009; Hinman, 2010; Hoen et al., 2011). Although this method has been used in existing studies, because of a paucity of data, margins of error for the estimates were large (e.g., 7% to 10% for Hoen et al. 2011). However, as discussed above, the extensive dataset for Massachusetts allows this approach to be taken while maintaining relatively small margins of error. Moreover, although others have estimated effects for multiple distance bins out to 5 or 10 miles, we have focused our estimates on the group of homes that are within a half mile of a turbine—although other groups, such as those within a quarter of a mile and between one half and one mile, are explored in the robustness models. The homes within a half mile of turbines are most likely to be impacted and are, therefore, the first and best place to look for impacts. Further, we use the entire group of homes outside of a half mile as the reference category, which gives us a large heterogeneous comparison group and therefore one that is likely *not* correlated with omitted variables—although we also explore other comparison groups in the robustness tests.

3.2 Robustness Tests

Models are built on assumptions and therefore practitioners often test those assumptions by trying multiple model forms. As was the case for this research, a "base" model is compared to a set of "robustness" models, each with slightly different assumptions, to explore the robustness of the study's findings.

The suite of robustness tests explored changes in: 1) the spatial extent at which both the effect and the comparable data are specified; 2) the variables used to describe fixed effects; 3) the screens that are used to select the final dataset as well as outliers and influencers; 4) the inclusion of spatially and temporally lagged variables to account for the presence of spatial autocorrelation; and 5) the inclusion of additional explanatory variables that are not populated across the whole dataset. Each will be described below.

3.2.1 Varying the Distance to Turbine

The base model tests for effects on homes sold within a half mile of a turbine (and compares the sales to homes located outside of a half mile and inside 5 miles of a turbine). Conceivably, effects are stronger the nearer homes are to turbines and weaker the further they are away—because that roughly corresponds to the nuisance effects (e.g., noise and shadow flicker) that we are measuring—but the base model does not explore this. Therefore, this set of robustness models investigates effects within a quarter mile as well as between a half and 1 mile. It is assumed that effects will be larger within a quarter mile and smaller outside of a half mile.

Additionally, the basis of comparison could be modulated as well. The base model compares homes within a half mile to those outside of a half mile and inside of 5 miles, most of which are between 3 and 5 miles. Conceivably, homes immediately outside of a half mile are also affected by the presence of the turbines, which might bias down the comparison group and therefore bias down the differences between it and the target group inside of a half mile. Therefore, two additional comparison groups are explored: 1) those outside of a half mile and inside of 10 miles, and 2) those outside of 5 miles and inside of 10 miles. It is assumed that effects from turbines are not experienced outside of 5 miles from the nearest turbine.

3.2.2 Fixed Effects

A large variety of neighborhood factors might influence a home price (e.g., the quality of the schools, the crime rate, access to transportation corridors, local tax rates), many of which cannot be adequately measured and controlled for in the model specifically. Thus, practitioners use a "fixed effect" to adjust prices based on the neighborhood, which accounts for all the differences between neighborhoods simultaneously. Examples of these fixed effects, moving from larger and less precise geographic areas to smaller and more precise areas are: zip code; census tract; and, census block group.

The base model uses census tract boundaries as the geographic extent of fixed effects, aiming to capture "neighborhood" effects throughout the sample area. Because this delineation is both arbitrary (a census tract does not necessarily describe a neighborhood) and potentially too broad (multiple neighborhoods might be contained in one census tract), the census block group is used in a robustness test. This is expected to allow a finer adjustment to the effects of individual areas of the sample and therefore be a more accurate control for neighborhood effects. The drawback is that the variables of interest (e.g., within a half mile and the development-period variables) might vary less within the block group, and therefore the block group will absorb the effects of the turbines, biasing the results for the variables of interest.

3.2.3 Screens, Outliers, and Influencers

As described below, to ensure that the data used for the analysis are representative of the sample in Massachusetts and do not contain exceptionally high- or low-priced homes or homes with incorrect characteristics, a number of screens are applied for the analysis dataset. To explore what effect these screens have on the results, they are relaxed for this set of robustness tests. Additionally, a selection of outliers (based on the 1 and 99 percentile of sale price) and influencers (based on a Cook's Distance of greater than 1[19]) might bias the results, and therefore a model is estimated with them removed.

3.2.4 Spatially and Temporally Lagged Nearest-Neighbor Data

The value of a given house is likely impacted by the characteristics of neighboring houses (i.e., local spatial spillovers, defined empirically as W_x) or the neighborhood itself. For example, a house in a neighborhood with larger parcels (e.g., 5 acres lots), might be priced higher than an otherwise identical home in a neighborhood with smaller parcels (e.g., 1 acre lots).

If statistical models do not adequately account for these spatial spillovers, the effects are relegated to the unexplained component of the results contained in the error term, and therefore the other coefficients could be biased. If this occurs, then the error terms exhibit spatial autocorrelation (i.e., similarity on the basis of proximity). Often, in the hedonic literature, more concern is paid to unobserved (and spatially correlated) neighborhood factors in the model.[20]

A common approach for controlling for the unobserved neighborhood factors is to include neighborhood fixed effects (see for example Zabel and Guignet, 2012), which is the approach we took in the base model. To additionally control for the characteristics of neighboring houses a model can be estimated that includes spatial lags of their characteristics as covariates in the hedonic model, as is done for this robustness test. Neighboring houses are determined by a set of *k*-nearest neighbors (*k*, in this case, equals 5), though alternative methods could have been used (Anselin, 2002). Further, although dependence often focuses on spatial proximity, it is also likely that sales are "temporally correlated," with nearby houses selling in the same period (e.g., within the previous 6 months) being more correlated than nearby houses selling in earlier periods (e.g., within the previous 5 years). To account for both of these possible correlations, we include a spatially and temporally lagged set of *k*-nearest neighbor data in a robustness model.

These spatially and temporally lagged variables were created using the set of the five nearest neighbors that sold within the 6 months preceding the sale of each house. These variables contained the average living area, lot size, age, and age squared of the "neighbors."

19 According to Cook, R. D. (1977) Detection of Influential Observations in Linear Regression. Technometrics. 19(1): 15-18.

20 LeSage and Pace (2009) have argued that including an expression of neighboring observations (i.e., a spatial lag, know as Wy) of the dependent variable (i.e., sale price) in the model is appropriate for dealing with these omitted variables. They show that spatially dependent omitted variables generate a model that contains spatial lags of the dependent and exogenous variables, known as the spatial Durbin model (Anselin, 1988). Ideally, we would have estimated these models, but this was not possible because of computing limitations.

3.2.5 Inclusion of Additional Explanatory Variables

Although the base model includes a suite of controlling variables that encompasses a wide range of home and site characteristics, the dataset contains additional variables not fully populated across the dataset that might also help explain price differences between homes. They include the style of the home (e.g., cape, ranch, colonial) and the type of heat the home has (e.g., forced air, baseboard, and steam). Therefore, an additional robustness model is estimated that includes these variables but uses a slightly smaller dataset for which these variables are fully populated.

Combined, it is assumed that the set of robustness tests will provide additional context and possibly bound the results from the base model. We now turn to the data used for the analysis.

3.3 Data Used For Analysis

To conduct the analysis, a rich set of four types of data was obtained from a variety of sources in Massachusetts, including 1) wind turbine data, 2) single-family-home sale and characteristic data, 3) U.S. Census data, and 4) amenities and disamenities data. From these, three other sets of variables were created: distance-to-turbine data, time-of-sale period relative to announcement and construction dates of nearby turbines, and spatially and temporally lagged nearest-neighbor characteristics. Each is discussed below.

3.3.1 Wind Turbines

Using data from the Massachusetts Clean Energy Center (MassCEC), every wind turbine in Massachusetts that had been commissioned as of November 2012 with a nameplate capacity of at least 600 kW was identified and included in the analysis. This generated a dataset of 41 turbines located in a variety of settings across Massachusetts, ranging in scope from a single turbine to a maximum of 10 turbines, with blade tip heights ranging from 58.5 meters (192 feet) to 390 meters (1,280 feet), with an average of approximately 120 meters (394 feet) (Table 1 and Figure 4). Spatial data for every turbine (e.g., x and y coordinates), derived from MassCEC records and a subsequent visual review of satellite imagery, were added, and wind turbine announcement and construction dates were populated by MassCEC. Announcement date is assumed to be the first instance when news of the projects enters the public sphere via a variety of sources including a news article, the filing of a permit application, or release of a Request for Proposals. Dates were identified in consultation with project proponents, developers or using Google News searches.

3.3.2 Single-Family-Home Sales and Characteristics

A set of arm's-length, single-family-home sales data for all of Massachusetts from 1998 to November 2012 was purchased from the Warren Group.[21] Any duplicate observations, cases where key information was missing (e.g., living area, lot size, year built), or observations where the data appeared to be erroneous (e.g., houses with no bathrooms) were removed from the dataset. These data included the following variables (and are abbreviated as follows in parentheses): sale date (*sd*), sale price (*sp*), living

21 See http://www.thewarrengroup.com/. The Warren Group identified all transactions that were appropriate for analysis. As discussed later, we used additional screens to ensure that they were representative of the population of homes. Single-family homes, as opposed to multi-family or condominiums, were selected because condos and multi-family properties constitute different markets and are generally not analyzed together (Goodman and Thibodeau, 1998; Lang, 2012).

Table 1: List of Locations, Key Project Metrics and Dates of Massachusetts Turbines Analyzed

Project Name	Number of Turbines	Capacity per Turbine (kW)	Project Nameplate Capacity (MW)	Blade Tip Height (meters)	Announcement Date	Construction Date	Commission Date	Wastewater or Water Treatment	Industrial Site	Landfill	Located at a School
Berkshire East Ski Resort	1	900	0.9	87	12/16/08	7/12/10	10/31/10				
Berkshire Wind	10	1500	15	118.5	1/12/01	6/1/09	5/28/11				
Fairhaven	2	1500	3	121	5/1/04	11/1/11	5/1/12	X			
Falmouth Wastewater 1	1	1650	1.65	121	4/1/03	11/1/09	3/23/10	X			
Falmouth Wastewater 2	1	1650	1.65	121	11/1/09	4/5/10	2/14/12	X			
Holy Name Central Catholic Jr/Sr HS	1	600	0.6	73.5	9/21/06	3/21/08	10/4/08				X
Hull 1	1	660	0.66	73.5	10/1/97	11/1/01	12/27/01				X
Hull 2	1	1800	1.8	100	1/1/03	12/1/05	5/1/06			X	
Ipswich MLP	1	1600	1.6	121.5	3/1/03	10/1/10	5/15/11				
Jiminy Peak Mountain Resort	1	1500	1.5	118.5	11/1/05	6/25/07	8/3/07				
Kingston Independence	1	2000	2	123	6/1/06	9/23/11	5/11/12				
Lightolier	1	2000	2	126.5	12/14/06	11/1/11	4/20/12		X		
Mark Richey Woodworking	1	600	0.6	89	11/10/07	11/1/08	2/22/09		X		
Mass Maritime Academy	1	660	0.66	73.5	1/31/05	4/12/06	6/14/06				X
Mass Military Reservation 1	1	1500	1.5	118.5	11/8/04	8/1/09	7/30/10		X		
Mass Military Reservation 2	1	1500	1.5	121	10/1/09	10/1/10	10/28/11		X		
Mass Military Reservation 3	1	1500	1.5	121	10/1/09	10/1/10	10/28/11		X		
Mt Wachusett Community College	2	1650	3.3	121	8/18/08	1/28/11	4/27/11				X
MWRA - Charlestown	1	1500	1.5	111	1/24/10	3/25/10	10/1/11	X			
MWRA - Deer Island	2	600	1.2	58.5	6/1/08	8/1/09	11/15/10	X			
No Fossil Fuel (Kingston)	3	2000	6	125	3/1/10	11/16/11	1/25/12		X		
NOTUS Clean Energy	1	1650	1.65	121	8/31/07	4/1/10	7/28/10		X		
Princeton MLP	2	1500	3	105.5	12/18/99	9/9/09	1/12/10				
Scituate	1	1500	1.5	111	3/15/08	2/15/12	3/15/12	X			
Templeton MLP	1	1650	1.65	118.5	7/24/09	2/1/10	9/1/10				
Williams Stone	1	600	0.6	88.5	1/11/08	5/1/08	5/27/09		X		
Total: 26 projects	**41**							**6**	**8**	**1**	**4**

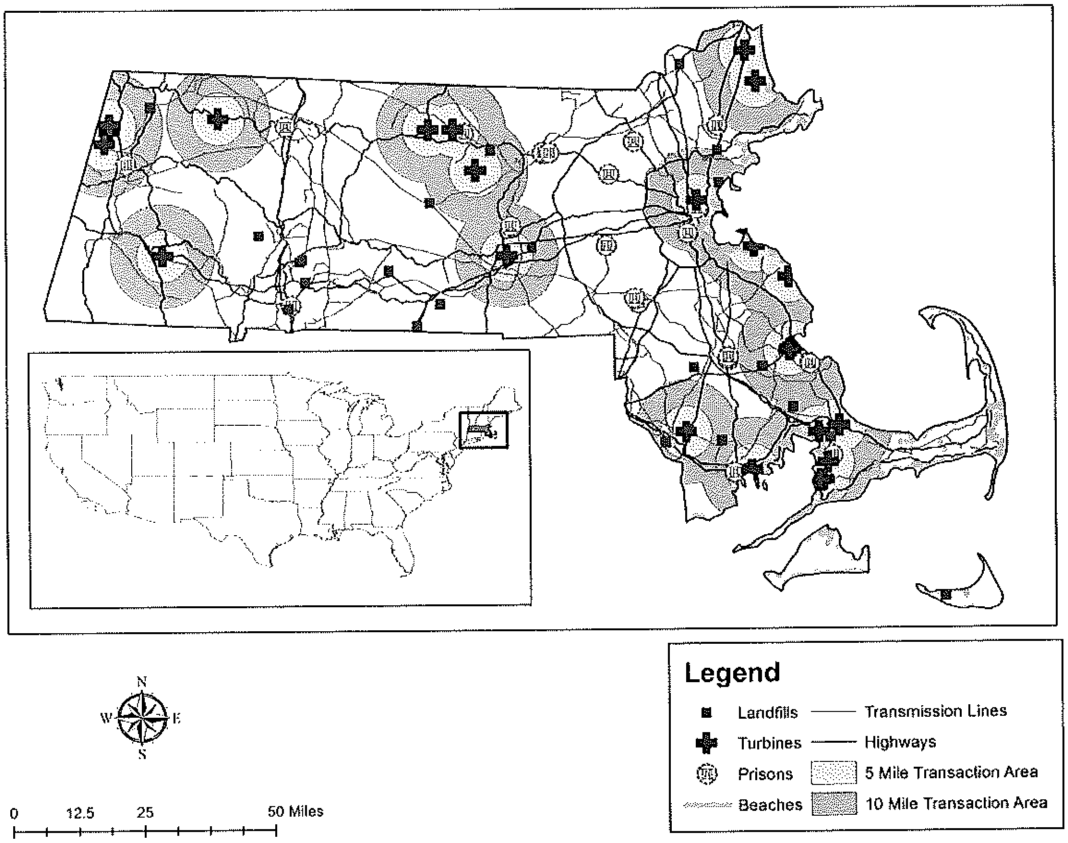
area in thousands of square feet (*sfla1000*), lot size in acres (*acres*), year the home was built (*yb*), most recent renovation year (*renoyear*), the number of full (*fullbath*) and half (*halfbath*) bathrooms, the style of the home (e.g., colonial, cape, ranch) (*style*), the heat type (e.g., forced air, baseboard, steam) (*heat*), and the x and y coordinates of the home.[22] From these, the following variables were calculated: natural log of sale price (*lsp*), sale year (*sy*), sale quarter (*sq*), age of the home at the time of sale (*age = sy – (yb or renoyear)*), age of the home at the time of sale squared (*agesqr = age × age*), lot size less than 1 acre (*acrelt1*), bathrooms (*bath = fullbath + (halfbath × 0.5)*).[23]

To ensure a relatively homogenous set of data, without outlying observations that could skew the results, the following criteria were used to screen the dataset: sale price between $40,000 and $2,500,000; less than 12 bathrooms or bedrooms; lot size less than 25 acres; and sale price per square foot between $30 and $1,250. As detailed below, these screens

22 The style is used in a robustness test.

23 Geocoding of x-y coordinates can have various levels of accuracy, including block level (a centroid of the block), street level (the midpoint of two ends of a street), address level (a point in front of the house – usually used for Google maps etc.), and house level (a point over the roof of the home). Warren provided x and y coordinates that were accurate to the street level or block level but not accurate to the house level. All homes that were within 2 miles of a turbine were corrected to the house level by Melissa Data. See: www.MelissaData.com. This was important to ensure that accurate measurements of distance to the nearest turbine were possible.

Figure 4: Locations of Massachusetts Wind Turbines Included in Study



were relaxed for a robustness test, and no significant alteration to the results was discovered.

3.3.3 Distance to Turbine

Geographic information system (GIS) software was used to calculate the distance between each house and the nearest wind turbine in the dataset (*tdis*) and to identify transactions within a 10-mile radius of a wind turbine. Transactions inside 5 miles were used for the base model, while those outside of 5 miles were retained for the robustness tests. This resulted in a total of 122,198 transactions within 5 miles of a turbine (and 312,677 within 10 miles of a turbine). Additionally, a binary variable was created if a home was within a half mile of a turbine or not (*halfmile*), which was used in the base model. As discussed above, the robustness models used additional distance variables, including if a home was within a quarter mile of a turbine (*qtrmile*) and if a home was outside a half mile but within 1 mile (*outsidehalf*).

3.3.4 Time of Sale Relative to Announcement and Construction Dates of Nearby Turbines

Using the announcement and construction dates of the turbine nearest a home and the sale date of the home, the facility development period (*fdp*) was assigned one of four values: the sale was more than 2 years before the wind facility was announced

Table 2: Distribution of Transaction Data Across Distance and Period Bins

	prioranc	*preanc*	*postanc-precon*	*postcon*	*all periods*
0-0.25mile	60	9	14	38	121
	0.04%	*0.02%*	*0.03%*	*0.06%*	*0.04%*
0.25-0.5mile	434	150	210	192	986
	0.25%	*0.39%*	*0.47%*	*0.33%*	*0.32%*
0.5-1mile	3,190	805	813	1,273	6,081
	1.9%	*2.1%*	*1.8%*	*2.2%*	*1.9%*
1-5mile	62,967	14,652	17,086	20,305	115,010
	37%	*38%*	*38%*	*34%*	*37%*
5-10mile	104,188	22,491	26,544	37,256	190,479
	61%	*59%*	*59%*	*63%*	*61%*
Total	**170,839**	**38,107**	**44,667**	**59,064**	**312,677**
	100%	*100%*	*100%*	*100%*	*100%*

(*prioranc*),[24] the sale was less than 2 years before the facility was announced (*preanc*), the sale occurred after facility announcement but prior to construction commencement (*postancprecon*), or the sale occurred after construction commenced (*postcon*). We are assuming that once construction was completed, the turbine went into operation. See Table 2 for the distribution of the 312,677 sales within 10 miles across the distance and period bins.

3.3.5 U.S. Census

Using GIS software, the U.S. Census tract and block group of each home were determined. The tract delineation was used for the base model, and the block group was used for one of the robustness tests. In both cases, the Census designations were used to control for "neighborhood" fixed effects across the sample.

3.3.6 Amenity and Disamenity Variables

Data were obtained from the Massachusetts Office of Geographic Information (MassGIS) on the location of beaches, open space,[25] electricity transmission lines, prisons, highways, and major roads.[26] As discussed above, these variables were included in the model to control for and allow comparisons to amenities and disamenities in the study areas near

24 This first period, more than two years before announcement, was used to ensure that these transactions likely occurred before the community was aware of the development. Often prior to the announcement of the project, wind developers are active in the area, potentially, arranging land leases and testing/measuring wind speeds, which can occur in the two years before an official announcement is made.

25 The protected and recreational open space data layer contains the boundaries of conservation land and outdoor recreational facilities in Massachusetts.

26 Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division. (www.mass.gov/mgis).

turbines. Based on the data, variables were assigned to each home in the dataset using GIS software. If a home was within 500 feet of a beach, it was assigned the variable *beach500ft*, and if a home was outside of 500 feet but inside of a half mile from a beach it was assigned the variable *beachhalf*. Similarly, variables were assigned to homes within a half mile of a publicly accessible open space with a minimum size of 25 acres (*openhalf*), a currently operating landfill (*fillhalf*), or a prison containing at least some maximum-security inmates (*prisonhalf*). Variables were also assigned to homes within 500 feet of an electricity transmission line (*line500ft*), a highway (*hwy500ft*) or otherwise major road (*major500ft*).[27] Figure 4 shows the location of these amenities and disamenities (except open space and major roads) across Massachusetts.

3.3.7 Spatially and Temporally Lagged Nearest-Neighbor Characteristics

Using the data obtained from Warren Group for the home and site characteristics, x/y coordinates and the sale date, a set of spatially and temporally lagged nearest neighbor variables were prepared to be used in a robustness test. For each transaction the five nearest neighbors were selected that: transacted

Table 3: Summary of Characteristics of Base Model Dataset

Variable	Description	Mean	Std. Dev.	Min	Median	Max
sp	sale price	$322,948	$238,389	$40,200	$265,000	$2,495,000
lsp	log of sale price	12.49	0.60	10.6	12	14.72
sd	sale date	10/19/04	1522	3/3/98	2/6/05	11/23/12
sy	sale year	2004	4	1998	2004	2012
syq	sale year and quarter (e,g., 20042 = 2004, 2nd quarter)	20042	42	19981	20043	20124
sfla1000	square feet of living area (1000s of square feet)	1.72	0.78	0.41	1.6	9.9
acre*	number of acres	0.51	1.1	0.0054	0.23	25
acrelt1*	the number of acres less than one	-0.65	0.31	-0.99	-0.77	0
age	age of home at time of sale	54	42	-1	47	359
agesq	age of home squared	4671	4764	0	3474	68347
bath**	the number of bathrooms	1.9	0.79	0.5	1.5	10.5
wtdis	distance to nearest turbine (miles)	3.10	1.20	0.098	3.2	5
fdp	wind facility development period	1.95	1.18	1	1	4
annacre	average nearest neighbor's acres	0.51	0.93	0.015	0.25	32
annage	average nearest neighbor's age	53.71	30.00	-0.8	52	232
annagesq	average nearest neighbor's agesq	4672	4766	0	3474	68347
annsfla1000	average nearest neighbor's sfla1000	1.72	0.53	0.45	1.6	6.8

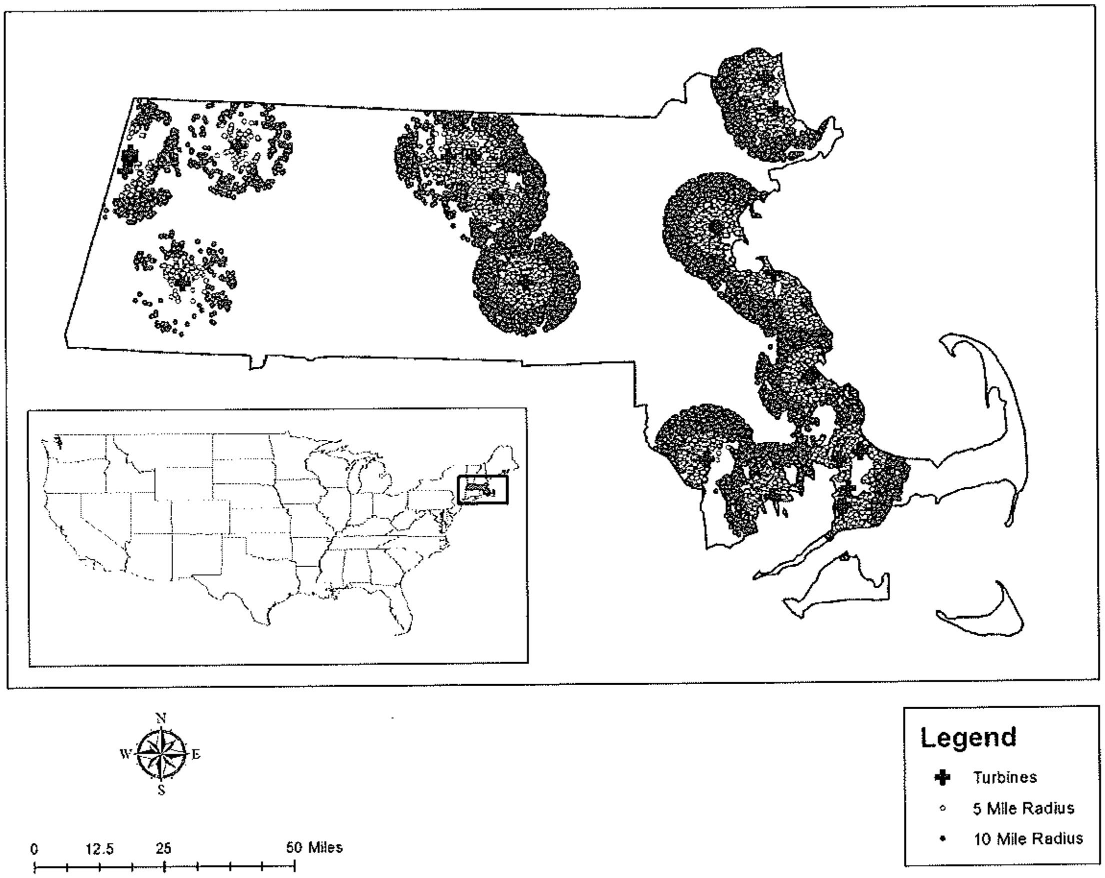
Note: Sample size for the full dataset is 122,198

* Together acrelt1 and acre are entered into the model as a spline function with acrelt1 applying to values from 0 to 1 acres (being entered as values from -1 to 0, respectively) and acre applying to values from 1 to 25 acres.

** Bath is calculated as follows: number of bathrooms + (number of half bathrooms *0.5)

27 Highways and majors road are mutually exclusive by our definition despite the fact that highways are also considered major roads.

Figure 5: Locations of Houses in Relation to Wind Turbines



within the preceding 6 months and were the closest in terms of Euclidian distance. Using those five transactions, average 1000s of square feet of living space (*annsfla1000*), average acres (*annacre*), average age (*annage*), and age squared (*annagesq*) of the neighbors were created for each home. These four variables were used in the robustness test.

3.3.8 Summary Statistics

The base model dataset includes all home sales within 5 miles of a wind turbine, which are summarized in Table 2. The average home in the dataset of 122,198 sales from 1998 to 2012 has a sale price of $322,948, sold in 2004, in the 2nd quarter, has 1,728 square feet of living area, is on a parcel with a lot size of 0.51 acres, is 54 years old, has 1.9 bathrooms, and is 3.1 miles from the nearest turbine. As summarized in Table 2, of the 122,198 sales within 5 miles of a turbine, 7,188 (5.9%) are within 1 mile of a turbine, 1,107 (approximately 0.9%) are within a half mile, and 121 (0.1%) are within a quarter mile. In the post-construction period, 1,503 sales occurred within 1 mile of a turbine, and 230 occurred within a half mile. These totals are well above those collected for other analyses and are therefore ample to discover considerably smaller effects. For example, as discussed in Section 2.5 above, an effect larger than 2.5% should be detectable within 1 mile, and an effect larger than approximately 4% should be detectable within a half mile, given the number of transactions that we are analyzing. Figure 5 shows the spatial distribution of sales throughout the sample area.

3.4 Results

3.4.1 Base Model Results

The base model results for the turbine, amenity, and disamenity variables are presented in Table 4 (with full results in the Appendix). The base model has a high degree of explanatory power, with an adjusted-R^2 of 0.80, while the controlling variables are all highly significant and conform to the *a priori* assumption as far as sign and magnitude (e.g., Sirmans et al., 2006).[28] The model interacts the four wind-facility periods with each of the controlling variables to test the stability of the controlling variables across the periods (and the subsamples they represent) and to ensure that the coefficients for the wind turbine distance variables, which are also interacted with the periods, do not absorb any differences in the controlling variables across the periods.[29] The controlling variables do vary across the periods, although they are relatively stable. For example, each additional thousand square feet of living area adds 21%–24% to a home's value in each of the four periods; the first acre adds 14%–22% to home value, while each additional acre adds 1%–2%; each year a home ages reduces the home's value by approximately 0.2% and each bathroom adds 6%–11% to the value. Additionally, the sale years are highly statistically significant compared to the reference year of 2012; prices in 1998 are approximately 52% lower, and prices in 2005 and 2006 are approximately 31% and 28% higher, after which prices decline to current levels. Finally, there is considerable seasonality in the transaction values. Compared to the reference third quarter, prices in the first quarter are approximately 7% lower, while prices in the second and fourth are about 1%–2% lower (see Appendix for full results).

Similar to the controlling variables, the coefficients for the amenity and disamenity parameters are, for the most part, of the correct sign and within the range of findings from previous studies. For example, being within 500 feet of a beach increases a home's value by 21%-30%, while being outside of 500 feet but within a half mile of a beach increases a home's value by 5%–13%, being within 500 feet of a highway reduces value by 5%–7%, and being within 500 feet of a major road reduces value by 2%–3%. Being within a half mile of a prison reduces value by 6%, but this result is only apparent in one of the periods. Similarly, being within a half mile of a landfill reduces value by 12% in only one of the periods, and being within a half mile of open space increases value by approximately 1% in two of the periods. Finally, being within 500 feet of an electricity transmission line reduces value by 3%-9% in two of the four periods. As noted above, the wind development periods are not meaningful as it relates to the amenity/disamenity variables, because they all likely existed well before this sample period began, and therefore the turbines. That said, they do represent different data groups across the dataset (one for each wind development period), and therefore are illustrative of the consistency of findings for these variables, with beaches, highways and major roads showing very consistent results, while electricity transmission lines, open space, landfills and prisons showing more sporadic results.

Turning now to the variables that capture the effects in our sample, for being within a half mile of a turbine, we find interesting results (see Table

28 All models are estimated using the .areg procedure in Stata MP 12.1 with robust estimates, which corrects for heteroskedasticity. The effects of the census tracts are absorbed. Results are robust to an estimation using the .reg procedure.

29 The results are robust to the exclusion of these interactions, but theoretically we believe this model is the most appropriate, so it is presented here.

Table 4. Selected Results from Base Model

		Wind Facility Development Period			
		prioranc	preanc	postanc-precon	postcon
Variables	Description	coefficient p-value	coefficient p-value	coefficient p-value	coefficient p-value
halfmile	within a half mile of a wind turbine	-5.1%*** 0.000	-7.1%*** 0.002	-7.4%*** 0.000	-4.6%* 0.081
	Net Difference Compared to *prioranc* Period			-2.3% 0.264	0.5% 0.853
beach500ft	within 500 feet of a beach	20.8%*** 0.000	30.4%*** 0.000	25.3%*** 0.000	25.9%*** 0.000
beachhalf	within a half mile and outside of 500 feet of a beach	5.3%*** 0.000	8.8%*** 0.000	8.7%*** 0.000	13.5%*** 0.000
openhalf	within a half mile of open space	0.6%** 0.021	0.1% 0.729	0.1% 0.903	0.9%* 0.062
line500ft	within 500 feet of a electricity transmission line	-3%*** 0.001	-0.9% 0.556	-0.9% 0.522	-9.3%*** 0.000
prisonhalf	within a half mile of a prison	-5.9%*** 0.001	2.6% 0.291	2.8% 0.100	-2.3% 0.829
hwy500ft	within 500 feet of a highway	-7.3%*** 0.000	-5.2%*** 0.000	-3.7%*** 0.000	-5.3%*** 0.000
major500ft	within 500 feet of a major road	-2.8%*** 0.000	-2.3%*** 0.000	-2.5%*** 0.000	-2%*** 0.000
fillhalf	within a half mile of a landfill	1.8% 0.239	-0.9% 0.780	1% 0.756	-12.2%*** 0.002
sfla1000	living area in thousands of square feet	22.9%*** 0.000	21.4%*** 0.000	22.6%*** 0.000	23.5%*** 0.000
acre	lot size in acres	1.1%*** 0.000	1.9%*** 0.000	1.3%*** 0.000	-0.02% 0.863
acrelt1	lot size less than 1 acre	21.7%*** 0.000	17.2%*** 0.000	14.7%*** 0.000	22.1%*** 0.000
age	age of the home at time of sale	-0.2%*** 0.000	-0.2%*** 0.000	-0.2%*** 0.000	-0.2%*** 0.000
agesq*	age of the home at time of sale squared*	0.6%*** 0.000	0.5%*** 0.000	0.6%*** 0.000	0.8%*** 0.000
bath	number of bathrooms	6.4%*** 0.001	7.9%*** 0.556	8.4%*** 0.522	11.1%*** 0.000

Coefficients represent the percentage change in price for every unit of change in the characteristic. For example, the model estimates that price increases by approximately 23% for every 1000 additional square feet. Coefficient values are reported as percentages, although the actual conversion is 100(exp(b)-1)% (Halvorsen and Palmquist, 1980). In most cases, the differences between the two are de minimis, though, larger coefficient values would be slightly larger after conversion.*

*p-value is a measure of how likely the estimate is different from zero (i.e., no effect) by chance. The lower the p-value, the more likely the estimate is expected to be different from zero. A p-value of less than 0.10 is considered statistically significant, with higher levels of significance being denoted as follows: * 0.10, ** 0.05, ***0.01.*

** coefficient values are multiplied by 1000 for reporting purposes only*

4). The coefficients for the *halfmile* variable over the four periods are as follows: *prioranc* (sale more than 2 years before the nearest wind turbine was announced) -5.1%, *preanc* (less than 2 years before announcement) -7.1%, *postancprecon* (after announcement but before the nearest turbine construction commenced) -7.4%, and *postcon* (after construction commenced) -4.6%.[30] Importantly, our model estimates that home values within a half mile of a future turbine were lower than in the surrounding area even before wind-facility announcement. In other words, wind facilities in Massachusetts are associated with areas with relatively low home values, at least compared to the average values of homes more than a half mile but less than 5 miles away from the turbines. Moreover, when we determine if there has been a "net" effect from the arrival of the turbines, we must account for this preexisting *prioranc* difference. The net *postancprecon* effect is -2.3% ([-7.4%] - [-5.1%] = -2.3%; *p*-value 0.26). The net *postcon* effect is 0.5% ([-4.6%] - [-5.1%] = 0.5%: *p*-value 0.85).[31] Therefore, after accounting for the "pre-existing price differential" that predates the turbine's development, there is no evidence of an additional impact from the turbine's announcement or eventual construction.

3.4.2 Robustness Test Results

To test and possibly bound the results from the base model, several robustness tests were explored (Section 3.2):

1. Impacts within a quarter mile
2. Impacts between a half and 1 mile
3. Impacts inside of a half mile when data between a half mile and 10 miles were used as a reference category
4. Impacts inside of a half mile when data between 5 miles 10 miles were used as a reference category
5. The inclusion of style (of the home) and heat (type of the home) variables
6. The use of the census block group as the fixed effect instead of census tract
7. Relaxing the screens (e.g., sale price between $40,000 and $2,500,000) used to create the analysis dataset
8. The removal of outliers and influential cases from the analysis dataset
9. The inclusion of spatially/temporally lagged variables to account for the presence of spatial autocorrelation.

Table 5 shows the robustness test results and the base model results for comparison (the robustness models are numbered in the table as they are above). For brevity only the "net" differences in value for the *postancprecon* and *postcon* periods are shown that quantify the *postancprecon* and *postcon* effects after deducting the difference that existed in the Prior period.[32] Throughout the rest of this section, those effects will be referred to as net *postancprecon* and net *postcon*.

There are a number of key points that arise from the results that have implications for stakeholders involved in wind turbine siting. For example, the effects for both the net *postancprecon* and net *postcon* periods for sales within a quarter mile of a turbine are positive and non-significant (which is believed to be a circumstance of the small dataset

30 Although a post-construction effect is shown here and for all other models, a post-operation (after the turbine was commissioned and began operation) effect was also estimated and was no different than this post-construction effect.

31 These linear combinations are estimated using the post-estimation .lincom test in Stata MP 12.1.

32 The full set of robustness results is available upon request.

Table 5: Robustness Results

				Prior Announcement Turbine Effect			"Net" Post Announcement Pre Construction Turbine Effect			"Net" Post Construction Turbine Effect		
				inside 1/4 mile	inside 1/2 mile	between 1/2 and 1 mile	inside 1/4 mile	inside 1/2 mile	between 1/2 and 1 mile	inside 1/4 mile	inside 1/2 mile	between 1/2 and 1 mile
#	Model Name	*n*	*Adj R^2*	coef / *p*-value	coef / *p*-value	coef / *p*-value	coef / *p*-value	coef / *p*-value	coef / *p*-value	coef / *p*-value	coef / *p*-value	coef / *p*-value
	Base Model	122,198	0.80		-5.1%***			-2.3%			0.5%	
					0.000			*0.264*			*0.853*	
1	Inside 1/4 mile	122,198	0.80	-5.3%			12.7%			0.7%		
				0.260			*0.118*			*0.916*		
2	Between 1/2 and 1 Mile	122,198	0.80		-5.0%***	-0.4%		-2.0%	1.4%		1.0%	1.3%
					0.000	*0.536*		*0.336*	*0.225*		*0.715*	*0.288*
3	All Sales Out to 10 Miles	312,677	0.82		-5.8%***			-3.0%			1.0%	
					0.000			*0.886*			*0.724*	
4	Using Outside of 5 Miles as Reference	312,677	0.82		-7.6%***			1.6%			1.1%	
					0.000			*0.435*			*0.695*	
5	Including Style & Heat Variables	120,292	0.81		-3.8%***			-3.3%			2.8%	
					0.004			*0.114*			*0.336*	
6	Using Block Group	122,198	0.81		-3.1%***			-1.3%			-2.6%	
					0.024			*0.554*			*0.324*	
7	No Screens	123,555	0.73		-4.0%***			-4.6%*			-0.8%	
					0.003			*0.072*			*0.800*	
8	Removing Outliers and Influencers	119,623	0.79		-4.3%***			-2.6%			0.04%	
					0.001			*0.205*			*0.989*	
9	Including Spatial Variables	122,198	0.80		-5.3%***			-1.5%			1.4%	
					0.000			*0.467*			*0.621*	

*Statistical Significance: * 0.10, ** 0.05, ***0.01. Note: For simplicity, coefficient values are reported as percentages, although the actual conversion is 100*(exp(b)-1)% (Halvorsen and Palmquist, 1980). In most cases, the differences between the two are de minimis, though, larger coefficient values would be slightly larger after conversion.*

in that distance range, see Table 2), providing no evidence of a large negative effect near the turbines. Further, there are weakly significant net *postancprecon* impacts for relaxing the screens (-4.6%), indicating a possible effect associated with turbine announcement that disappears after turbine construction. Finally, and most importantly, no model specification uncovers a statistically significant net *postcon* impact, bolstering the base model results. Moreover, all net *postcon* estimates for homes within a half mile of a turbine fall within a relatively narrow band that equally spans zero (-2.6% to 2.8%), further reinforcing the non-significant results from the base model.

4. DISCUSSION AND CONCLUSIONS

The study estimated a base hedonic model along with a large set of robustness models to test and bound the results. These results are now applied to the research questions listed in Section 3.

4.1 Discussion of Findings in Relation to Research Questions

Q1) Have wind facilities in Massachusetts been located in areas where average home prices were lower than prices in surrounding areas (i.e., a "pre-existing price differential")?

To test for this, we examined the coefficient in the *prioranc* period, in which sales occurred more than 2 years before a nearby wind facility was announced. The -5.1% coefficient for the *prioranc* period (for home sales within a half mile of a turbine compared to the average prices of all homes between a half and 5 miles) is highly statistically significant (p-value < 0.000). This clearly indicates that houses near where turbines eventually are located are depressed in value relative to their comparables further away. Other studies have also uncovered this phenomenon (Hoen et al., 2009; Hinman, 2010; Hoen et al., 2011). If the wind development is not responsible for these lower values, what is?

Examination of turbine locations reveals possible explanations for the lower home prices. Six of the turbines are located at wastewater treatment plants, and another eight are located on industrial sites (Table 1). Some of these locations (for example, Charlestown) have facilities that generate large amounts of hazardous waste regulated by Massachusetts and/or the U.S. Environmental Protection Agency and use large amounts of toxic substances that must be reported to the Massachusetts Department of Environmental Protection.[33] Regardless of the reason for this "pre-existing price differential" in Massachusetts, the effect must be factored into estimates of impacts due to the turbines' eventual announcement and construction, as this analysis does.

Q2) Are post-construction (i.e., after wind-facility construction) home price impacts evident in Massachusetts, and how do Massachusetts results contrast with previous results estimated for more rural settings?

To test for these effects, we examine the "net" *postcon* effects (*postcon* effects minus *prioranc* effects), which account for the "pre-existing price differential" discussed above. In the base model, with a *prioranc* effect of -5.1% and a *postcon* effect of -4.6%, the "net" effect is 0.5% and not statistically significant. Similarly, none of the robustness models reveal a statistically significant "net" effect, and the range of estimates from those models is -2.6% to 2.8%, effectively bounding the results from the base model. Therefore, in our sample of more than 122,000 sales, of which more than 21,808 occurred

33 See, e.g., http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/dep-bwp-major-facilities-.html

after nearby wind-facility construction began (with 230 sales within a half mile), no evidence emerges of a *postcon* impact. This collection of *postcon* data within a half mile (and that within 1 mile: n = 1,503) is orders of magnitude larger than had been collected in previous studies and is large enough to find effects of the magnitude others have claimed to have found (e.g., Heintzelman and Tuttle, 2012; Sunak and Madlener, 2012).[34] Therefore, if effects are captured in our data, they are either too small or too sporadic to be identified.

These *postcon* results conform to previous analyses (Hoen, 2006; Sims et al., 2008; Hoen et al., 2009; Hinman, 2010; Carter, 2011; Hoen et al., 2011). Our study differed from previous analyses because it examined sales near turbines in more urban settings than had been studied previously. Contrary to what might have been expected, there do not seem to be substantive differences between our results and those found by others in more rural settings, thus it seems possible that turbines, on average, are viewed similarly (i.e., with only small differences) across these urban and rural settings.

Q3) Is there evidence of a post-announcement/pre-construction effect (i.e., an "anticipation effect")?

To answer this question, we examine the "net" *postancprecon* effect (*postancprecon* effect of -7.4% minus *priorance* effect of -5.1%), which is -2.3% and not statistically significant. This base model result is bounded by robustness-model *postancprecon* effects ranging from -4.6% to 1.6%. One of the robustness models reveals a weakly statistically significant effect of -4.6% (p-value 0.07) when the set of data screens is relaxed. It is unclear, however, whether these statistically significant findings result from spurious data or multi-collinear parameters, examination of which is outside the scope of this research. Still, it is reasonable to say that these *postancprecon* results, which find some effects, *might* conform to effects found by others (Hinman, 2010), and, to that extent, they *might* lend credence to the "anticipation effect" put forward by Hinman and others (e.g., Wolsink, 2007; Sims et al., 2008; Hoen et al., 2011), especially if future studies also find such an effect. For now, we can only conclude that there is weak and sporadic evidence of a *postancprecon* effect in our sample.

Q4) How do impacts near turbines compare to the impacts of amenities and disamenities also located in the study area, and how do they compare with previous findings?

The effects on house prices of our amenity and disamenity variables are remarkably consistent with a priori expectations and stable throughout our various specifications. The results clearly show that home buyers and sellers accounted for the surrounding environment when establishing home prices. Beaches (adding 20% to 30% to price when within 500 feet, and adding 5% to 13% to price when within a half mile), highways (reducing price 4% to 8% when within 500 feet), and major roads (reducing price 2% to 3% when within 500 feet) affected home prices consistently in all models. Open space (adding 0.6%-0.9% to price when within a half mile), prisons (reducing price 6% when within a half mile), landfills (reducing price 13% when within a half mile) and electricity transmission lines (reducing price 3%-9% when within 500 feet) affected home prices in some models.

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34 Though, as discussed earlier, their findings might be the result of their continuous distance specification and not the result of the data, moreover, although Heintzelman & Tuttle claim to have found a *postcon* effect, their data primary occurred prior to construction.

Our disamenity findings are in the range of findings in previous studies. For example, Des Rosiers (2002) found price reduction impacts ranging from 5% to 20% near electricity transmission lines; although those impacts faded quickly with distance. Similarly, the price reduction impacts we found near highways and major roads appear to be reasonable, with others finding impacts of 0.4% to 4% for homes near "noisy" roads (Bateman et al., 2001; Andersson et al., 2010; Blanco and Flindell, 2011; Brandt and Maennig, 2011). Further, although sporadic, the large price reduction impact we found for homes near a landfill is within the range of impacts in the literature (Ready, 2010), although this range is categorized by volume: an approximately 14% home-price reduction effect for large-volume landfills and a 3% effect for small-volume landfills. The sample of landfills in our study does not include information on volume, thus we cannot compare the results directly.

Our amenity results are also consistent with previous findings. For example, Anderson and West (2006b) found that proximity to open space increased home values by 2.6% per mile and ranged from 0.1% to 5%. Others have found effects from being on the waterfront, often with large value increases, but none have estimated effects for being within 500 feet or outside of 500 feet and within a half mile of a beach, as we did, and therefore we cannot compare results directly.

Clearly, home buyers and sellers are sensitive to the home's environment in our sample, consistently seeing more value where beaches, and open space are near and less where highways and major roads are near—with sporadic value distinctions where landfills, prisons and electricity line corridors are near. This observation not only supports inclusion of these variables in the model—because they control for potentially collinear aspects of the environment—but it also strengthens the claim that the market represented by our sample does account for surrounding amenities and disamenities which are reflected in home prices. Therefore, buyers and sellers in the sample should also have accounted for the presence of wind turbines when valuing homes.

Q5) Is there evidence that houses that sold during the post-announcement and post-construction periods did so at lower rates than during the pre-announcement period?

To test for this sales-volume effect, we examine the differences in sales rate in fixed distances from the turbines over the various development periods (Table 2). Approximately 0.29% percent of all homes in our sample (i.e., inside of 10 miles from a turbine) that sold in the *prioranc* period were within a half mile of a turbine. That percentage increases to 0.50% in the *postancprecon* period and then drops to 0.39% in the *postcon* period for homes within a half mile of a turbine. Similarly, homes located between a half mile and 1 mile sold, as a percentage of all sales out to 10 miles, at 1.9% in the *prioranc* period, 1.8% in the *postancprecon* period, and 2.2% in the *postcon* period (and similar results are apparent for those few homes within a quarter mile). Neither of these observations indicates that the rate of sales near the turbines is affected by the announcement and eventual construction of the turbines, thus we can conclude that there is an absence of evidence to support the claim that sales rate was affected by the turbines.[35]

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35 This conclusion was confirmed with Friedman's two-way Analysis of Variance for related samples using period as the ranking factor, which confirmed that the distributions of the frequencies across periods was statistically the same.

4.2 Conclusion

This study investigates a common concern of people who live near planned or operating wind developments: How might a home's value be affected by the turbines? Previous studies on this topic, which have largely coalesced around non-significant findings, focused on rural settings. Wind facilities in urban locations could produce markedly different results. Nuisances from turbine noise and shadow flicker might be especially relevant in urban settings where other negative features, such as landfills or high voltage utility lines, have been shown to reduce home prices. To determine if wind turbines have a negative impact on property values in urban settings, this report analyzed more than 122,000 home sales, between 1998 and 2012, that occurred near the current or future location of 41 turbines in densely-populated Massachusetts.

The results of this study do not support the claim that wind turbines affect nearby home prices. Although the study found the effects on home prices from a variety of negative features (such as electricity transmission lines, landfills, prisons and major roads) and positive features (such as open space and beaches) that accorded with previous studies, the study found no net effects due to the arrival of turbines in the sample's communities. Weak evidence suggests that the announcement of the wind facilities had an adverse impact on home prices, but those effects were no longer apparent after turbine construction and eventual operation commenced. The analysis also showed no unique impact on the rate of home sales near wind turbines. These conclusions were the result a variety of model and sample specifications.

4.3 Suggestions for Future Research

Although our study is unparalleled in its methodological scope and dataset compared to the previous literature in the subject area, we recommend a number of areas for future work. Because much of the existing work on wind turbines has focused on rural areas—which is where most wind facilities have been built—there is no clear understanding of how residents would view the introduction of wind turbines in landscapes that are already more industrialized. Therefore, investigating residents' perceptions, through survey instruments, of wind turbines in more urbanized settings may be helpful. Policy-makers may also be interested in understanding the environmental attitudes and perceptions towards wind turbines of people who purchase houses near wind turbines after they have been constructed. Also, our study has aggregated the effects of wind turbines on the price of single-family houses for the study area as a whole. Although the data span an enormous range of sales prices, and contain the highest mean value of homes yet studied, it might be fruitful to analyze impacts partitioned by sales price or neighborhood to discover whether the effects vary with changes in these factors.

Finally, in our study we did not investigate the ownership structure of the turbines (i.e., in Massachusetts some projects benefit town budgets while others are owned by private entities) and assess whether any benefits accrued to surrounding communities, factors that the existing literature suggests are important determinants of community perceptions. This was considered beyond the scope of the existing study, but could be addressed in future research.

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APPENDIX: BASE MODEL FULL RESULTS

	Coef	SE	t	p-value
Intercept	12.15	0.01	1133.88	0.000
within a half mile of a wind turbine				
prioranc	-0.051	0.01	-3.95	0.000
preanc	-0.071	0.02	-3.08	0.002
postancprecon	-0.074	0.02	-4.34	0.000
postcon	-0.046	0.03	-1.74	0.081
Net Difference Compared to prioranc Period—within a half mile of a wind turbine				
postancprecon	-0.023	0.02	-1.12	0.264
postcon	0.005	0.03	0.19	0.853
within 500 feet of a electricity transmission line				
prioranc	-0.030	0.01	-3.41	0.001
preanc	-0.009	0.02	-0.59	0.556
postancprecon	-0.009	0.01	-0.64	0.522
postcon	-0.093	0.02	-4.79	0.000
within 500 feet of a highway				
prioranc	-0.073	0.01	-14.28	0.000
preanc	-0.052	0.01	-4.57	0.000
postancprecon	-0.037	0.01	-4.16	0.000
postcon	-0.053	0.01	-3.95	0.000
within 500 feet of a major road				
prioranc	-0.028	0.00	-12.18	0.000
preanc	-0.023	0.00	-5.05	0.000
postancprecon	-0.025	0.00	-5.43	0.000
postcon	-0.020	0.00	-4.01	0.000
within a half mile of a landfill				
prioranc	0.018	0.02	1.18	0.239
preanc	-0.009	0.03	-0.28	0.780
postancprecon	0.010	0.03	0.31	0.756
postcon	-0.122	0.04	-3.08	0.002
within a half mile of a prison				
prioranc	-0.059	0.02	-3.38	0.001
preanc	0.024	0.02	1.05	0.291
postancprecon	0.028	0.02	1.64	0.100
postcon	-0.020	0.09	-0.22	0.829

	Coef	SE	t	p-value
within 500 feet of a beach				
prioranc	0.208	0.02	12.71	0.000
preanc	0.304	0.03	12.09	0.000
postancprecon	0.253	0.02	12.72	0.000
postcon	0.259	0.02	16.95	0.000
within a half mile and outside of 500 feet of a beach				
prioranc	0.053	0.01	10.07	0.000
preanc	0.088	0.01	10.52	0.000
postancprecon	0.087	0.01	11.99	0.000
postcon	0.135	0.01	17.30	0.000
within a half mile of open space				
prioranc	0.006	0.00	2.31	0.021
preanc	0.001	0.00	0.35	0.729
postancprecon	0.001	0.00	0.12	0.903
postcon	0.009	0.00	1.87	0.062
living area in thousands of square feet				
prioranc	0.229	0.00	86.37	0.000
preanc	0.214	0.01	41.62	0.000
postancprecon	0.226	0.00	48.41	0.000
postcon	0.235	0.01	46.58	0.000
lot size in acres				
prioranc	0.011	0.00	6.67	0.000
preanc	0.019	0.00	6.51	0.000
postancprecon	0.013	0.00	4.17	0.000
postcon	-0.001	0.00	-0.17	0.863
lot size less than 1 acre				
prioranc	0.217	0.01	34.79	0.000
preanc	0.172	0.01	18.45	0.000
postancprecon	0.147	0.01	16.03	0.000
postcon	0.221	0.01	21.71	0.000
age of the home at time of sale				
prioranc	-0.0016	0.00	-21.87	0.000
preanc	-0.0016	0.00	-11.33	0.000
postancprecon	-0.0020	0.00	-13.99	0.000
postcon	-0.0025	0.00	-16.47	0.000

	Coef	SE	t	p-value
age of the home at time of sale squared				
prioranc	0.000006	0.00	28.55	0.000
preanc	0.000005	0.00	17.03	0.000
postancprecon	0.000006	0.00	20.01	0.000
postcon	0.000008	0.00	26.4	0.000
number of bathrooms				
prioranc	0.064	0.00	29.22	0.000
preanc	0.079	0.00	17.98	0.000
postancprecon	0.084	0.00	20.31	0.000
postcon	0.111	0.00	25.54	0.000
sale year				
1998	-0.52	0.007	-73.48	0.000
1999	-0.41	0.007	-58.44	0.000
2000	-0.26	0.007	-37.59	0.000
2001	-0.13	0.007	-18.03	0.000
2002	0.02	0.007	2.33	0.020
2003	0.14	0.007	21.26	0.000
2004	0.24	0.007	37.05	0.000
2005	0.31	0.006	49.32	0.000
2006	0.28	0.006	43.94	0.000
2007	0.23	0.006	37.58	0.000
2008	0.12	0.006	18.43	0.000
2009	0.04	0.006	7.29	0.000
2010	0.04	0.006	6.15	0.000
2011	-0.02	0.006	-3.74	0.000
2012	Omitted			
sale quarter				
1	-0.07	0.002	-28.05	0.000
2	-0.02	0.002	-9.56	0.000
3	Omitted			
4	-0.01	0.002	-3.03	0.002

n	**122,198**
R^2	**0.80**
Adj R^2	**0.80**
F	**2418**

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BEFORE THE SOUTH DAKOTA PUBLIC UTILITIES COMMISSION

DOCKET NO. EL18-003

IN THE MATTER OF THE APPLICATION BY DAKOTA RANGE I, LLC AND DAKOTA RANGE II, LLC FOR A PERMIT OF A WIND ENERGY FACILITY IN GRANT COUNTY AND CODINGTON COUNTY, SOUTH DAKOTA, FOR THE DAKOTA RANGE WIND PROJECT

Surrebuttal Testimony of David Lawrence
On Behalf of the Staff of the South Dakota Public Utilities Commission
June 8, 2018

Q: State your name.

A: My name is David Lawrence.

Q: Did you provide Direct Testimony in the Docket on May 4, 2018?

A: Yes.

Q: Did you conduct any further market research since your Direct Testimony on May 4, 2018?

A: Yes. In response to Mr. MaRous' direct testimony indicating there was only one sale in South Dakota near a wind project, I performed research in Brookings County to identify sales that have been influenced by a wind tower, turbine or wind project. My preliminary research identified thirteen arm's length transfers in the proximity of a wind tower. Of these thirteen sales, six sales were rural residential properties, and seven sales were agricultural properties. With the time requirements of my direct testimony, hearings and preliminary research, I was not able to investigate and verify the Brookings sales research before the filing deadline. Since submission of my Direct Testimony, I have taken the opportunity to study the Brookings sales research. A summary of the research is found in the addendum of my testimony, identified as Exhibit 1.

Q: Can you briefly describe the scope of work that was applied to the Brookings County sales?

A: Due to time constraints of the June 12, 2018 hearing, I was not able to perform a complete case-by-case analysis for the thirteen sales identified. I did prioritize the residential sales BK1, BK2, BK3, BK4, BK5 and BK7. For these sales I performed a site inspection, interview analysis, and a sales analysis. The remaining sales were analyzed with site inspections and interviews. I set out on May 23, 2018 to begin my field research and inspect each property with particular emphasis on examining the proximity of a wind tower and how the tower proximity relationship can influence rural properties. Inspections were done from the public roadway for sales BK1, BK2.5, BK6, BK7, BK9, BK10, BK11 and BK12. In five cases the property owner was present, and I was able to complete an on-site inspection with sales BK2, BK3, BK4, BK5, and BK8. I did not have time to drive to Jerauld County, and relied on high resolution aerial images for sale JD13 and a telephone participant interview. In addition to the BK sales, I visited several rural residential and agricultural properties in the market area influenced by a wind tower. These inspections allowed me to evaluate the influences a wind tower can have on the different property types in the market area of Brookings County. After completing the field work, the next step was to interview as many of the participants in the transaction as possible. I knew a buyer's name and address, and/or a broker involved with the transaction from preliminary research I accomplished at the beginning of May. Given the name and address, I was able to search for phone numbers. Unfortunately, finding a working phone number for participants is becoming more difficult, but I was able to talk with about twenty participants by phone or in person. The objective of the interview analysis was to verify terms of the sale and to inquire whether the sale and/or subsequent use of the property were in any way affected by the proximity of a wind tower. A set of scripted questions were asked in such a manner that no bias or preconceived notions were projected during the interview. Based on the recorded legal documents, site inspections, and information gathered, a detailed description of BK1, BK2, BK3, BK4, BK5 and BK7 was developed for the sales analysis. The next step was to develop data on property sales that were similar in time, location and property type to each of the BK sales, but not in proximity to a wind tower. The methodology of the analysis is similar to the sales comparison approach in the appraisal process. To identify this research, I used the Brookings County MLS, Beacon and aerial images to confirm that each comparable sale was unaffected by a wind tower, turbine or wind project. Then each of these sales were summarized in terms of physical characteristics and qualitatively analyzed for differences. The uninfluenced sales were compared to the BK influenced sale for analysis. The final step was to analyze the information collected for each transaction and draw conclusions with respect to the effect, if any, of the proximity of the wind tower on the transaction or on use of the property. The summary of BK1, BK2, BK3, BK4, BK5 and BK7 can be found in Exhibit 1. As mentioned previously, I did not have sufficient time to complete a thorough analysis with each of the thirteen individual sales. My scope of work did not include: 1) a sales analysis for sales BK6, BK8, BK9, BK10, BK11, BK12 and JD13; 2) a site visit for JD13; 3) a review of the chain of title for each property ownership since the project first became operational; 4) a site visit and additional verification for the comparable sales identified with MLS; 5) an analysis of the history of the wind project(s) in Brookings County, such as installation date, tower characteristics, project capacity, project construction, operational history etc. and 6) supplemental research in the other thirteen South Dakota counties with operating wind projects.

Q: What are the results of your additional market research?

A: The results of the market research are provided in the addendum and identified as Exhibit 1. The research is presented in the following order:

1. Transaction Summary Table -- sales BK1, BK2, BK3, BK4, BK5, and BK7
2. Transaction Summary Table -- sales BK6, BK8, BK9, BK10, BK11, BK12 & JD13
3. Interview Summary Table
4. Individual Sales Analysis -- sales BK1, BK2, BK3, BK4, BK5 & BK7

Q: What are your general conclusions about the research you completed?

A: Based on my research within the Brookings County market, the evidence supports the presumption there have been no adverse effects on the selling price of rural residential properties in proximity to a wind tower, turbine or wind project. However, the interview and site analysis support the presumption that proximity to a wind tower could influence the property owner's bundles of rights, such as the right to quiet enjoyment. Given the responses from market participants, there is a relationship between the distance from a turbine and the effects on value perceived by individual property owners who live in proximity to wind towers. Wind tower noise is the number one reason cited by market participants for a perceived impact on value; however, the sales data suggests otherwise. More specifically, the Brookings County research for rural residential properties suggests: 1) there was no discernible adverse impact on the selling prices in Brookings County that could be supported for sales BK1, BK2, BK3, BK4, BK5 and BK7; 2) Interviews with buyers of properties near wind towers were unanimous to report the proximity of the wind tower did not influence the price they paid; 3) In six of six rural residential sales, the market data was consistent, even though the site inspection observed influences of noise and view obstructions within the property boundaries.

Although I did not complete a sales analysis for the agricultural sales, the research supports the presumption there have been no adverse effects on the selling price of agricultural properties in proximity to and within the boundaries of the property with a wind tower. During the interview process, participants of agricultural properties were consistent to report the price paid was not affected by a wind tower and in some cases reported a stronger price per acre when the wind payments transferred with the property. The most common issues farmers cited about wind towers is the limitation of aerial spraying, poor reclamation, and compaction issues after the installation of the towers, possible yield loss due to the inability to plant straight rows and the difficulties associated with working around the towers during planting and harvest. Without comparison of the sales evidence with the interview evidence, the agricultural analysis is determined to be inconclusive; however, all agricultural participants were consistent to report there was no adverse effect to the price paid because of the presence of a wind tower. The summary of my research is limited to Brookings County and supported by analyzing six rural residential sales, seven agricultural sales, and twenty market participant interviews.

Q: What is your response to the research and analysis completed for the Brookings County?

A: I would caution the commissioners or any reader of my testimony that the above research is only a small representation of 1 of 14 counties in South Dakota where there is an operating wind project. With an assignment of this nature, I would typically have a multi-county or tri-state research area with a sales population of at least fifteen sales for a case-by-case analysis (per property type) with participant interviews of more than thirty. While the research is consistent with the NBNL study and Mr. Marous' research, a pool of six rural residential and seven agricultural sales is a limited population upon which to base conclusive results. Brookings County represents only seven percent of the study area that is available in South Dakota for research of the impacts of wind projects on real property values. Nevertheless, the research reported in my testimony provides a useful starting point from which to consider the facts of a particular situation, and does not rule out that an individual property could be adversely impacted from the presence of a wind tower, turbine, or wind project.

Q: Mr. Mauersberg attaches the Brookings County 2015 Property Value Survey to his Rebuttal Testimony (Exhibit 1), and Mr. MaRous concurs with the study in his testimony. Do you agree with the methodology and results of the study?

A: No, I do not agree. I have read the Brookings County 2015 Property Value Survey developed by Prevailing Winds, LLC and the results of the study could be misleading. Moreover, 1) it does not follow the accepted appraisal methodology for a study of this type; 2) the data was developed by Prevailing Winds, LLC, who is an advocate for wind energy in South Dakota. The purpose of a study of this nature is to promote and maintain a high level of public trust in the development and reporting of such results. There is no way to ascertain if the assignment was developed with impartiality, objectivity, and independence. Personal interests and bias surround the author of the study; 3) As previously discussed in my Direct Testimony on page thirteen, assessment value is not market value. Assessment value can be higher or lower than market value. I have difficulty understanding the correlation in using assessment value trends to measure the impacts on market value from a wind project. Mass appraisal techniques are used for assessing thousands of properties in the county for taxation, not determining if an individual property shows a negative or positive influence from an externality such as a wind tower.

Q: Does this conclude your testimony?

A: Yes.

Exhibit 1:

Rural Residential Transaction Summary Table						
Transaction Reference	**Property Type**	**Physical Evidence of Effects**	**Interview Evidence of Effects**	**Sales Evidence of Effects**	**Consistency of Sale Evidence with Interview Evidence**	**Overall Conclusion**
BK1	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK2	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK3	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK4	Rural Residential	Yes	None	None	Consistent	No measurable effects
BK5	Rural Residential	*None*	None	None	Consistent	No measurable effects
BK7	Rural Residential	Yes	None	None	Consistent	No measurable effects

****Turbines were not in operation during the site visit of BK5. Winds light and variable. ****

Ag Transaction Summary Table

Transaction Reference	Property Type	Physical Evidence of Effects	Interview Evidence of Effects	Sales Evidence of Effects	Consistency of Sale Evidence with Interview Evidence	Overall Conclusion
BK2.5	AG	None	None	**Not Developed**	Inconclusive	None apparent per interview
BK6	AG	None	None	**Not Developed**	Inconclusive	None apparent per interview
BK8	AG/Res	None	None	**Not Developed**	Inconclusive	None apparent per interview
BK9	AG	None	None	**Not Developed**	Inconclusive	None apparent per interview
BK10	AG	None	None	**Not Developed**	Inconclusive	None apparent per interview
BK11	AG	None	None	**Not Developed**	Inconclusive	None apparent per interview
BK12	AG	None	None	**Not Developed**	Inconclusive	None apparent per interview
JD13	AG	None	None	**Not Developed**	Inconclusive	None apparent per interview

****Sales analysis not developed due to time constraints****

Interview Summary Table

Interview Reference	Property Type	Participant	Interview Summary Comments
BK1	Residential	Broker	Can be noisy. Limits potential buyers . Doesn't seem to affect price.
BK2	Residential	Buyer	Did not affect purchase decision. Don't like the noise. Flicker effect certain times of the day. Blade broke and threw fragments near the house. Sounds like a continual swooshing sound when it's windy.
BK2 BK2.5	Res/AG	Seller	Satisfied with price. Could feel vibrations inside the house. Glad not to be living near wind towers. Had to give up a wind lease option to sell the house.
BK2.5	AG	Buyer	No affect on purchase price of BK2.5. Own & lease farmland with wind towers. Live in proximity to wind towers. Noisy. Poor reclamation after construction of towers; compaction & loss of yields. Difficult to farm around towers. Currently have farmland under contract with towers.
BK3	Residential	Broker	Some buyers won't look at home near wind towers. However, there is demand for acreages in the market and it doesn't seem to affect the price.
BK3	Residential	Buyer	The towers sound like jet planes when you are working in the yard. But paid the same, even though they don't like the noise.
BK4	Residential	Buyer	Some noise, but doesn't bother me. Paid the same. Happy with purchase.
BK4	Residential	Seller	Got tired of the annoying noise. Decided to sell. We thought it would effect the value; but it didn't matter to the buyer. Glad to not be living next to wind towers.
BK4	Residential	Broker	Though sellers initally expressed concerns about the turbines affecting the price, it took only four months to sell a high-end rural home. Agent doesn't think there was any effect on the price.
BK5	Residential	Broker	Really noisy. Distracts some buyers. Limited acreages in the market. Doesn't seem to be a negative effect on the price. Distance from Brookings is more of a concern to buyers than the wind towers.
BK5	Residential	Buyer	Can be noisy, but didn't matter to us when we purchased the home. Paid the same. No issues.
BK6	AG	Broker	Sales and manages properties with wind towers. Doesn't seem to affect the price or ability to get market rents. There are issues with towers. Can't aerial spray. Breaks up the land; can't plant straight rows. Some guys like them; some don't. It really comes down to a personal decision.
BK7	Residential	Buyer	No affect on value. Property value has increased. Proximity to towers doesn't matter. Little bit of noise when working in the yard. No affect to animals. No concerns or issues.
BK8	AG	Buyer	No issues or concerns. Cattle don't care about the noise. Purchased the land on a CFD and paid market price with towers located on the quarter and no wind payment. No difference in price to me.

Interview Summary Table (continued)			
Interview Reference	**Property Type**	**Participant**	**Interview Summary Comments**
BK9	AG	Buyer	Has over 47 towers located on various ground. Lives near towers, too. Issues with lightning strikes and shattered blades. The company does not clean up well. Good wind payments. Have some towers that pay $12,000/year. Increases land value with wind payments. No affect with land without payments. People who complain are not getting the payments. Just purchased another 152 acres with a wind tower with no payment. Doesn't affect the price as long as you can farm it and there are no affects with yields.
BK12	AG	Broker	Managed auction with wind payments from two towers. Pasture land sold to adjoining land owner. Wind payments $12,373 per year. Property sold in 2018 for $616,000. Wind payments alone are approximately a 2% return and you still can lease or use the property. Believes sale price was positively influenced by the wind payments. No issues with pasture land; have had some issues with tillable ground. Can't plant straight rows, no aerial spraying and can't hunt around the towers. You can hear them run if you are near a tower. Payments offset the hassles with towers.
JD13	AG	Broker	Managed a pasture land auction with towers. Wind lease with 43 years remaining and a 1% annual increase. Land sold for a 10%-15% premium according to auctioneer. Some restrictions because of the towers. You can't shoot around them. Noisy and limits aerial applications.
BKGH	Residential	Seller	Trying to sell a house within the proposed project area. Currently listed on MLS. Had an offer on the property, but believes the disclosure of the proposed wind project near the property ended the deal.
BKDJ	Residential	Owner	Built retirement home prior to the wind project. Towers within 1,000 ft of property on all sides. Noisy. Shadow and flicker effect during certain times of the day. Have to deal with constant noise. Some days louder than others, depending of direction on the wind. Believes the towers are effecting his ability to sell the property.
BKBB	Residential	Owner	Purchased home prior to the wind project. There are periods of the day when there is a shadow effect depending on the angle of the sun. Best way to describe it is like a camera flash. The curtains in the house have to be closed during the flicker times. The flash scares the horses. The red lights, light up the night sky and destroy star gazing. The house was listed for sale and most potential buyers drove away when they saw how close the towers are to the house. The wind company over promised and under delievered.

SALES ANALYSIS BK1	**SALE No.**	BK1
	STATE	South Dakota
	COUNTY	Brookings

Property Characteristics:

Highest & Best Use:	Rural Acreage
Land Size:	8 Acres
Improvements:	2003 Ranch modular design
Finished Area:	2,356 S.F. GLA, 300 S.F. Lower Level
Garage:	Attached 2-Stall
Features:	Treed shelter belt. (2) Pole buildings 40x96 & 34x50
Access:	Gravel road linkage

Sales Analysis Data:

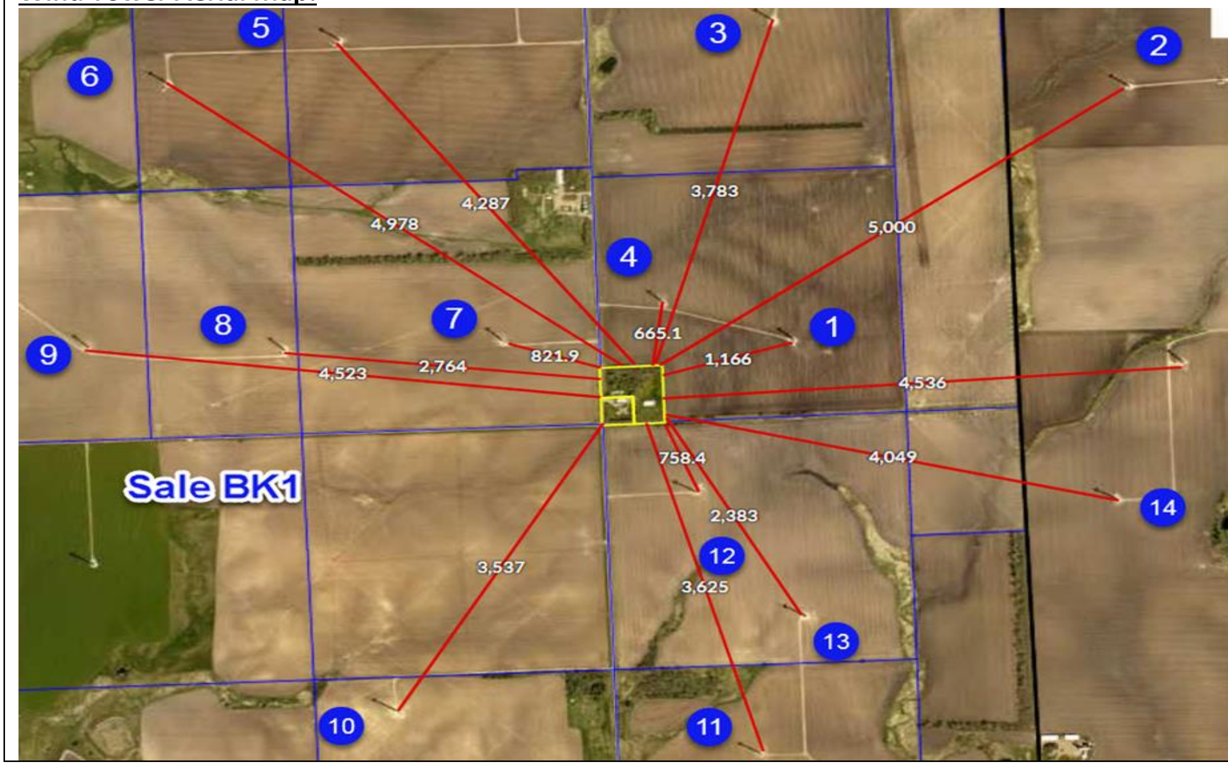
Date of Sale:	January 28, 2016
Market Exposure:	MLS
Listing Price:	$218,000
Sale Price:	$183,000
Verification:	Deed; Beacon; Interview with Broker
Type:	Arm's Length Sale
DOM:	153

Wind Project:

Project:	Buffalo Ridge
Turbine Type:	Gamesa G87 2.0 MW
Hub Height/Rotor Diameter:	78/87 meters
Height from Ground:	399 feet
Wind Tower Property Notes:	Encompassed by 14 wind turbines circling the property. Tower #1 1,200 +/- feet to the east. Tower #2 5,000 +/- feet to the northeast. Tower #3 3,800 +/- feet to the north. Tower #4 665 +/- feet to the north. Tower #5 4,300 +/- feet to the northwest. Tower #6 5,000 +/-

	feet to the northwest. Tower #7 800 +/- feet west. Tower #8 2,700 +/- feet west. Tower #9 4,500 +/- feet southwest. Tower #10 3,500 +/- feet southwest. Tower #11 3,600 +/- feet southeast. Tower #12 750 +/- feet southeast. Tower #13 2,400 +/- feet southeast. Tower #14 4,000 +/- feet southeast.

Wind Tower Aerial Map:



Appreciation Analysis:

(Influenced by Tower) Sale 1 Bk1:	October 30, 2009	$166,000
(Influenced by Tower) Sale 2 BK1:	January 28, 2016	$183,000
	6.24 Years	$23,000
BK1 Appreciation:	**$3,685/Year**	**1.64%/Year**
(Uninfluenced) Sale 1 486th:	December 7, 2004	$133,000
(Uninfluenced) Sale 2 486th:	October 11, 2013	$145,000
	9.25 Years	$12,000
486th Appreciation:	**$1,298/Year**	**.98%/Year**
(Uninfluenced) Sale 213th:	August 10, 2013	$266,000
(Uninfluenced) Sale 213th:	May 24, 2018	$290,903
	4.62 Years	$24,906
213th Appreciation:	**$5,390/Year**	**2.02%/Year**

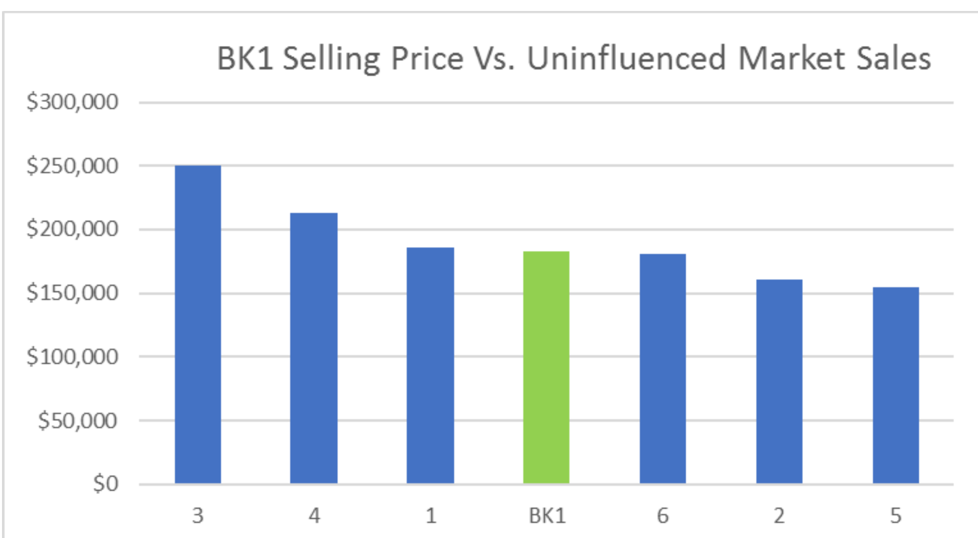
Conclusion:	Sale BK1 has market appreciation within the range of the market sales that are not influenced by a wind tower, turbine or wind project.

Site Analysis:	
Site Visit Conducted by:	David Lawrence
Site Visit Date:	May 23, 2018
View Obstruction:	Wind towers within view of residence
Noise Analysis:	Operational & blade noise present during site visit.
Interview Analysis:	
Interview Conducted by:	David Lawrence
Party Interviewed:	Broker
Interview Date:	May 28, 2018

Interview Notes with Broker:	This is the second time the broker has sold the property. The property sold within 150 days. The broker made sure to include pictures of the wind towers in the photos so potential buyers would be aware of the proximity. The broker stated that some potential buyers did not like the proximity of the wind turbines, while other potential buyers didn't care. There were more issues with the manufactured home design than concern for the wind towers. Broker stated the buyers liked the majestic beauty of the towers and there was no detrimental effect on the selling price because of the proximity of the wind towers.

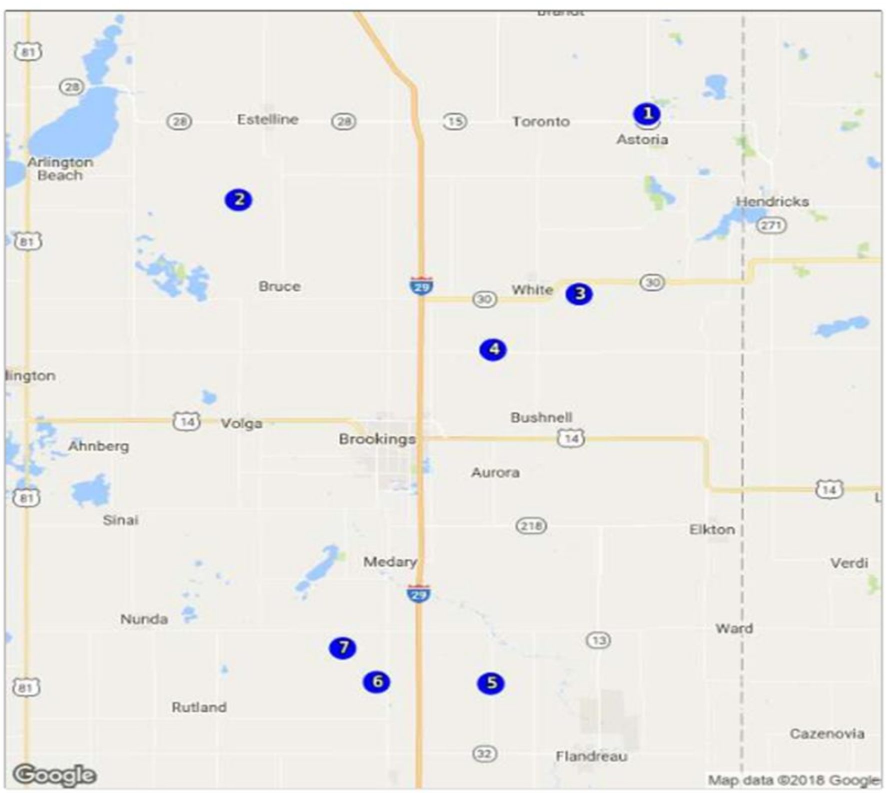
Interview Notes with Buyer:	The owner was not available during the site visit. I left a voice mail message; the owner did not return my phone call.

Market Sales Analysis:



Sales Analysis BK1									
Sale No.	Location	Sale Date	Price	Year/E.A.	GLA	Acres	Style	Outbuildings	Overall Analysis
BK1	Elkton	2016	$183,000	2003	2,356	8	Ranch	Pole Buildings	
1	Astoria	2015	$186,000	1910	1,472	14	Story1/2	Outbuildings	**Comparable**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Superior(-)*	*Similar (=)*	*Similar(=)*	
2	Bruce	2015	$161,000	1952	1,134	6.44	Ranch	1-car garage	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Similar(=)*	*Similar(=)*	*Inferior (+)*	
3	White	2015	$250,000	2010	1,518	22.48	Ranch	Barn/Guest House	**Superior**
			Adjustments:	*Superior(-)*	*Inferior (+)*	*Superior(-)*	*Similar(=)*	*Superior(-)*	
4	Aurora	2016	$213,000	1910	1,140	12.37	Story 1/2	Pole Building/Barn	**Comparable**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Superior(-)*	*Similar(=)*	*Similar(=)*	
5	Colman	2015	$155,000	1979	1,568	3.13	Ranch	Quonset/Garage	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior(+)*	*Inferior(+)*	*Similar(=)*	*Inferior(+)*	
6	*Colman*	*2015*	*$180,400*	*1961*	*2,240*	*10*	*Ranch*	*Barn/Outbuildings*	**Comparable**
			Adjustments:	*Similar(=)*	*Similar(=)*	*Similar(=)*	*Similar(=)*	*Similar(=)*	

Sale Location Map:



Legend	
1. 19367 483RD AVE, Astoria, SD 57213(13-122)	5. 22603 476th Ave., Flandreau, SD 57028(14-156)
2. 19851 464th Avenue, Bruce, SD 57220(15-394)	6. 47023 226th Street, Colman, SD 57071(15-368)
3. 20383 480TH AVE, White, SD 57276(15-434)	7. 22409 468th Avenue, Colman, SD 57017(15-39)
4. 47594 207th St, Aurora, SD 57002(16-467)	

Market Sales Analysis Conclusion:	Seven sales are from the market without the influence of a wind tower. All transactions have similar highest and best use and are bracketed by the market sales. Sales one, four and six have stronger similarities for comparison and bracket the range of BK1. The market evidence suggests the selling price was not affected by the proximity of the wind towers.

Overall Conclusion:	An interview analysis, site observation, and sales analysis were completed for BK1. The research and data suggest the proximity of the wind towers did not influence the selling price. Sale BK1 sold in 2009 and then resold in 2016 with a market appreciation rate within the range of other uninfluenced sales not in the proximity of a wind tower. Even though there are visual & noise effects observed during the site visit, the interview and market data suggest the proximity of the wind towers has not negatively influenced sale BK1.

SALES ANALYSIS BK2	SALE No.	BK2
	STATE	South Dakota
	COUNTY	Brookings

Property Characteristics:

Highest & Best Use:	Rural Acreage
Land Size:	10 Acres
Improvements:	1998 Story 1/2 design
Finished Area:	1,850 S.F. GLA, 1,004 S.F. Lower Level
Garage:	Attached 1-Stall
Features:	Treed shelter belt. Shed, storage building & hobby building
Access:	Paved highway linkage

Sales Analysis Data:

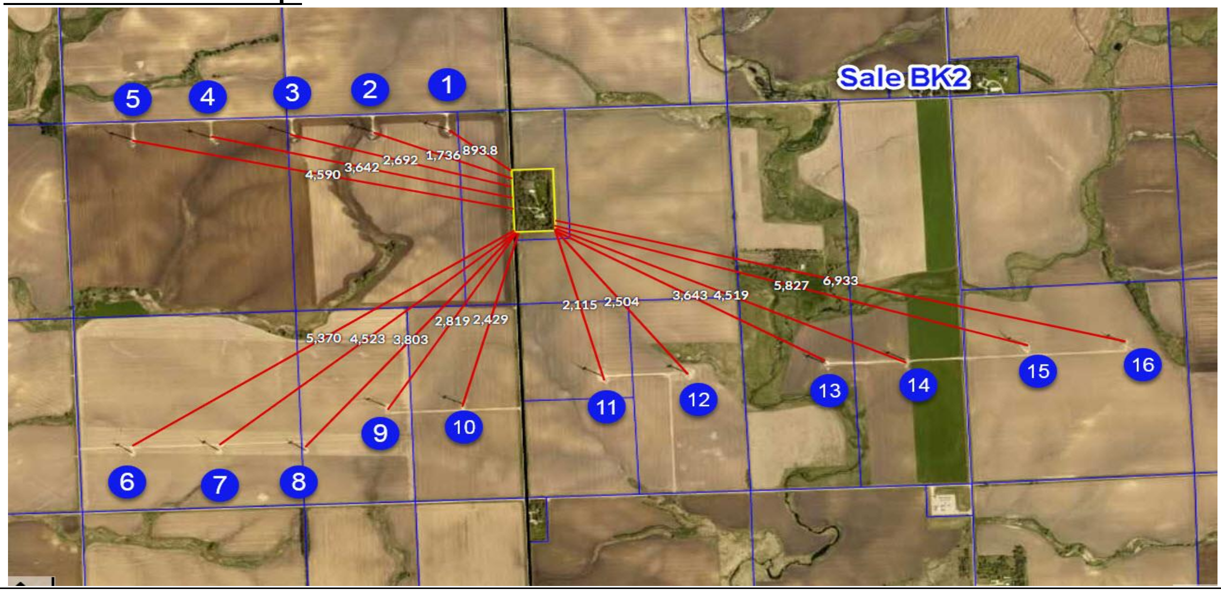
Date of Sale:	March 14, 2011
Market Exposure:	MLS
Listing Price:	$339,000
Sale Price:	$235,000
Verification:	Deed; Beacon; Interview with Buyer & Seller
Type:	Arm's Length Sale

Wind Project:

Project:	Buffalo Ridge
Turbine Type:	Gamesa G87 2.0 MW
Hub Height/Rotor Diameter:	78/87 meters
Height From Ground:	399 feet
Property & Wind Tower Notes:	Encompassed by 16 wind turbines. Tower #1 890 +/- feet northwest. Tower #2 1,700 +/- feet northwest. Tower #3 2,700 +/- feet northwest. Tower #4 3,600 +/- feet northwest. Tower #5 4,600 +/- feet northwest. Tower #6 5,400 +/- feet southwest. Tower #7 4,500 +/- feet southwest. Tower #8 3,800 +/- feet southwest. Tower #9 2,800 +/- feet southwest. Tower #10 2,400 +/- feet south. Tower #11 2,100 +/- feet southeast.

	Tower #12 2,500 +/- feet southeast. Tower #13 3,600 +/- feet southeast. Tower #14 4,500 +/- feet. Tower #15 5,800 +/- feet southeast. Tower #16 7,000 +/- feet southeast.

Wind Tower Aerial Map:



Site Analysis:

Site Visit Conducted by:	David Lawrence
Site Visit Date:	May 23, 2018
View Obstruction:	Wind towers within view of residence
Noise Analysis:	Operational & blade noise present during site visit.

Interview Analysis:

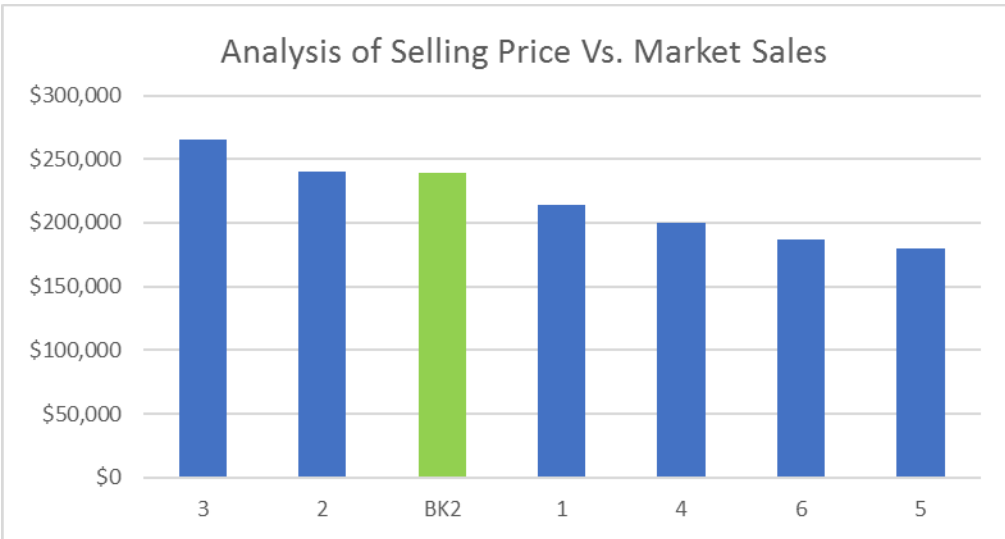
Interview Conducted by:	David Lawrence
Party Interviewed:	Buyer & Seller
Interview Date Buyer:	May 28, 2018
Interview Date Seller:	April 11, 2018

Interview Notes with Buyer:	The home was purchased with the assistance of a real estate agent. Towers were in place at the time of purchase. Turbines surrounding the property didn't affect purchase decision or price paid; although they would prefer not to have them. Some flicker effect and noise. Haven't noticed any health effects. When they purchased the home, there was an encumbrance on the title for a wind easement they had to work with the seller to clean up before closing.

Interview Notes with Seller:	(Interview performed by Northern Plains Appraisal) Sellers desired their privacy and would only allow an interview with NPA. Seller stated when they sold the house, they couldn't get the listing price of $339,000, the price was lowered and sold it for what they could. They also owned the adjoining land around the home. The buyer did not

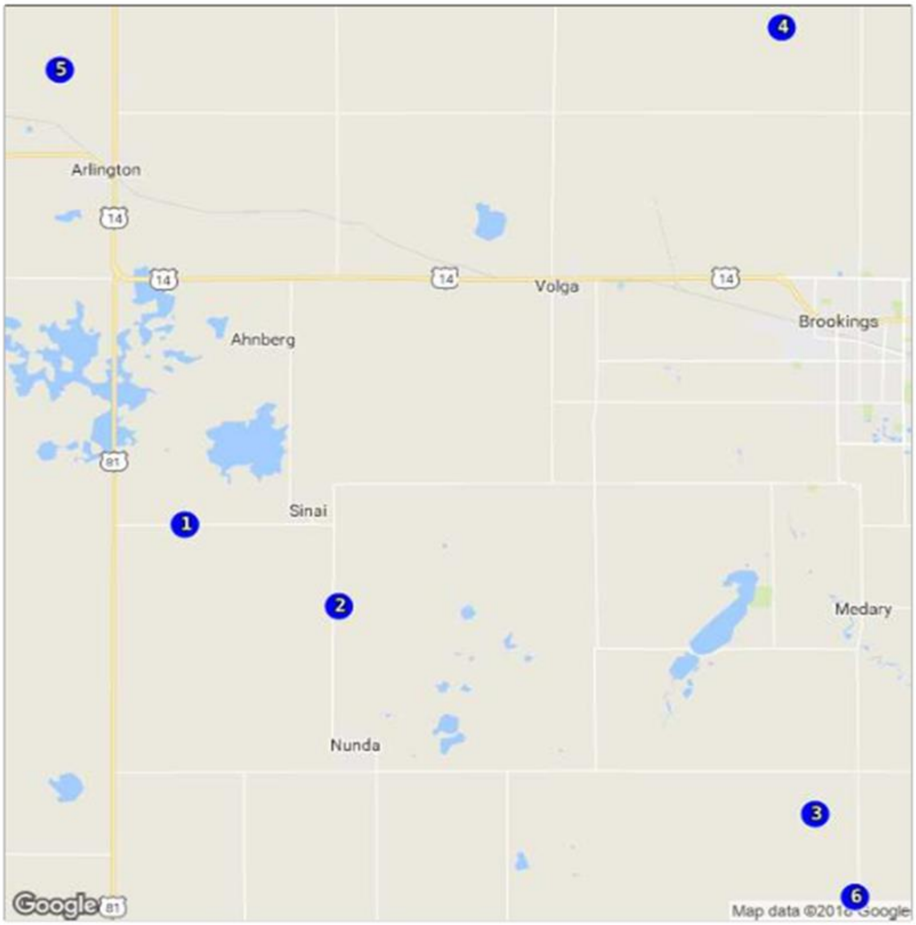
	want any wind towers near the house and therefore had a condition of sale not to sign a wind lease. Seller stated it was difficult to find a buyer, but they were satisfied with the purchase price. Seller stated you could feel the vibrations in the air and towers create issues with the body. They are glad they do not live around wind towers.

Market Sales Analysis:



Sales Analysis BK2									
Sale No.	Location	Sale Date	Price	Year/E.A.	GLA	Acres	Style	Outbuildings	Overall Analysis
BK2	**Toronto**	**2011**	**$239,000**	**1998**	**1,850**	**10**	**Story 1/2**	**Shed/Storage Bld**	
1	Arlington	2009	$214,000	2007	1,748	13	Ranch	Barn/Shed/2car	**Comparable**
			Adjustments:	*Similar(=)*	*Similar(=)*	*Similar(=)*	*Similar (=)*	*Similar(=)*	
2	Volga	2012	$240,000	1983	1,784	4.5	Ranch	Shed/Pole	**Comparable**
			Adjustments:	*Similar(=)*	*Similar(=)*	*Inferior(+)*	*Similar(=)*	*Similar(=)*	
3	Colman	2009	$265,000	2006	1,500	9.88	Ranch	Barn/2Car/Shed	**Superior**
			Adjustments:	*Superior (-)*	*Inferior (+)*	*Similar(=)*	*Similar(=)*	*Superior(-)*	
4	Brookings	2011	$200,000	1949	1,344	9.75	Story1/2	Barn/Shed	**Inferior**
			Adjustments:	*Inferior(+)*	*Inferior (+)*	*Similar(=)*	*Similar (=)*	*Similar(=)*	
5	Arlington	2011	$180,000	1917	1,510	11.79	Story1/2	2cGarage/Sheds	**Inferior**
			Adjustments:	*Inferior(+)*	*Inferior(+)*	*Similar(=)*	*Similar(=)*	*Similar(=)*	
6	*Volga*	*2011*	*$187,000*	*1954*	*1,491*	*5*	*Story1/2*	*Outbuildings*	**Inferior**
			Adjustments:	*Inferior(+)*	*Inferior(+)*	*Inferior (+)*	*Similar(=)*	*Similar(=)*	

Sale Location Map:



Legend	
1. 45674 217th St, Arlington, SD 57002(09-653)	4. 46922 205TH ST, Brookings, SD 57006(11-219)
2. 45916 219TH ST, Volga, SD 57071(12-313)	5. 45279 206TH ST, Arlington, SD 57212(11-307)
3. 22406 470th Ave, Colman, SD 57017(09-852)	6. 22609 471ST AVE, Colman, SD 57017(11-511)

Market Sales Analysis Conclusion:	The analysis uses six sales from the Brookings market with similar highest and best use. All sales are without the influence of a wind tower in proximity to the property. Sales one and two are the most similar sales and bracket the selling price of the subject. The remaining sales provide further market support of the selling range of market substitutes. After analyzing the elements of comparison, sale BK2 is within the range of the uninfluenced market sales. The data suggests the wind towers did not negatively influence the selling price.

Overall Conclusion:	An interview analysis, site visit, and sales analysis have been completed for BK2. During the site visit, wind tower noise was present on the on the property. The buyer interview indicated this was not a factor during

	the buying process. There are inconsistencies between the seller interview and the buyer interview; however, the sales data and the buyer's interview comments are consistent. The evidence suggests the proximity of the wind towers did not negatively influence the purchase price.

SALES ANALYSIS BK3	SALE No.	BK3
	STATE	South Dakota
	COUNTY	Brookings

Property Characteristics:

Highest & Best Use:	Rural Acreage
Land Size:	14.28 Acres
Improvements:	1918 Story 1/2 design
Finished Area:	2,208 S.F. GLA
Garage:	Attached 2-Stall
Features:	Treed shelter belt. Shed, storage building
Access:	Paved highway linkage

Sales Analysis Data:

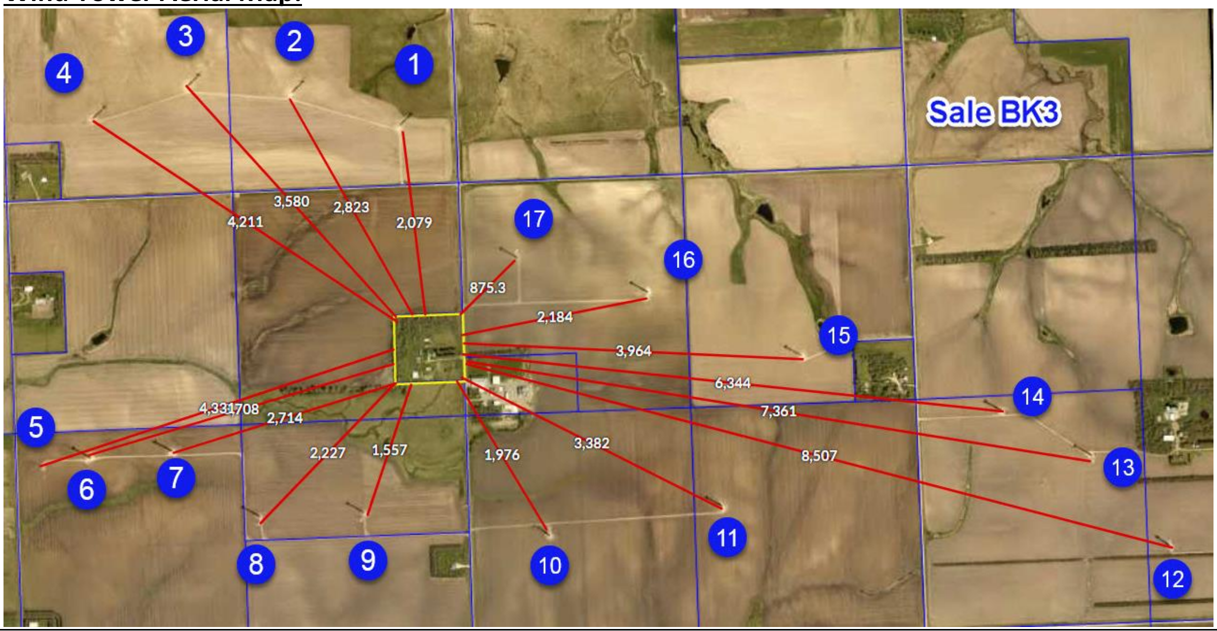
Date of Sale:	December 06, 2011
Market Exposure:	MLS
Listing Price:	$189,000
Sale Price:	$175,000
Verification:	Deed; Beacon; Interview with Buyer & Agent
Type:	Arm's Length Sale

Wind Project:

Project:	Buffalo Ridge
Turbine Type:	Gamesa G87 2.0 MW
Hub Height/Rotor Diameter	78/87 meters
Height From Ground:	399 feet
Wind Tower Property Notes:	Tower # 1 2,000 +/- feet north. Tower #2 2,800 +/- feet northwest. Tower #3 3,600 +/- feet northwest. Tower #4 4,200 feet +/- northwest. Tower #5 4,300 +/- feet southwest. Tower #6 3,700 +/- feet southwest. Tower #7 2,700 +/- southwest. Tower #8 2,200 +/- feet southwest. Tower #9 1,500 +/- feet south. Tower #10 1,900 +/- feet southeast.

Tower #11 3,400 +/- feet southeast. Tower #12 8,500 +/- southeast. Tower #13 7,400 +/- feet southeast. Tower #14 6,400 +/- feet east. Tower #15 4,000 +/- feet east. Tower #16 2,100 +/- northeast. Tower #17 875 +/- feet northeast.

Wind Tower Aerial Map:



Site Analysis:

Site Visit Conducted by: David Lawrence
Site Visit Date: May 23, 2018
View Obstruction: Wind towers within view of residence
Noise Analysis: Operational & blade noise present during site visit.

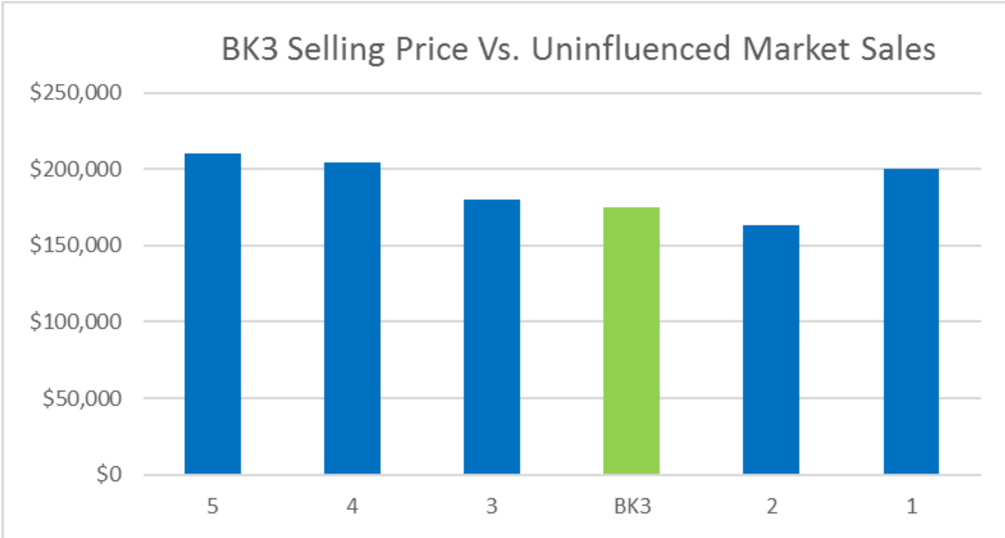
Interview Analysis:

Interview Conducted by: David Lawrence
Party Interviewed: Buyer & Agent
Interview Date: May 23, 2018 (Buyer) May 28, 2018 (Agent)

Interview Notes with Buyer: The buyer was interested in the property because of the proximity to work. When the agent showed the property, the wind towers were not a factor in their purchase decision. Paid the same even though they do not like the noise and could see the towers from the house. Buyer stated the wind towers could be loud when you are working in the yard.

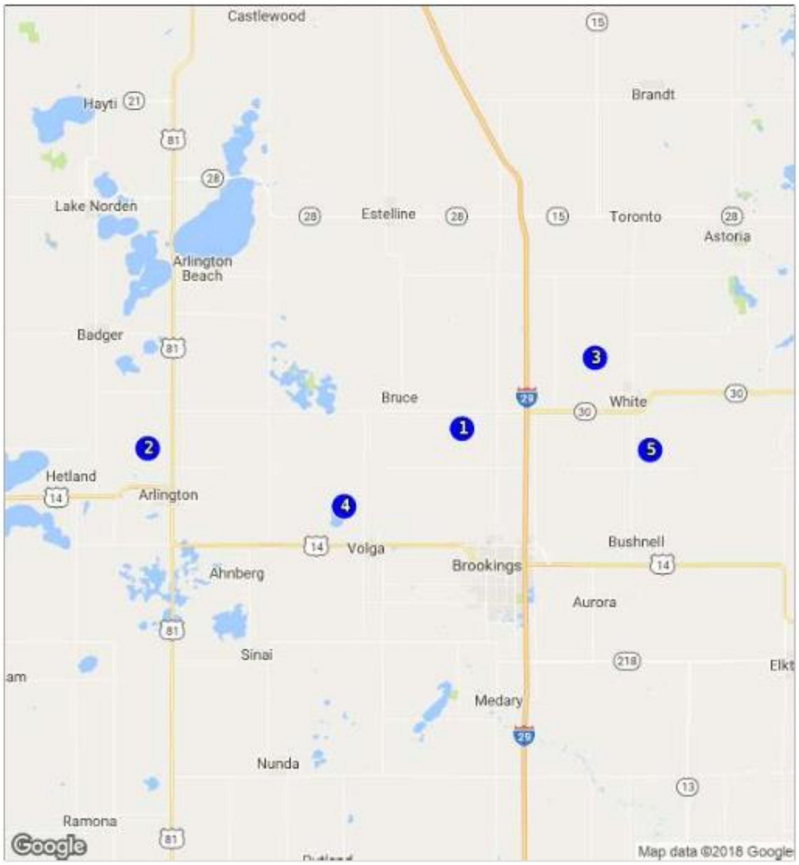
Interview Notes with Agent: There is high demand for acreages in the Brookings market. Most buyers do not care about the wind towers. Buyers are looking for the features of an acreage. Although there have been potential buyers, some buyers refuse to look at a property near wind towers. The price seems unaffected by properties I've sold near wind towers.

Market Sales Analysis:



Sales Analysis BK3									
Sale No.	**Location**	**Sale Date**	**Price**	**Year/E.A.**	**GLA**	**Acres**	**Style**	**Outbuildings**	**Overall Analysis**
BK3	**Elkton**	**2011**	**$175,000**	**1918**	**2,208**	**14.28**	**Story 1/2**	**Shed/Storage Bld**	
1	Brookings	2011	$200,000	1949	1,344	9.75	Story1/2	Barn/Shed	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Inferior(+)*	*Similar (=)*	*Similar(=)*	
2	White	2009	$163,000	1910	1,762	3.84	Story 1/2	Barn/Shed	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Inferior(+)*	*Similar (=)*	*Similar(=)*	
3	Arlington	2011	$180,000	1917	1,510	11.79	Story1/2	2cGarage/Sheds	**Comparable**
			Adjustments:	*Similar(=)*	*Inferior(+)*	*Similar(=)*	*Similar(=)*	*Similar(=)*	
4	Volga	2011	$204,000	1910	2,294	12.65	Story1/2	Barn/Shed/2car	**Comparable**
			Adjustments:	*Similar(=)*	*Superior(-)*	*Similar(=)*	*Similar (=)*	*Similar(=)*	
5	White	2012	$210,500	1938	2,405	17.12	Story1/2	Shed/Pole	**Superior**
			Adjustments:	*Similar(=)*	*Superior(-)*	*Superior(-)*	*Similar(=)*	*Similar(=)*	

Sale Location Map:



Legend
1. 46922 205TH ST, Brookings, SD 57006(11-219)
2. 45279 206TH ST, Arlington, SD 57212(11-307)
3. 47612 201ST ST, White, SD 57276(09-474)
4. 46306 209TH ST, Volga, SD 57071(11-436)
5. 20608 479th Ave., White, SD 57276(12-315)

Market Sales Analysis Conclusion:	Five sales are analyzed in the sales grid from the market area. All sales are uninfluenced by the proximity of a wind tower. Sales one and two are inferior sales and bracket the lower end of the range. Sale five is superior and brackets the higher end of the range. Sales three and four have stronger similarities. After considering the differences in the elements of comparison, the market evidence indicates the selling price was not negatively influenced by the proximity of the wind towers.

Overall Conclusion:	An interview analysis, site visit and sales analysis has been completed for BK3. Although the buyer commented about the noise and view obstructions, the market evidence is consistent with the interview comments. The evidence suggests the overall purchase price was not negatively influenced by the proximity of the wind tower.

SALES ANALYSIS BK4	**SALE No.**	BK4
	STATE	South Dakota
	COUNTY	Brookings

Property Characteristics:

Highest & Best Use:	Rural Acreage
Land Size:	13 Acres
Improvements:	1989 Story ½
Finished Area:	2,728 SF GLA; 4500 SF Finished (Updated)
Garage:	Attached 3-Stall
Features:	Treed shelter belt. 50x112 & 160x120 Commercial Building
Access:	Gravel road linkage; paved driveway

Sales Analysis Data:

Date of Sale:	November 21, 2013
Market Exposure:	MLS
Listing Price:	$569,000
Sale Price:	$530,000
Verification:	Deed; Beacon; Interview with buyer, seller & agent
Type:	Arm's Length Sale
DOM:	117 days

Wind Project:

Project:	Buffalo Ridge
Turbine Type:	Gamesa G87 2.0 MW
Hub Height/Rotor Diameter:	78/87 meters
Height From Ground:	399 feet.
Property & Wind Tower Notes:	Tower #1 10,500 +/- feet east. Tower #2 9,200 +/- feet east. Tower #3 7,700 +/- feet southeast. Tower #4 6,500 +/- feet southeast. Tower #5 5,400 +/- feet southeast. Tower #6 4,100 +/- feet southeast. Tower #7

	3,100 +/- feet southeast. Tower #8 2,400 +/- feet southeast. Tower #9 1,800 +/- feet south, southeast.

Wind Tower Aerial Map:

Site Analysis:	
Site Visit Conducted by:	David Lawrence
Site Visit Date:	May 23, 2018
View Obstruction:	Wind towers within view of residence
Noise Analysis:	Operational & blade noise present during site visit.

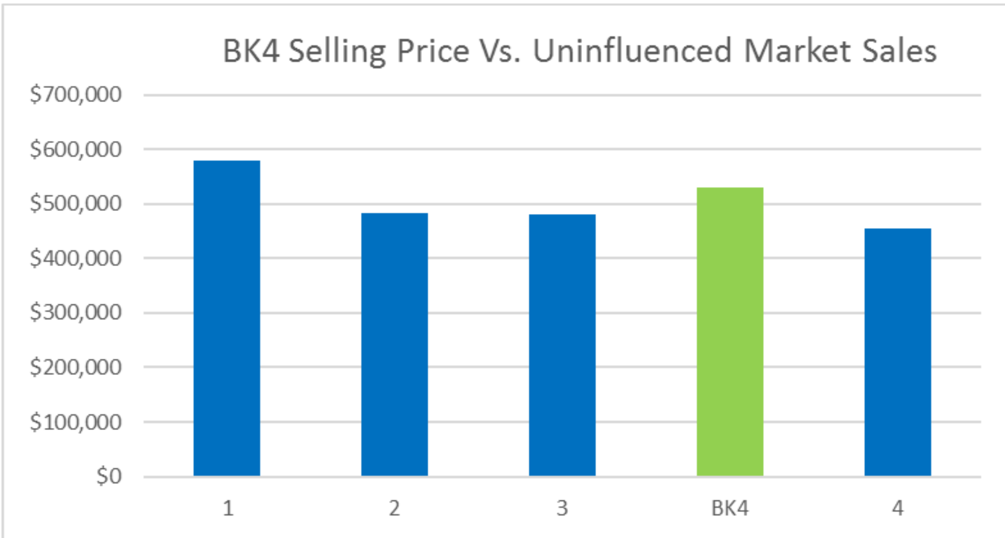
Interview Analysis:	
Interview Conducted by:	David Lawrence
Party Interviewed:	Buyer, Seller & Agent
Interview Date Buyer:	May 23, 2018
Interview Date Seller:	May 24, 2018
Interview Date Agent:	May 29, 2018

Interview Notes with Buyer:	Proximity to wind turbines didn't make a difference in the purchase. Paid the same. Purchased property because it had a perfect setup with a remodeled house and two metal buildings. Towers are south of the house, so it doesn't affect the view from the house. The towers make noise and you can hear them in the yard. Doesn't matter, happy with the purchase.

Interview Notes with Seller:	We moved because we were sick and tired of the wind tower noise. We thought it would matter when we sold, but a buyer purchased the house and never mentioned the wind towers. Didn't have any issues with closing or the appraisal. We are happy not to be living next to a wind tower.

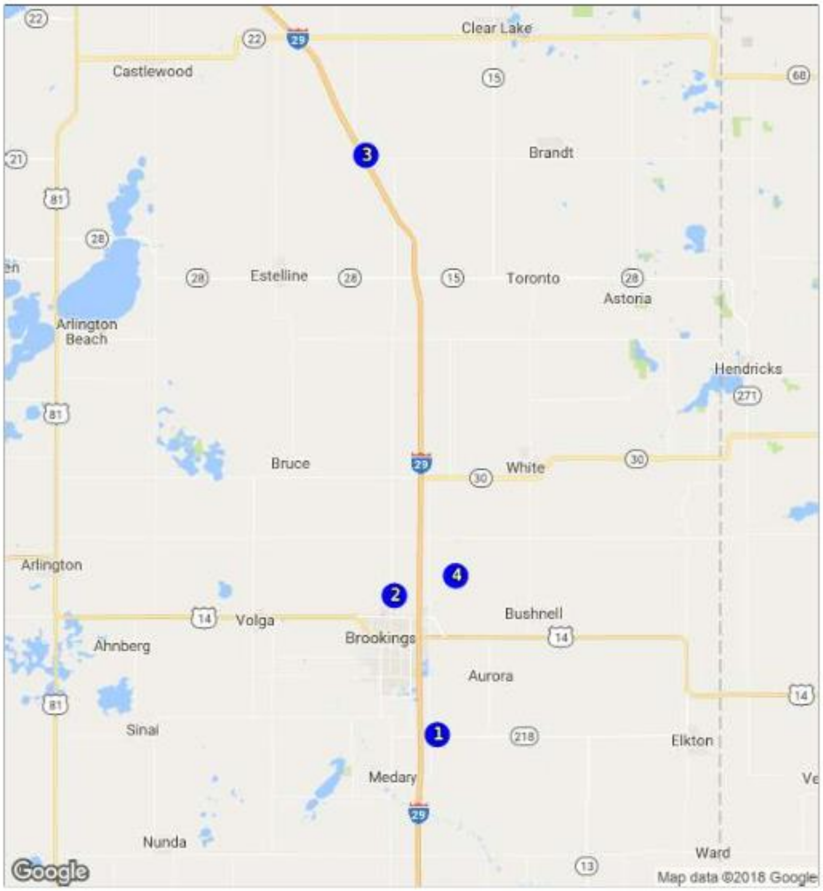
Interview Notes with Agent:	Although the sellers initially expressed concerns about the turbines, and it took four months to sell the property, the agent does not think there was any real effect with potential buyers and she did not hear that from any other realtors regarding this property. The home is an executive home and the market is smaller in that price range according to the agent.

Market Sales Analysis:



Sales Analysis BK4									
Sale No.	**Location**	**Sale Date**	**Price**	**Year/E.A.**	**GLA**	**Acres**	**Style**	**Outbuildings**	**Overall Analysis**
BK4	**Elkton**	**2013**	**$530,000**	**1989**	**2,728**	**13**	**Story 1/2**	**(2) Metal Buildings**	
1	Brookings	2016	$578,264	1920	3,365	39.87	Story1/2	Barn/Shed	**Superior**
			Adjustments:	*Inferior(+)*	*Superior(-)*	*Superior(-)*	*Similar (=)*	*Similar(=)*	
2	Brookings	2015	$482,500	2007	1,726	5	Ranch	Metal Building	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Inferior(+)*	*Similar (=)*	*Inferior(+)*	
3	Esteline	2016	$480,000	2003	2,651	4.99	Story1/2	Metal Buildings	**Inferior**
			Adjustments:	*Similar(=)*	*Similar(=)*	*Inferior(+)*	*Similar(=)*	*Similar(=)*	
4	Aurora	2010	$455,000	1890	3,342	15	Story1/2	Barn/Shed/2car	**Inferior**
			Adjustments:	*Inferior(+)*	*Superior(-)*	*Similar(=)*	*Similar (=)*	*Inferior(+)*	

Sale Location Map:



Legend
1. 47358 SD Highway 324, Brookings, SD 57006(16-276)
2. 1320 W 30TH ST, Brookings, SD 57006(14-381)
3. 46958 188TH ST, Estelline, SD 57234(15-251)
4. 47437 209th St, Aurora, SD 57002(10-196)

Market Sales Analysis Conclusion:	No sales could be found to bracket the selling price within the time of the transaction date; therefore, the sales search was expanded into 2017. Only one sale was found prior to the selling date in 2010. Sales one, two, and three occurred after the selling date in 2015 and 2016 and located near the city of Brookings. According the MLS data, BK4 was the highest sale price in 2013. The sale evidence suggests the selling price was not influenced by the proximity of the wind towers.

Overall Conclusion:	An interview analysis, site visit and sales analysis has been completed for BK4. The buyer's comments are consistent with the sales evidence. All evidence suggests the sale price was not affected by the proximity of the wind towers.

SALES ANALYSIS BK5	**SALE No.**	BK5
	STATE	South Dakota
	COUNTY	Brookings

Property Characteristics:

Highest & Best Use:	Rural Acreage
Land Size:	6.95 Acres
Improvements:	1936 Two-Story Design
Finished Area:	2,160 SF GLA. Basement 864 S.F.
Garage:	Attached 1-Stall
Features:	Treed shelter belt. Shed, storage building. Detached 1-Stall
Access:	Gravel linkage

Sales Analysis Data

Date of Sale:	March 26, 2014
Market Exposure:	MLS
Listing Price:	$219,000
Sale Price:	$190,000 (Previous sale 2010 $215,000)
Verification:	Deed; Beacon; Interview with Buyer
Type:	Arm's Length Sale

Wind Project:

Project:	Buffalo Ridge
Turbine Type:	Gamesa G87 2.0 MW
Hub Height/Rotor Diameter:	78/87 meters
Height From Ground:	399 feet
Property & Wind Tower Notes:	Four turbines located east, north and west. Tower #1 2,000 +/- feet northeast. Tower #2 3,600 +/- feet north. Tower #3 745 +/- feet west. Tower #4 2,700 +/- feet west.

Site Analysis:	
Site Visit Conducted by:	David Lawrence
Site Visit Date:	May 23, 2018
View Obstruction:	Wind towers within view of residence
Noise Analysis:	None at time of site visit. (no wind present)

Wind Tower Aerial Map:

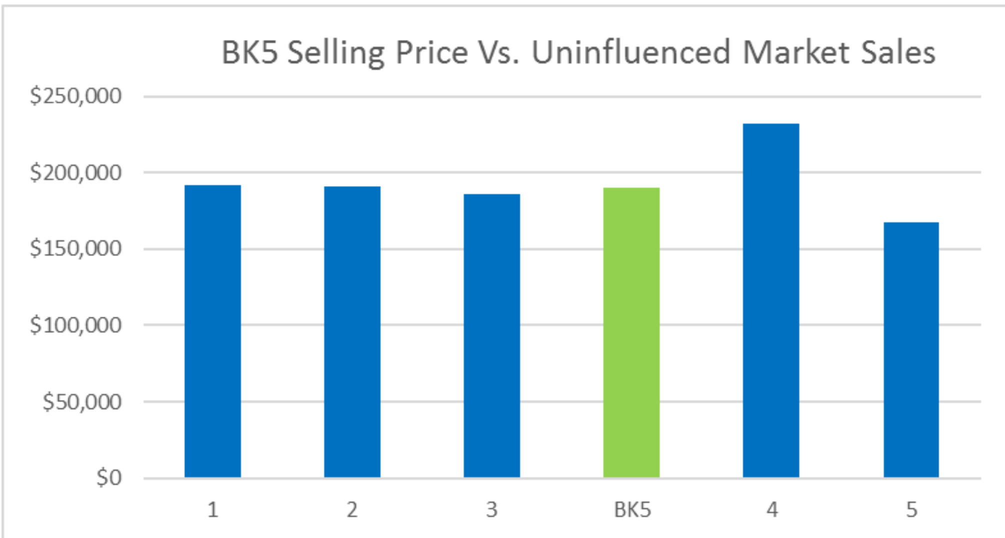
Interview Analysis:	
Interview Conducted by:	David Lawrence
Party Interviewed:	Buyer
Party Interviewed:	Agent
Interview Date:	May 23, 2018 (Buyer) May 30,2018 (Agent)

Interview Notes with Buyer:	Property was listed for 3 years and seller had two previous offers fall through; seller was living alone and motivated to sell. Made a good deal. Wind towers can be noisy but didn't matter to us when we bought the home. Really no issues, besides the noise. Doesn't seem to bother wild life, deer come in the yard while the turbines are running.

Interview Notes with Agent:	There are limited acreages within the Brookings market and if the property is in good condition with the features of an acreage, it sells. Lots of buyers looking for acreages. The price was reduced (BK5) because of a dysfunctional floor plan and seller motivations. The floor

	plan eliminated older buyers. Steep stairs. Old house and new house addition with weird layout. During the open house, buyers did not comment about the proximity of the wind towers, even though you can hear them in the yard. Distance from Brookings is what effects the price with acreages, not wind towers. If a property is past the 15-mile mark, price drops considerably. Price/distance relationship. Closer to Brookings prices increase. Acreage buyers are young people with kids. Lots of work to maintain an acreage. If it is too far from town, less buyers. No negative effects on purchase price from wind towers. Buyers did not seem to comment or raise concerns.

Market Sales Analysis:



Sales Analysis BK5									
Sale No.	**Location**	**Sale Date**	**Price**	**Year/E.A.**	**GLA**	**Acres**	**Style**	**Outbuildings**	**Overall Analysis**
BK5	**Elkton**	**2014**	**$190,000**	**1936**	**2,160**	**6.95**	**Story 1/2**	**Shed/Storage Bld**	
1	Flandreau	2014	$191,900	1880	1,950	8.95	Story1/2	Barn/Shed	**Comparable**
			Adjustments:	*Similar(=)*	*Similar(=)*	*Similar(=)*	*Similar (=)*	*Similar(=)*	
2	Volga	2015	$190,600	1918	1,680	15	Story 1/2	Barn/Shed	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Superior(-)*	*Similar (=)*	*Inferior(-)*	
3	Astoria	2014	$186,000	1910	1,472	14	Story1/2	Outbuildings	**Comparable**
			Adjustments:	*Similar(=)*	*Inferior(+)*	*Superior(-)*	*Similar(=)*	*Similar(=)*	
4	Brookings	2013	$232,000	1912	2,075	30.59	Story1/2	Barn/Shed/2car	**Superior**
			Adjustments:	*Similar(=)*	*Inferior(+)*	*Superior(-)*	*Similar (=)*	*Superior(-)*	
5	Nunda	2013	$167,900	1922	1,198	14.63	Story1/2	Shed/Barn/Metal	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior(+)*	*Superior(-)*	*Similar(=)*	*Superior(-)*	

Sale Location Map:

Legend
1. 22603 476th Ave., Flandreau, SD 57028(14-156)
2. 19367 483RD AVE, Astoria, SD 57213(13-122)
3. 612 Wicklow Ln, Brookings, SD 57006(13-312)
4. 22125 457th Ave., Nunda, SD 57050(13-147)
5. 46464 218TH ST, Volga, SD 57071(14-579)

Market Sales Analysis Conclusion:	Five sales uninfluenced by the proximity of wind towers are used for the analysis. The sales have similar highest and best use as acreages in the Brookings rural market. Sale BK5 is bracketed by the market sales. Sales two and five are inferior sales. Sale four is a superior sale. Sales one and three are the most similar. The market evidence suggests the selling price of BK5 was not influenced by the proximity of the wind towers.

Overall Conclusion:	An interview analysis, site visit, and sales analysis have been completed for sale BK5. The buyer's comments indicated the purchase price was influenced by seller motivations and not by the presence of the wind towers. The market data is consistent with the interview analysis and suggests the proximity of the wind towers did not negatively influence the selling price of BK5

SALES ANALYSIS BK7	SALE No.	BK7
	STATE	South Dakota
	COUNTY	Brookings


Property Characteristics:

Highest & Best Use:	Rural Acreage
Land Size:	13.35 Acres
Improvements:	1992 Ranch
Finished Area:	1680 SF GLA; 1680 L.L.
Garage:	Attached 2-Stall
Features:	Treed shelter belt. Metal outbuilding
Access:	Gravel road linkage

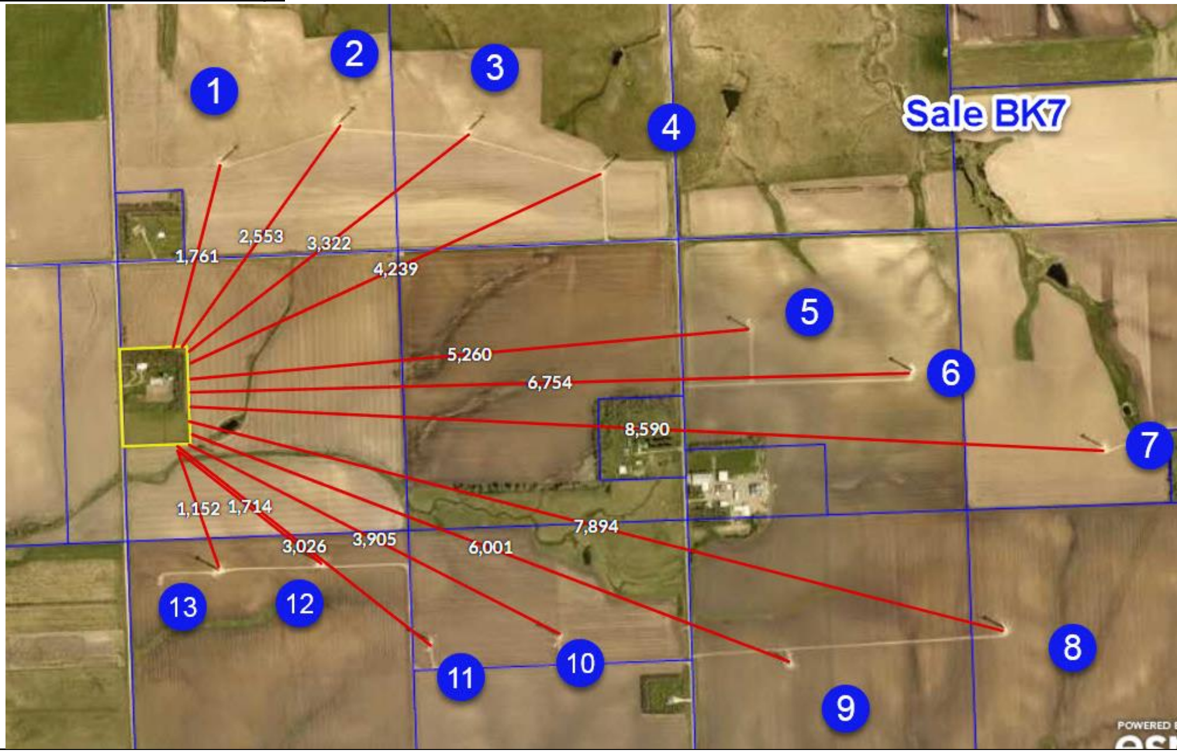
Sales Analysis Data:

Date of Sale:	August 4, 2010
Market Exposure:	Word of mouth
Sale Price:	$180,000
Verification:	Deed; Beacon; Interview with Buyer
Type:	Arm's Length Sale (estate sale, purchased based on appraisal)

Wind Project:

Project:	Buffalo Ridge
Hub Height/Rotor Diameter:	78/87 meters
Height from Ground:	399 feet
Wind Tower Property Notes:	Thirteen wind turbines surround the property. Tower #1 1,800 +/- feet north. Tower #2 2,500 +/- feet northeast. Tower #3 3,300 +/- feet northeast. Tower #4 4,200 +/- feet northeast. Tower #5 5,200 +/- feet northeast. Tower #6 6,700 +/- feet east. Tower #7 8,500 +/- feet east. Tower #8 7,900 +/- feet southeast. Tower #9 6,000 +/- feet southeast. Tower #10 3,900 +/- feet southeast. Tower #11 3,000 +/- feet southeast. Tower #12 1,700 +/- feet southeast. Tower #13 1,100 +/- feet south

Wind Tower Aerial Map:

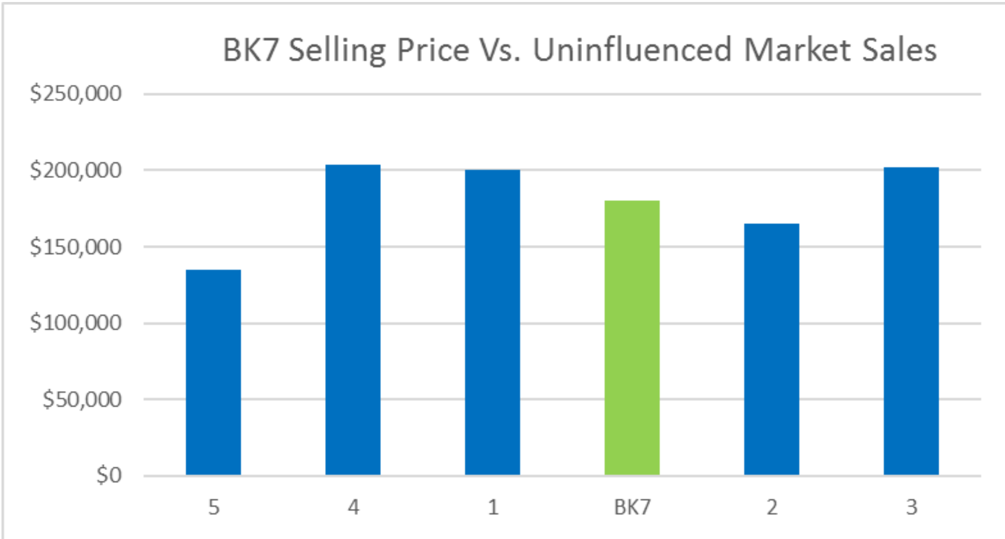


Site Analysis:	
Site Visit Conducted by:	David Lawrence
Site Visit Date:	May 23, 2018
View Obstruction:	Wind towers within view of residence
Noise Analysis:	Operational & blade noise present during site visit.

Interview Analysis:	
Interview Conducted by:	David Lawrence
Party Interview:	Buyer
Interview Date Buyer:	May 30, 2018

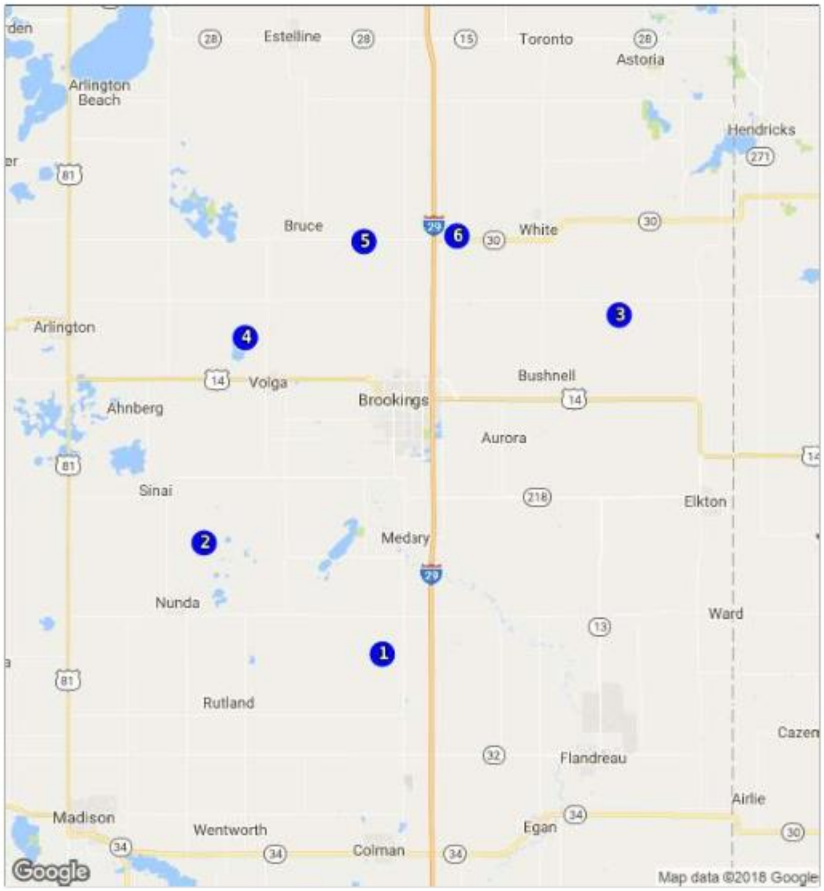
Interview Notes with Buyer:	Property value has increased by at least $75,000 since purchase. No issues or concerns with living near wind towers. There is no effect on the value. No effect to the animals. Can hear a faint “swoosh” noise. No big deal.

Market Sales Analysis:



Sales Analysis BK7									
Sale No.	**Location**	**Sale Date**	**Price**	**Year/E.A.**	**GLA**	**Acres**	**Style**	**Outbuildings**	**Overall Analysis**
BK7	**Elkton**	**2010**	**$180,000**	**1992**	**1,680**	**13.35**	**Ranch**	**Outbuild/2Car**	
1	Volga	2011	$200,000	2005	1,232	10	Ranch	Barn/2Car	**Superior**
			Adjustments:	*Superior(-)*	*Inferior(+)*	*Superior(-)*	*Similar (=)*	*Similar(=)*	
2	Colman	2009	$165,000	2001	910	22.03	Ranch	None	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior (+)*	*Superior(-)*	*Similar (=)*	*Inferior(-)*	
3	White	2010	$202,000	1967	1,304	12.78	Ranch	Metal Building/Shed	**Superior**
			Adjustments:	*Similar(=)*	*Inferior(+)*	*Similar(=)*	*Similar(=)*	*Superior(-)*	
4	Volga	2011	$204,000	1910	2,294	12.65	Story1/2	Barn/Shed/2car	**Superior**
			Adjustments:	*Similar(=)*	*Superior(-)*	*Similar(=)*	*Similar (=)*	*Superior(-)*	
5	Brookings	2010	$135,000	1974	1,288	7.5	Ranch	Shed/2Car	**Inferior**
			Adjustments:	*Similar(=)*	*Inferior(+)*	*Inferior(+)*	*Similar (=)*	*Inferior(+)*	

Sale Location Map:



Legend	
1. 47005 225th St., Colman, SD 57017(09-595)	**4.** 46306 209TH ST, Volga, SD 57071(11-436)
2. 21935 461ST AVE, Volga, SD 57071(11-226)	**5.** 20456 469TH Ave, Brookings, SD 57006(09-581)
3. 20787 482ND AVE, White, SD 57276(10-599)	**6.** 47318 SD Highway 30, Brookings, SD 57006(10-430)

Market Sales Analysis Conclusion:	Six sales are utilized in the grid that is not influenced by the proximity of a wind tower. All sales share in highest and best use as a rural acreage and sold around the same time as BK7. After analyzing the elements of comparison, the market sales bracket the selling price of BK7 and suggest the selling price has not been negatively affected by the proximity of the wind tower.

Overall Conclusion:	An interview analysis, site observation, and sales analysis were completed for sale BK7. The market sales and buyer interview comments are consistent. The evidence suggests wind towers have not negatively impacted the selling price of BK7.